

Master's Thesis



Submitted to: Reykjavík
University School of
Business

INVESTMENT MANAGEMENT

BEHAVIOURAL INFLUENCES IN PORTFOLIO COMPOSITION

Capitalizing on stock market mispricing through
fundamental analysis

Andrew Britten-Kelly
15.05.2015

Supervisor
Már Wolfgang Mixa

Reykjavík, May 2015

Abstract

The efficient markets explanation for pricing anomalies has faced mounting challenges from the field of behavioural finance in recent times, with growing research suggesting evidence of sustained asset mispricing across equity markets. This study examines whether there are benefits to be gained from incorporating behavioural influences into the portfolio composition process. This is achieved through examination of behavioural theory and its successful practitioners in achieving excess returns on the market through fundamental analysis. Based upon this examination a framework was researched, devised and implemented through the asset selection and asset allocation process. The study found that the resultant portfolio achieved above market risk adjusted returns, across multiple weighting combinations. The results suggest that behavioural driven fundamental analysis can aid in capitalizing on equity mispricing in the market, and furthermore behavioural influences can bring benefit to the asset selection and allocation process of portfolio composition.

Keywords: Behavioural finance, value investing, fundamental analysis, mispricing, portfolio composition, asset selection, asset allocation.

Acknowledgements

Foremost I would like to convey my utmost gratitude to my advisor Már Wolfgang Mixa for providing the inspiration behind the choice of subject for this thesis, for his motivation and enthusiasm in getting the job done, and for lending his wealth of knowledge in his advisory role. His valued guidance is very much appreciated; it is difficult to imagine this project without his influence.

I would like to additionally convey a special thanks to Júlíana and Emma who made this difficult period bearable, and for bringing joy and light to my life.

Declaration of Research Work Integrity

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature of any degree. This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by giving explicit references. A bibliography is appended.

By signing the present document I confirm and agree that I have read RU's ethics code of conduct and fully understand the consequences of violating these rules in regards of my thesis.

.....
Date and place

Kennitala

Signature

Table of Contents

| | |
|---|----|
| 1. Introduction..... | 1 |
| 1.1 Background..... | 1 |
| 1.2 Research Aims | 2 |
| 2. Behavioural Finance | 4 |
| 2.1 Introduction..... | 4 |
| 2.2 Efficient Market Hypothesis | 4 |
| 2.3 Behavioural Finance | 5 |
| 2.3.1 Limits to Arbitrage..... | 6 |
| 2.3.2 Psychology | 6 |
| 2.4 Behavioural Finance Discussion..... | 8 |
| 3. The Guru Investors..... | 10 |
| 3.1 Introduction..... | 10 |
| 3.2 Benjamin Graham | 10 |
| 3.3 Peter Lynch | 12 |
| 4. Financial Ratios..... | 15 |
| 4.1 Introduction..... | 15 |
| 4.2 Market Ratios..... | 15 |
| 4.3 Liquidity and Debt ratios | 18 |
| 4.4 Financial Ratio Summary..... | 19 |
| 5. Portfolio Management..... | 20 |
| 5.1 Investment Philosophy | 20 |
| 5.2 Asset classes..... | 22 |
| 5.3 Asset Allocation..... | 23 |
| 5.4 Mean Variance Model..... | 23 |
| 5.5 Portfolio Performance Measures..... | 24 |
| 6. Empirical study | 26 |
| 6.1 Introduction..... | 26 |
| 6.2 Data..... | 28 |
| 6.2.1 Introduction..... | 28 |
| 6.2.2 Market | 28 |
| 6.2.3 Horizon / Time Frame | 29 |
| 6.2.4 Sources | 29 |
| 6.3 Part I – Screening Process..... | 32 |
| 6.3.1 Methodology | 32 |

| | |
|--|----|
| 6.3.2 Results | 41 |
| 6.2.3 Discussion | 42 |
| 6.4 Part II – Portfolio Construction..... | 45 |
| 6.4.1 Methodology | 45 |
| 6.4.2 Results | 52 |
| 6.4.3 Discussion | 59 |
| 6.5 Part III – Performance Testing..... | 63 |
| 6.5.1 Methodology | 63 |
| 6.5.2 Results | 64 |
| 6.5.3 Discussion | 69 |
| 7. Conclusion | 75 |
| Appendix I - Financial Ratio Definitions..... | 77 |
| Appendix II – Utility Theory | 80 |
| Appendix III - Mean Variance Model..... | 81 |
| Appendix IV – Portfolio Performance Measures | 86 |
| Appendix V – Part I Screening Results..... | 87 |
| Appendix VI – Additional Model Statistics..... | 95 |
| Appendix VII – Portfolio II Performance | 96 |
| References..... | 99 |

List of Tables, Figures and Equations

| | |
|---|----|
| Table 1 - Screening Process Results | 41 |
| Table 2 - Stock Tier Rankings | 43 |
| Table 3 - Portfolio I Constituents..... | 52 |
| Table 4 - Portfolio II Constituents | 53 |
| Table 5 - Portfolio II Rationale | 55 |
| Table 6 - Mean Variance Asset Statistics | 55 |
| Table 7 - James-Stein Estimator | 56 |
| Table 8 - Portfolio II Optimised Weights | 57 |
| Table 9 - Portfolio II Value Weights..... | 57 |
| Table 10 - Portfolio II Variations..... | 58 |
| Table 11 - Mean Variance Statistics | 59 |
| Table 12 - Portfolio II Equal Weights Composition | 65 |
| Table 13 - Portfolio II Optimised Weights Composition | 65 |
| Table 14 - Portfolio II Value Weights Composition..... | 65 |
| Table 15 - Portfolio II Performance Summary..... | 66 |
| Table 16 - Portfolio II Individual Stock Performance..... | 68 |
| Table 17 - Portfolio II Health Care Industry Sector..... | 71 |
| Table 18 - Portfolio II Financial Industry Sector | 72 |

| | |
|--|----|
| Table 19 - Portfolio II Housing and Real Estate Industry Sector..... | 73 |
| Table 20 - Portfolio II Automotive Industry Sector..... | 73 |
| Table 21 - Key Statistics | 82 |
| Table 22 - Criteria 1 Results | 87 |
| Table 23 - Criteria 2 Results | 88 |
| Table 24 - Criteria 3 Results | 89 |
| Table 25 - Criteria 4 Results | 90 |
| Table 26 - Criteria 5 Results | 91 |
| Table 27 - Criteria 6 Results | 92 |
| Table 28 - Criteria 9 Results | 92 |
| Table 29 - Criteria 7 Results | 93 |
| Table 30 - Criteria 8 Results | 94 |
| Table 31 - Correlation Statistics..... | 95 |
| Table 32 - Covariance Statistics..... | 95 |
| Table 33 - Portfolio II Optimised Weights..... | 96 |
| Table 34 - Portfolio II Equal Weights..... | 97 |
| Table 35 - Portfolio II Value Weights..... | 98 |
| | |
| Figure 1 - Screening Results by Industry Sector..... | 42 |
| Figure 2 - Portfolio I Methodology | 46 |
| Figure 3 - Portfolio I Constituents | 53 |
| Figure 4 - Portfolio II Variations | 58 |
| Figure 5 - Portfolio II Performance Summary | 67 |
| Figure 6 - Individual Stock Performance | 68 |
| Figure 7 - Log Utility Function..... | 80 |
| | |
| Equation 1 - Log Normal Returns..... | 81 |
| Equation 2 - Expected Return | 82 |
| Equation 3 - Portfolio Expected Return | 83 |
| Equation 4 - Portfolio Variance | 83 |
| Equation 5 - Portfolio Variance Matrix | 83 |
| Equation 6 - Objective Function | 83 |
| Equation 7 - James-Stein Estimator | 84 |
| Equation 8 - Shrinking Factor | 84 |
| Equation 9 - Beta..... | 86 |
| Equation 10 - Jensen's Alpha | 86 |
| Equation 11 - Treynor Ratio | 86 |

1. Introduction

1.1 Background

The concept of beating the market has been the white whale for many an active investor in modern times. The reality, however, is that the majority of active fund managers fail to match, let alone beat the market.

There is a great preoccupation with outperforming the market, but what exactly does this entail? The predominant theory in the past has been the efficient markets theory, which is the belief that stock prices always incorporate all available information regarding fundamental values, and as such always trade close to their fair value. As a consequence, this also means that it would be theoretically impossible for stocks to be undervalued or overpriced. Eugene Fama (1970) in particular has carried out extensive study and research in this regard. Expanding on these considerations, the bottom line of the efficient markets theory is that beating the market with any form of consistency would be an act of futility.

The notion of efficient markets has not gone unchallenged however, with notable opponents such as Robert Shiller (2003) explaining that while the efficient markets theory has been largely unquestioned in the past, the field of behavioural finance is gaining momentum in the academic field of finance. Behavioural finance, by broad definition, concerns itself with the view of finance from a sociological and psychological perspective. In contrast to the efficient markets theory, behavioural finance tells us that stock prices can deviate significantly from their fair value through under and over reactions from the market.

In the late 1970's, Sanjoy Basu (1977) laid a challenge to the efficient markets theory by exploring the relationship between the performance of common stocks and their price to earnings ratio, concluding that low P/E ratio portfolios tended to earn superior risk adjusted returns. These findings have been supported by subsequent studies, with Dreman and Berry (1995) finding that low P/E stocks enjoyed above market returns for extended periods of time due to market overreaction to events and subsequent under reaction in price correction.

While Shiller and other academics demonstrated opposition to the efficient markets theory in words, investment gurus such as Benjamin Graham, Warren Buffet and Peter Lynch did so in their deeds. The sustained above market performance of these investment gurus appears to be at odds with the bottom line of efficient markets theory, and indeed not futile to all who haven't disowned the concept of material possessions. In similar fashion, the brilliantly simple yet effective Robot Portfolio from finance columnist John Dorfman offers a practical demonstration of the effectiveness of low P/E ratio strategies, with the portfolio outperforming the market over a 16 year period (Dorfman, 2015)

With this academic literature and practical demonstration taken into consideration, the question is – can influence from the behavioural finance teachings and the investment guru approaches be employed to replicate above-market returns. This study seeks to provide an investigation into this problem.

1.2 Research Aims

The aim of this paper is to investigate the positive effects that can be gained from incorporating influences from the field of behavioural finance into portfolio composition. In order to accomplish this aim, insight into the fundamentals of behavioural finance and portfolio composition is required, followed by a three part research study implementing the explored concepts.

As the incorporation of behavioural influences is of primary significance, the paper will begin with exploration of the key theoretical concepts of behavioural finance. With the theory outlined, practical implementation of these concepts is then examined through the literary works of selected investment gurus. In addition to exploring the investment guru motivations, the aim at this point would be to develop a practical method of implementation of their philosophy – in the form of behavioural indicators. These indicators come in the form of financial ratios, which will be identified and outlined for further use.

The assembly of an equity portfolio is a methodical process comprised of numerous steps. With the behavioural influences explored, the subsequent step would be in outlining the fundamental concepts in the practice of portfolio management, upon which the behavioural influences will be applied. The aim in this section would be in preparing

a conceptual framework for the three part research study. The research study is divided into three parts - asset selection in the form of a stock screening process, asset allocation in construction of the portfolio, and evaluation through performance testing.

Part I of the research will concern itself with the study of asset selection from a behavioural finance perspective. What this entails is incorporating the financial ratios determined as a result of the behavioural finance discussion into a stock screening process that seeks to capture the effect of over and under reactions of the market on stock prices. A market is defined and screened in accordance to a set of criteria based upon the financial ratios, with the results collated and ranked. The ultimate aim of this part of the research is to narrow down the market of available companies for selection through a number of relevant predetermined criteria.

Part II of the research will seek to approach asset allocation from a behavioural perspective. Securities to fulfil these broad targets will be sourced from the results of Part I of the study. Initially, Part II will compose two portfolios demonstrating the differing approaches to investment strategy, outlined in the portfolio management framework. The purpose of the two initial portfolios is to indicate the multiple paths that are available to the investor in adopting behavioural influences into portfolio composition. One investment strategy approach will be selected and employed through the remainder of the study – specifically the approach that entails identification of key industry sectors as suitable targets for investment through the application of behavioural aspects on a macro level. The aim of this section of the research is to build a complete portfolio, through the merging of selected industry targets and the available stocks for selection from Part I, resulting in top to bottom incorporation of behavioural influences throughout the portfolio.

Part III of the research will seek to evaluate the effectiveness of the previous two stages, through comparison against a benchmark index. This stage will entail the theoretical construction of a portfolio from the results of Part II. This portfolio will be tested and evaluated through historical data, providing a real world examination of the results. The results will be evaluated through key performance measures and against market wide and industry sector performance figures. The aim of the final part of the research, in alignment with the primary aim of the paper, is to determine the effects gained from the composition of a behavioural finance influenced portfolio.

2. Behavioural Finance

The aim of the study seeks to incorporate behavioural influences into the field of portfolio management – but what exactly is behavioural finance?

2.1 Introduction

Robert Shiller (2003) defines behavioural finance as finance from a broad social science perspective, including psychology and sociology.¹ The field of behavioural finance then seeks to provide explanations for financial and economic phenomena through the examination of human decisions from this psychological and social angle. In its essence, humans are not always rational and thus exhibit irrational behaviour. As key components in financial markets, investors exert this irrational influence onto the investment and financial world. Awareness of the concepts and workings of behavioural finance affords the chance to not only mitigate downside risk, but to discover opportunities which may otherwise not be apparent.

The field of behavioural finance has gained traction in the academic field over the last few decades, emerging from an era of complete assurance in market efficiency. Challenge to the efficient markets theory emerged with a number of academics lending their scepticism, with high profile financial crises providing some legitimacy to the claims. In order to further examine the emergence of behavioural finance, it is prudent to first examine the preceding and still prevalent belief in the Efficient Market Hypothesis.

2.2 Efficient Market Hypothesis

The concept of market efficiency has been a pervasive belief in the academic field of finance, supported by legends and Laureate alike. The Efficient Market Hypothesis (EMH) tells us that prices are always “correct”, in that they always trade at close to their fair value with all relevant information being reflected in the price. As a consequence, stocks prices are not under- or overvalued, making it difficult or impossible to outperform the market on a consistent basis (Copeland, Weston, & Shastri, 2004).

¹ From Efficient Markets Theory to Behavioural Finance (Shiller, 2003), p. 84.

Market efficiency comes in three forms – weak, semi-strong and strong.

- i. **Weak** – The current price of a security reflects all the historical price and return information.
- ii. **Semi-strong** – The current price of a security reflects all publicly available information.
- iii. **Strong** – The current price of a security reflects all information, be it public or private insider details.

Fabozzi, Modigliani and Jones (2009) note that a wealth of empirical evidence supports the implications of weak-form efficiency, that is, the examination of historical price and return information cannot be used to achieve excess returns on the market. In this assertion, they infer that practitioners employing this approach, such as technical analysts, should not expect to outperform the market, notably so once having accounted for transaction costs. There is however less such evidence to support semi-strong efficiency, which would entail making use of public information such as company financials and economic indicators in order to achieve excess returns, with the existence of pricing anomalies suggesting evidence of sustained mispricing of securities. Most studies involving strong-form efficiency concern the failure of professional fund managers to outperform the market, thereby assuming that these managers have access to all available information. This assumption appears substantial, as access to true inside information has produced results to the contrary, with evidence of participants with insider knowledge commonly achieving above market returns.²

2.3 Behavioural Finance

The efficient markets theory contends that markets react to new information in a timely and efficient manner. Behavioural finance suggests that markets can be inefficient in that there are barriers to the efficient reaction to new information, and that markets exhibit over and under reaction to available information, resulting in a slower price adjustment.³ Barberis and Thaler (2002) identified these two aspects as the two

² Further discussion available in Foundations of Financial Markets and Institutions (Fabozzi, Modigliani, & Jones, 2009), p. 357

³ For a discussion on this topic from an efficient markets perspective, see Market Efficiency, Long-Term Returns, and Behavioral Finance (Fama, 1997), p. 284

building blocks in behavioural finance – limits to arbitrage and psychology. Limits to arbitrage concerns itself with issues that could prevent a market from taking advantage of new information in the manner outlined by the efficient markets theory. Psychology explores deviation from rationality and the cognitive bias that get us there, telling us how and why the market might react to new information in an irrational manner.

2.3.1 Limits to Arbitrage

The Efficient Market Hypothesis tells us that as new information becomes apparent, market forces immediately act to take advantage and correct the price to its fair value – a process referred to as arbitrage.⁴ In reality however, there are associated risks and costs in making use of this of new information.

Andrei Shleifer (2000) contends that the textbook definition of arbitrage is unrealistic, in light of the fact that arbitrageurs run the risk of the security mispricing deepening through noise trader risk, before experiencing revision to the mean. Additionally, Barberis and Thaler (2002) point out that with the absence of perfect substitutes, fundamental risk is a key issue for arbitrageurs expected to make the appropriate security movements. The arbitrageur faces additional agency problems if their strategy of taking advantage of mispricing does not result in short term returns upon which they will be evaluated on.

What this tells us is that there are practical obstacles to the theoretical instant price adjustments to new information in the market. The implication of this observation is that mispricing may be prevalent in the market for longer than the efficient markets theory contends.

2.3.2 Psychology

The psychology element is primarily concerned with deviations from rationality. Irrational behaviour from investors in this context can be seen as a misapplication of

⁴ Arbitrage is defined by the Oxford Dictionary (2010) as the „simultaneous buying and selling of securities, currency, or commodities in different markets or in derivative forms in order to take advantage of differing prices for the same asset.“

Bayesian inference and/or deviation of Subjective Expected Utility.⁵ The source of this irrational behaviour can be explained by a number of cognitive biases. Cognitive biases can be both a bias in judgement, or in the form of information processing procedures, more commonly known as heuristics. Tversky and Kahneman (1974) explain that heuristics are mental shortcuts that enable decisions to be made under uncertainty. While useful for facilitating decisions when faced with an unfeasible number of options, they can lead to systematic errors. In the context of this study, this irrational investor behaviour is the driving force behind the mispricing of securities in the market.

From the work of Tversky and Kahneman (1974) and Barberis and Thaler (2002), we are able to formulate a brief overview of the common heuristics featured in behavioural finance.

Representativeness – The representative heuristic tells us that when a data sample is representative of an underlying model, people tend to overweight that data. In other words, this is where probabilities are over weighted based upon how representative something is, with insufficient consideration for the base rate probability. This error leads to stereotyping, and features base rate and sample size neglect.

Conservatism – Conservatism, on the other hand, is the situation in which the base rate probabilities are over emphasised and when the data sample is not representative, and the probabilities are under weighted.

Availability – This heuristics is based upon how easily retrievable information is from a person's memory. When assessing an event, should this information be easily retrievable, it is likely that they will overstate its occurrence probability.

Anchoring – When faced with the task of formulating an estimate, people tend to establish an arbitrary starting point, from which all further assessments are adjusted. This initial estimate, or anchor, while arbitrary in nature, has too great an importance placed thereon.

⁵ A Survey of Behavioral Finance (Barberis & Thaler, 2002), p. 1053.

Overconfidence - This heuristic details the finding that people are poorly calibrated when estimating the probabilities of certain events.

Optimism – Research has found that people have exaggerated views of their own abilities.

Herdning – Herding is the tendency to follow the crowd without due consideration of the situation itself. This heuristic is closely linked to regret aversion, or simply the innate fear of missing out.

An additional challenge to convention came in the form of prospect theory - a concept that deals with the notion of utility theory.⁶ Markowitz (1952b) proposed that utility is defined over wealth, whereas prospect theory proposes that it be defined in terms of gains and losses. The ultimate findings of Khaneman and Tversky (1979) are that people are risk averse over gains and risk seeking over losses.

2.4 Behavioural Finance Discussion

There are a number of discussed aspects which contribute to the aims of the research study. When faced with an insurmountable number of options, such as the securities markets, the availability heuristic can result in investors selecting attention grabbing stocks, or whichever stock simply happened to be fresh in their memory for any number of reasons. Devising a process or method to avoid this pitfall would prove most valuable to further the aim of the study. Also relevant to the central aim of this study is the concept of securities being mispriced, or having deviated from their fundamental value. The over and under reaction of investors due to the representativeness and conservatism bias, as noted by Poteshman (Poteshman, 2001), can be applied to the study in order to explore why certain stocks may be undervalued.

When both of the building blocks of behavioural finance are viewed in a holistic fashion, there exists the scenario where a number of cognitive bias and instinctive heuristics are fuelling irrational investor behaviour, driving the security prices away from the true or fair value. The limits to arbitrage result in no immediate corrective

⁶ Please see Appendix II for an outline of utility theory

measures, causing the mispricing to persist in the market. With these opportunities presenting themselves, the issue at hand is employing them to good effect.

3. The Guru Investors

With the fundamentals of behavioural finance explained, the next question is how is this theory practically demonstrated in ways that support the aims of the study?

3.1 Introduction

The efficient markets theory tells us that all relevant stock information is incorporated into the stock price resulting in a correct and fair market value, and consequently making it theoretically impossible to beat the market with any form of consistency. Seemingly at odds with this assertion, a number of high profile investors have managed to achieve above market returns consistently over an extended period of time. Relevant to this study is the explanation of how and why they achieved this outstanding feat. This section will then examine a few of those who have consistently defied this belief and the implications thereof – the guru investors.

3.2 Benjamin Graham

Commonly referred to as the father of value investing, Benjamin Graham was an investor and financial scholar whose investment philosophy and approach has had a profound impact on the financial world. The guru's guru, Graham had a remarkable influence on legendary investors such as Warren Buffet, Irving Khan and the soon to be discussed Peter Lynch. Graham produced two acclaimed works of literature – *Security Analysis* and, the book upon which this study will lay focus, *The Intelligent Investor*.

From the onset, Graham draws a clear distinction between what he considers an investor and a speculator – a distinction which is pervasive throughout the book. Investors are considered to have conducted a thorough analysis of their investment, accounting for risk, or safety, within an aura of reasonable return expectations.⁷ This essentially entails examination of the investment from a “behind the scenes” perspective, seeking further fundamental specifics regarding the company. Additionally, as an investor you become invested in the company in every sense of the word – a part owner position that requires time and patience to realise benefit. Speculators on the other hand are the counterpoint – seeking substantial risky gains through examination of fewer variables, in some cases market price alone. Speculators seek to enter and exit securities at opportune times, in

⁷ Full details of this definition and discussion in *The Intelligent Investor* (Graham, 2003), p. 18.

accordance to market trends which does not require substantial knowledge of the company existing behind the exchange ticker.

The concepts of value and safety run prominent through Graham's philosophy. With regards to stocks, Graham acknowledges that investors face an eternal struggle with the concept of investing in the present for the future, and has two methods of approaching this issue – predication and protection.⁸ Prediction concerns itself with attempting to project the future performance of the company in question, usually in the form of earnings or earnings growth, often with positive incremental results. Protection, on the other hand, concerns itself with examination of the company's key facts and figures, such as the market price, earnings, dividends, along with assets and debts – thereby assessing the current company value against its market price. Graham describes this difference as qualitative versus quantitative, with the latter value guided approach based less on whim and more on fundamental statistics.

The protection provided by this quantitative approach presents itself in the concept of margin of safety – the difference between intrinsic and market value.⁹ The protection aspect is in the sense that paying less for a stock than its fundamental value offers protection should issues be faced down the road. Margin of safety is possibly the key concept presented in *The Intelligent Investor* and a central tenet of the value approach to investing. While providing protection, purchasing stocks below their perceived intrinsic value also provides an excellent platform upon which an investor can attempt to realise potentially good returns. Graham's criteria for stock selection, outlined in the book¹⁰ and later utilised in this study, are based firmly upon this principle.

There are a number of aspects to the book that can be discussed in a behavioural light. The predicting or projecting approach to the future involves a great deal of human involvement and judgement, opening the door to invite irrational influences within. Graham mentions that projection from analysts often results in positive price evaluations that do not stray far from the original estimate, suggesting that the new estimate is anchored to the previous price. As noted by Cote and Goodstein (1999), stock analysts are not immune to the herding phenomena, often anchoring their estimates in order to keep in touch with the estimates of their peers. By adopting a more quantitative view in the protection approach, this pitfall can be avoided to some degree.

⁸ The Intelligent Investor (Graham, 2003), p. 364

⁹ For a thorough discussion see Chapter 20 of The Intelligent Investor (Graham, 2003), p. 512

¹⁰ The Intelligent Investor (Graham, 2003), p. 369

The concept of finding securities that have prices below their intrinsic value and thus being undervalued, as such, is greatly aided when a market or industry is experiencing a bearish period. Indeed, Graham notes¹¹ that while speculators may attempt to follow market trends to their detriment, investors can use market trends in a more productive fashion, such as using downturns to pursue cheap or value stocks. It is in these market fluctuations that we are able to see evidence of over and under reaction to information in the market. Stocks that are representative of an industry may experience price fluctuations based upon association alone, availing itself in both representativeness in overreaction to new information, and conservatism in under reaction to new information. How this could be practically relevant to Graham's approach is that a company in a troubled industry sector could itself have perfectly healthy fundamentals while having its market price depressed through persistent negative news – resulting in the price being below that of its intrinsic fair value.

Graham's book was initially penned before the rise in popularity of behavioural finance (or the Efficient Market Hypothesis for that matter) however it contains a wealth of knowledge applicable to this study. Finding a undervalued stocks containing a margin of safety appears imperative in achieving the aims of this study, just as avoiding irrational pitfalls is equally so. As stated by Warren Buffet in his preface to the book, "Follow Graham and you will profit from folly rather than participate in it."¹²

3.3 Peter Lynch

Between the years of 1977 and 1990, Peter Lynch was the portfolio manager of Fidelity Investment's Magellan Fund, which under his watch became the best performing mutual fund in recorded history.¹³ Lynch has authored a number of books, the most relevant for the purposes of this study being his seminal *One Up on Wall Street*. Co-authored with John Rothchild, the book outlines the investment philosophy and views behind Lynch's remarkable success.

The easy, colloquial fashion in which Lynch sets out his approach to investing is somewhat mirrored by the refreshing simplicity of his investment philosophy. Probably the foremost item of advice offered in the book is to invest in what you know, and in turn, know what you own.¹⁴ This knowledge also extends to being in a position to

¹¹ Complete discussion on the topic in Chapter 8, *The Intelligent Investor* (Graham, 2003), p. 188

¹² *The Intelligent Investor* (Graham, 2003), p. ix

¹³ *The Intelligent Investor* (Graham, 2003), p. 125.

¹⁴ Chapter 6, *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 95

observe factors which may indicate positive or negative implications for the company, providing an edge by being at ground level. In echoing Graham's suggestion that market downturns provide opportunity for value investments, Lynch further contends that it is this intimate knowledge of the company that provides the investor with assurance that the company is indeed good quality, in the face of contrary sentiment. The book additionally offers reassurance to readers that the process of investing is not exclusively the realm of Wall Street, while also providing sound advice on the practical implications of investing, such as investing only what you can afford.¹⁵

Running parallel to the investors versus speculators drive in *The Intelligent Investor*, the book also contends that attempts in predicting the market is an act in futility,¹⁶ and that investing in a stock means investment in a company – as Lynch states that it is oft forgotten that a share of stock is not a lottery ticket, but ownership in a business.¹⁷ The two do not share the same soul entirely however, as there is minor disparity in a few instances. A notable example is in Graham's predictive and protective approaches - Graham has a strong preference towards the quantifiable, whereas Lynch appears more flexible when it comes to judging a company based upon its product potential or placement.¹⁸ That is not to say that Lynch shies away from quantifiable measures at all, as the book has an extensive chapter¹⁹ on analysis of earnings, growth and company debt, all of which will also be employed later in the study in conjunction with Graham's suggestions. Lynch and Graham also tend to share somewhat differing views on the role of fixed income, with Graham advocating a standard 50-50²⁰ portfolio split, whereas Lynch, while not being dismissive, is less enthusiastic of fixed income in general.

There are a number of behavioural aspects to consider from *One Up on Wall Street*. Lynch makes a brief comment on the efficient markets theory, noting that in his early years with Fidelity he had witnessed sufficient unexplainable fluctuations to exclude the concept of a rational market.²¹ The book contends that the worst possible stock would be the hottest, most talked about stock in the trendiest industry.²² Such a stock offers a wealth of heuristics and biases, exhibiting herding behaviour and regret aversion, with

¹⁵ Chapter 4, *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 77

¹⁶ Chapter 5, *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 85

¹⁷ *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 161

¹⁸ Chapter 7, *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 106

¹⁹ Chapter 13, *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 198

²⁰ *The Intelligent Investor* (Graham, 2003), p. 89

²¹ *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 52

²² *One Up on Wall Street* (Lynch & Rothchild, 2000), p. 161

investors not wishing to miss out on the next big thing, coupled with the stock being representative of a popular industry, applying additional irrational exuberance.

While Lynch and Graham are clearly on the same page when it comes to value investing as a whole, it is beneficial to consider both views in light of the study. While Graham had rather firm views about the fundamentals he examined, Lynch was flexible enough to be more forward thinking as to consider incorporating earnings growth, a projected figure, into his analysis.²³ Together, both provide a sound, practical framework upon which the study can base its research.

²³ PEGY ratio, One Up on Wall Street (Lynch & Rothchild, 2000), p. 199

4. Financial Ratios

With behavioural theory and investment guru philosophies explored, how can these concepts be practically implemented?

4.1 Introduction

The semi-strong form of market efficiency tells us that the current price of a security reflects all publicly available information, including company financial statements. The presence of pricing anomalies provides counterpoint to this theory, suggesting sustained mispricing of securities in the market. It stands to reason, therefore, that further examination of publicly available information, and appropriately financial statements, may indeed be of value. Both Graham and Lynch strongly advocated exploring the company behind the stock, with Graham being a particularly ardent supporter of quantifiable metrics. Financial ratios provide the tools by which the company behind the stock can be examined. This overview of financial ratios will then provide a framework upon which behavioural signals will be developed later in the study.

4.2 Market Ratios

Price to Earnings (P/E) Ratio

The PE Ratio is the ratio of the price of a stock and the company's earnings per share.

$$\text{Ratio: } \frac{\text{Market Price}}{\text{Earnings per Share}}^{24}$$

Interpretation

The P/E ratio is a highly popular equity valuation multiple. The ratio essentially evaluates the price that the market has attributed to the company relative to the income the company is generating. Remembering that ownership in equity entitles the holder to share in the future revenue of a company, this ratio provides insight into the price paid for this future revenue stream. This concept can be expanded further when you consider what constitutes value in a company. Lynch states that it is both earnings and assets, but places particular emphasis on earnings.²⁵ If indeed you do place this sort of emphasis on

²⁴ Please refer to Appendix I – Financial Ratio Definition for component definitions

²⁵ Chapter 10, One Up on Wall Street (Lynch & Rothchild, 2000), p. 161

earnings, what this essentially produces is a metric indicating in relative terms how cheap or expensive a stock or company may be.

The inverse of the P/E ratio, also known as earnings yield, provides the ratio of the annual earnings to the market price. Benjamin Graham, in referring to earnings yield as earnings power, stated that this was the figure that a company could be expected to earn if all current conditions remained constant.²⁶ The earnings yield converts the P/E ratio, a number with little relevance outside of direct comparison with other P/E ratios, into an earnings percentage figure. This figure now can be compared to any investment option that yields a return in percentage terms, such as a bond or interest deposit, providing a far easier and more intuitive method of comparing stocks to other investments in the market.

Price to Cash Flow (P/CF)

The P/CF ratio is the ratio of a stock's price divided by the cash flow per share.

$$\text{Ratio: } \frac{\text{Market Price}}{\text{Cash Flow per Share}} \quad ^{27}$$

Interpretation

The price to cash flow ratio is an alternative means in estimating how expensive or cheap a stock may be, as discussed previously with the P/E ratio. The core difference is in defining what constitutes value in a company - where the P/E ratio assumes earnings the P/CF ratio assumes this to be cash flow. Indeed there are stock valuation models based primarily on discounting the company cash flows in order to determine the stock price, making use of cash flows a substantiated choice.²⁸ A positive factor too is that manipulation of the cash flow figure is more difficult than that of earnings, providing a slight edge in that regard.

Price to Book Ratio (P/B)

The P/B ratio is the ratio of the stock price to the book value per share.

²⁶ The Intelligent Investor (Graham, 2003), p. 513

²⁷ Please refer to Appendix I – Financial Ratio Definition for component definitions

²⁸ For further information see Chapter 2 of Investment Valuation (Damodaran, 2012b), p. 11

$$\text{Ratio: } \frac{\text{Market Price}}{\text{Book Value per Share}}^{29}$$

Interpretation

Following on from the previously discussed P/E and P/CF ratios, the price to book ratio provides a third variation on the evaluation of how expensive or cheap a stock may be, where the value of the company is assumed to be represented by the company book value. Where the previous two measures had been based upon earnings and income, this rounds it off with the P/B taking the company assets into account. This application of valuation may seem the most intuitive when considering Graham's previously discussed margin of safety – however in truth all of the three ratios discussed so far incorporate valid forms of company valuation, and ideally should be used in conjunction with each other when establishing the presence of a margin of safety

Dividend Yield

Dividend yield gives the amount of dividends paid out relative to the share price.

$$\text{Ratio: } \frac{\text{Dividend per Share}}{\text{Market Price}}^{30}$$

Interpretation

The dividend yield gives an indication on the income generated by a share of a company. In general terms, value is returned back to a share holder via one of two avenues - price appreciation and dividends. Dividends are paid out from average earnings, and with that in mind, this metric can be seen as an extension of the previously discussed earning yield. Graham notes that a solid record of dividend payments is a positive signal of a quality stock or company.³¹

PEGY Ratio

A variation on the P/E Ratio, the PEGY Ratio evaluates a company's stock by additionally taking into account forecasted earnings growth and dividend yield.

²⁹ Please refer to Appendix I – Financial Ratio Definition for component definitions

³⁰ Please refer to Appendix I – Financial Ratio Definition for component definitions

³¹ The Intelligent Investor (Graham, 2003), p. 294

$$\text{Ratio: } \frac{P/E \text{ Ratio}}{\text{Projected EPS Growth} + \text{Dividend Yield}}^{32}$$

Interpretation

The PEGY ratio is based upon the previously covered price to earnings ratio, with a few important modifications. In his examination of the price to earnings ratio, Lynch notes that a company that is fairly priced will have a growth rate equal to that of the P/E ratio.³³ In order to adequately capture this relationship, the P/E ratio is compared to the projected earnings growth rate along with the previously discussed dividend yield. It is worth noting at this point, in light of the previous discussion on Graham's views, the earnings growth is a projected figure and therefore not a hard and fast known quantity. It is also worth remembering from a behavioural finance perspective that professional analysts are not immune from heuristics and bias,³⁴ allowing possible influence at this point.

4.3 Liquidity and Debt ratios

Tangible Book Value per Share

The Tangible Book Value per Share (TBVPS) is a ratio evaluating a company's tangible assets on a per share basis.

$$\text{Ratio: } \frac{\text{Tangible Common Equity}}{\text{Shares Outstanding}}^{35}$$

Interpretation

Tangible book value per share is essentially the amount that shareholders can expect to receive should the company be liquidated and have the assets sold at book value, on a per share basis. As this scenario necessitates liquidation, only the tangible assets are taken into consideration. Tangible assets by definition do not include intangible items such as goodwill, brand recognition and trademarks.

Current ratio

The Current Ratio is the ratio of the company's total assets to total liabilities.

³² Please refer to Appendix I – Financial Ratio Definition for component definitions

³³ One Up on Wall Street (Lynch & Rothchild, 2000), p. 199

³⁴ A Breed Apart? Security Analysts and Herding Behavior (Cote & Goodstein, 1999)

³⁵ Please refer to Appendix I – Financial Ratio Definition for component definitions

Ratio: $\frac{\text{Current Assets}}{\text{Current Liabilities}}$ ³⁶

Interpretation

The current ratio is a liquidity ratio, indicating the ability of the company to repay their short term obligations. This classic and commonly employed ratio is considered a measure of the quality of a company in terms of financial position by Graham.³⁷

Total Debt against Tangible Book Value

This measure compares the total debt of a company to its tangible common equity.

Interpretation

This comparison seeks to determine the level of leverage within the company, and as such provide insight into the level of risk in the company's operating procedures and capital structure. Graham makes note that large leverage structures can make for speculative profit opportunities.³⁸ Leverage enables a firm to take advantage of small profit margins by borrowing heavily and therefore amplifying small gains into large profits. There exists a considerable risk element however, in that that when experiencing losses, the large debt component results in a rapidly eroding equity, resulting in an expedient bankruptcy.³⁹

4.4 Financial Ratio Summary

The analysis of key financial ratios can offer insight into the relative value and safety of a company or stock. In viewing these ratios from a market mispricing perspective, a behavioural influenced foundation has been laid upon which the stock screening criteria can be built. This then concludes the conceptual framework behind the asset selection part of the study, opening the way to the asset allocation part of the study, where the framework for the implementation of the selected assets into portfolio form will be detailed.

³⁶ Please refer to Appendix I – Financial Ratio Definition for component definitions

³⁷ The Intelligent Investor (Graham, 2003), p. 348

³⁸ The Intelligent Investor (Graham, 2003), p. 293

³⁹ As was famously evident in the case of Long Term Capital Management, a fixed income arbitrage hedge fund that operated between 1994 and 1998, making extensive use of leverage to its own eventual detriment, and almost the entire U.S. financial sector.

5. Portfolio Management

Having explored the theory of behavioural finance and the value and safety based financial ratios – the study now turns to an overview on the implementation of this framework in the form of portfolio management, where the portfolio composition and evaluation process will be outlined

5.1 Investment Philosophy

An investment philosophy can be defined as a core set of beliefs that you have about the market. These beliefs include how the markets work, how they do not work and the mistakes that are believed to underlie investor behaviour (Damodaran, 2012a). As such, they are the foundation upon which the investor bases their investment activities. When viewed from a functional perspective, Swensen (2009) notes that the investment philosophy can be viewed as the investor's approach to generating returns for their portfolio. An investment strategy would be the implementation of the investment philosophy.⁴⁰

There are a number of common choices that feature in the investment philosophy and the implementation thereof. The widest distinction lies in the passive or active approach.

Passive approach – An investor using a passive approach seeks to replicate a market or reference index. An index is a theoretical collection of securities chosen to represent a particular market or segment of the market. The fundamental belief behind passive investing is that it is either extremely difficult or impossible to consistently outperform the market – a belief evident in the prior discussion concerning the efficient markets theory. Index tracking is in itself a complicated and arduous process, with a segment of the finance industry dedicated to this practice.

Active approach - An investor with an active approach tends to seek to outperform the market through considered investment choices. In most cases, the investor has a view on some aspect of the market, and formulates portfolio decisions accordingly. The active

⁴⁰ Chapter 4 in Pioneering Portfolio Management (Swensen, 2009), p. 50.

approach underlies a belief that well researched and studied decisions can result in a portfolio performance above and beyond the market itself, much like those embodied by Graham and Lynch. The active approach covers both decisions in taking advantage of potential gains and counteractive measures to mitigate potential losses. For balance, efficient markets connoisseur William Sharpe (1991) noted that active management is a zero sum game, with active managers achieving above market returns at the cost of those achieving below market returns, if you consider that the average of all active investor returns must be equal to the market average return. Including the effect of transaction costs, which are typically higher in active than passive investors, it is argued that this results in a negative sum game for the active investor.

Top-down approach – Typically the top-down approach entails examination of the economic environment on a macro scale. Through this broad picture process the investor can narrow their focus on areas or industries in which they feel there may be potential. Thereafter, individual securities are selected to fulfil the purpose.

Bottom-down approach – To an investor who has a view on a company or specific market segment, individual securities are of more interest than the big picture (Solnik, 1995). Such an example would be if an investor believes that a previously troubled company is about to experience a rebound, they would seek out and invest in the associated securities to take advantage of the perceived opportunity. It stands to reason therefore that the selection begins at the “bottom” with individual securities, while the broader picture becomes a result of the securities selected, rather than the origin. Lynch’s teaching typifies this particular approach to investing, as the driving force behind his philosophy is investigating the company behind the stock, kicking a few tyres in the process. In fact Lynch goes as far as to assert that he, like famed investor Warren Buffet, do not pay much heed at all to the stock market and overall market conditions.⁴¹

Quantitative and qualitative – This distinction recognises that there are investors who rely strongly on their personal judgement while others favour quantitative figures as the basis for decision. As previously explored, Graham’s ideal protective value investor places a great deal of emphasis on the company’s quantitative fundamental figures in

⁴¹ One Up on Wall Street (Lynch & Rothchild, 2000), p. 89

the assessment of quality. “Quantitative” is a broad reaching term however, as speculators using technical indicators could also be considered as being quantitative based, while on polar ends of the spectrum when viewed in light of Graham’s philosophy. Naturally, there are investors who find the most reasonable philosophy to be a measured balance of the two (Solnik, 1995).

5.2 Asset classes

This study will be focusing on equity portfolios comprised entirely of equity securities - however for reference it is worth bearing in mind that there are a number of investment options available to an investor.

- a. Equities – Equities, or stocks, represent a share of ownership in a company for the holder. With this share of ownership comes entitlement to a claim on the company’s assets and revenue, usually materialising in the form of dividends or value appreciation.
- b. Bonds – Also known as fixed income, bonds are loans issued by governments or corporate entities to be purchased by investors. In return, investors can expect to receive interest on their investment, typically in the form of regular coupon payments or a discounted purchase price.
- c. Cash – Money market or cash equivalents represent highly liquid short term investment options, providing low risk with limited growth potential.

In addition to the three aforementioned classes, there exists a group of securities regarded as “alternative investments”. Covered under this umbrella would be derivatives, real estate and commodities, among others. Investments in this category are generally considered complicated, risky or illiquid, and mostly suitable for institutional or highly sophisticated investors.

Also to consider is the emergence of ETF securities, or Exchange Traded Funds. ETFs seek to track an index or a basket of assets, and are packaged and traded in the same way as equities on an exchange. ETFs have grown in stature in recent times as they represent a convenient avenue of passive investing while providing tax efficiency benefits.

5.3 Asset Allocation

Asset allocation can be categorised in terms of strategic and tactical employment.

Strategic – Strategic asset allocation is based upon the long term goals of the investor. This broad approach seeks to satisfy the investment goals through consistency and stability over an extended period of time. While in theory this appears to be a fixed allocation, in practice the allocations are reviewed periodically (Stewart, Piro, & Heisler, 2010).

Tactical – Tactical allocation entails the adjustment of allocations in order to take advantage of perceived opportunities in the market as they arise. This added element of flexibility allows the investor to respond to short term market fluctuations. The emphasis on this approach is on short term opportunities rather than long term goals, as constant adjustment may result in the long term allocations veering off their original trajectory (Stewart et al., 2010).

Despite these two methods appearing at odds with each other, the two approaches are not mutually exclusive. A strategic allocation may consist of variable target weights within a predetermined range – facilitating the option of tactical allocation should an opportunity in the market arise.

5.4 Mean Variance Model

With an investment philosophy established, all the various asset classes considered and an asset allocation method decided upon, the following step would be to decide the asset weights that make up the portfolio. There are a number of options available when deciding on how much of your portfolio will consist of each asset, from the purely arbitrary to well established quantitative models.

One such quantitative model is the mean variance model. developed by Harry Markowitz (1952) and others. The mean variance model analyses the risk and return characteristics of a selection of securities, along with the covariance relationship between each security.⁴² With this information, the model seeks to maximise a

⁴² Please refer to the Optimisation Process chapter in Appendix III for details.

theoretical investor utility function in accordance with the degree to which they are risk averse,⁴³ against the portfolio and individual security risk and return characteristics. The model practically accomplishes this by finding the combination of weights in each security which will result in a portfolio that provides the investor with the highest expected utility.⁴⁴

While the model is highly flexible and may be tailored and customised to suit a range of needs, the model does have a number of important assumptions and limitations.⁴⁵ One such limitation is that the model is sensitive to the return characteristics of the securities, which may require methods of refinement⁴⁶ in order to be of greater use to the model. Furthermore, the portfolio weights are determined through a process which assumes a “rational man”, in Markowitz’s terms,⁴⁷ seeks to maximise his expected utility. As explored in the discussion on behavioural finance, there are many innate heuristics and biases through which humans deviate from rationality, making this assumption from a behavioural perspective very grand indeed.

5.5 Portfolio Performance Measures

Once portfolio weights have been determined, through one method or another, a complete portfolio has been composed. There are a number of metrics available to evaluate the performance of a portfolio or stock after a period of time – this section will explore those most relevant to the aim of the study.

Total Return

The total return on a stock compares the current stock price to a reference historical stock price, while taking into account all distributions. Distributions are typically dividends paid out by the company, considered as being reinvested.

Beta⁴⁸

The beta of a portfolio or stock is a measure of how its movements coincide with that of a benchmark index, commonly considered the market. Beta is a measure of volatility,

⁴³ Please refer to the Utility Theory chapter in Appendix II for details.

⁴⁴ Please refer to the Optimisation Process chapter in Appendix III for details.

⁴⁵ Please refer to the Assumptions chapter in Appendix III for details.

⁴⁶ Please refer to the James-Stein Estimation chapter in Appendix III for details.

⁴⁷ Portfolio Selection: Efficient Diversification of Investments (H. Markowitz, 1959), p. 207

⁴⁸ Please refer to Appendix IV – Portfolio Performance Measures for equation

representing an element of risk inherent in a portfolio or stock. Beta is presented as a number, with 1 representing equal movement and volatility to the benchmark, lower than 1 representing less volatility, and greater than 1 representing more volatility. Beta can be interpreted in a number of ways, however generally a beta of lower than the benchmark represents lower volatility and therefore lower risk.

Alpha⁴⁹

Alpha is the measure of a portfolio's excess return over the compensation for taking on risk. Jensen's Alpha, in particular is this excess return relative to a benchmark index.⁵⁰ Alpha reflects the goal of all investors who have adopted the active approach to investing – to generate returns greater than the market (when used as the benchmark), when taking into account the amount of risk borne in the process. In more loose terms, alpha can be seen as the return generated due to the actions of the investor or portfolio manager. When considering the aim of the study, which is to determine benefits gained from incorporating behavioural aspects into portfolio composition, alpha can provide a useful metric in the determination of success in this regard.

Treynor Ratio⁵¹

While the previously discussed alpha measure does account for risk, two portfolios can share the same alpha but have inherently different levels of risk. Developed by Jack Treynor, the Treynor ratio shows the excess return per risk, providing a measure of the return received in light of the risk taken.⁵² This allows the investor to further examine the performance of the portfolio from a volatility angle, which in the case of this ratio is represented by the previously discussed beta. It is generally considered that lower volatility represents lower risk, and is therefore rewarded in the Treynor ratio.

⁴⁹ Please refer to Appendix IV – Portfolio Performance Measures for equation

⁵⁰ Running Money: Professional Portfolio Management (Stewart, Piro, & Heisler, 2010), p. 437

⁵¹ Please refer to Appendix IV – Portfolio Performance Measures for equation

⁵² Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 438

6. Empirical study

Having examined the concepts of behavioural finance and teachings of the investment gurus, a framework of financial ratios was established with the aim of incorporating value and safety into the asset selection process. The portfolio management framework provided a platform upon which the selected assets can be approached and allocated into a complete portfolio, along with means of performance evaluation. The empirical study serves as a practical demonstration of these concepts, and in doing so, investigating the primary aim of determining the benefits of incorporating behavioural influences into portfolio composition.

6.1 Introduction

Heuristics are the mental shortcuts people take when faced with a decision involving an insurmountable amount of information or variables. With thousands of listed stocks available for selection, the equity market would constitute an immense, overwhelming mass of information and choices. The availability heuristic, for example, enables investors to select stocks based on what is fresh or available in their minds at the time, such as attention grabbing stocks.

The purpose of the first part of this study is to take the vastness of the stock market and narrow down the selection based on a common set of value and safety criteria, rather than rely on the idiosyncratic heuristics that may lead the investor astray with irrational conclusions. These criteria are rational in the sense that they examine stocks not on whether they have been in the news or talked about over last weekend's dinner party, but rather that they are based on fundamental metrics of financial health, company value and dividend distribution potential. Once the field is narrowed, it is hoped that the consequent stock selections will have captured both value mispricing signals in the market and companies of sound financial health.

The second part of the study concerns itself with portfolio composition through asset allocation. This step entails consideration of the securities that have emerged from the filtration process, and allocating them in accordance with the aims of the study. The resultant portfolio is additionally optimised using the Markowitz mean variance asset allocation model. The examination of this portfolio optimisation process is in aid of a

side study to determine whether the mean variance model can provide value to the portfolio through risk/return trade off analysis.

Once the portfolio and asset weights have been determined, the portfolio will be practically implemented using historical security prices, and subsequently tested against historical data to simulate a passage through time. The results will then be considered against a benchmark index and industry sector returns for comparative analysis.

Portfolio risk and return statistics will be computed for further analysis. The aim of this final section of the study is to determine the performance of the portfolio, and in doing so, to determine the success or shortcomings of the entire approach.

6.2 Data

6.2.1 Introduction

As this research deals primarily with issues related to company stocks, the study could have been conducted on a number of world's equity markets. The U.S. equities market was deemed the most appropriate choice for this study due to the wealth of historical and current data being readily available, with the markets themselves having been subject to innumerable academic studies. These studies are widely discussed and available, allowing for comparison and review.

6.2.2 Market

Within the U.S. there are a number of exchanges, notably the New York Stock Exchange and the NASDAQ. With thousands of listed and OTC stocks in the U.S. market, for the purposes of practicality this study considers the entire market to be the constituents of the Standard & Poor's 500 (S&P 500) stock market index. As earlier defined, a stock market index is a theoretical collection of securities chosen to represent a particular market or segment of the market. The S&P 500, established in its present form in 1957, is considered by many to be the best representation of the U.S. market. The index is a value weighted index, meaning that each stock's weight in the index is in accordance to its market capitalisation, making it distinct from other indices such as the Dow Jones Industrial Average. Index constituents are chosen by a committee based on selection criteria ranging from market capitalisation to trading volume, and are chosen in order to be representative of the industries within the U.S. economy (S&P Dow Jones Indices LLC, 2015a). Accordingly, the S&P 500 is commonly employed as a benchmark for determining whether a portfolio or fund outperforms the "market."

This choice to consider the S&P 500 as the market does unfortunately result in a biased sample. By narrowing the sample there is a risk that results would not be applicable to the wider universe (Damodaran, 2012b). Randomised selection of securities would reduce this effect – however this would in turn greatly increase the difficulty in finding historical data for all the resultant securities. Access to data pertaining to listed constituents of the S&P 500 proved arduous on its own, therefore for the purposes practicality this issue would have to be tolerated and taken into account when drawing conclusions.

6.2.3 Horizon / Time Frame

The time period chosen for the study was that of 5 years - specifically 1st March 2010 to 1st March 2015. A primary driving factor in the choice of this horizon is the desire to keep the study and results relevant in an ever-changing environment. The hyper acceleration in the development of the financial industry in recent decades provides some justification in keeping the focus as relevant as possible. Studies on low P/E ratio strategies had been conducted in prior periods, necessitating the need to keep the study period recent to reduce results crossover as much as possible while also providing historical comparison for discussion.

The time frame of 5 years places the beginning of the study in the aftermath of the 2008 financial crisis. This time was categorised by a crisis of confidence in both the financial system and individual corporations – providing a unique and fertile platform to explore the effectiveness of behavioural approaches to finance. A consequence however, is that the strategy would not put through a crisis period and perhaps the theory is therefore not as rigorously tested as it could have been. However the strategy aim is not specifically to mitigate losses in the occurrence of an outlier event, making the absence of a crisis event unessential in the study.

6.2.4 Sources

S&P 500 Data and Ratios

Usage

The initial information required for the study was data containing the historical constituents of the S&P 500 index, as of 1st March 2010. In order to further categorise and filter the equity securities based upon their particular financial characteristics, an array of historical financial, debt and liquidity ratios were required for each index member as of 1st March 2010. From this point it is a case of sorting and arranging the data based upon predetermined indicators and thresholds.

Source

The information for this purpose was retrieved from Bloomberg Terminal⁵³, using the MEMB function and selecting the applicable date and ratios for analysis.

Historical prices

Usage

Historical stock prices were used in the latter two areas of the study – the mean variance model inputs and the portfolio performance testing. For the mean variance model inputs, 20 years worth of monthly historical data was used where available. Historical data for performance testing covered two areas – monthly asset prices and monthly industry sector indices, covering the 5 year period from March 2010 to March 2015.

Source

The data used for the areas concerning historical stock prices were sourced from Yahoo! Finance (<http://finance.yahoo.com/>)⁵⁴. Historical stock prices are typically available in daily, weekly or monthly variants. Along with the date, this source provides an “adjusted close” price, which is the closing price for the requested month, adjusted for all applicable splits and dividend distributions (“Finance | - SLN2311 - About historical prices,” n.d.). The adjusted closing price is a convenient source for the analysis of the historical data as it represents the total return, rather than just the change in market price. Industry sector indices were obtained in the form of the S&P 500 Sector and Industry indices, retrieved from the S&P Dow Jones Indices (<http://us.spindices.com/>)⁵⁵ and Bloomberg Terminal⁵⁶.

Fixed income data

Usage

The data employed from fixed income securities were largely for comparative use. The AAA bond yields were used for comparison to relevant equity earnings yields, while the 3 Month U.S. Treasury Bill yield was used as the risk-free rate where necessary.

⁵³ See Appendix IV for full S&P 500 data references

⁵⁴ (“Yahoo Finance,” n.d.)

⁵⁵ (S&P Dow Jones Indices LLC, 2015b)

⁵⁶ Industry index data obtained from (Bloomberg L.P., 2015l) and (Bloomberg L.P., 2015m)

Source

The AAA bond index (Moody's Seasoned Aaa Corporate Bond Yield) was sourced from the Federal Reserve Bank of St. Louis (<https://research.stlouisfed.org/>)⁵⁷ and the 3 Month U.S. Treasury yield were sourced directly from the U.S. Department of the Treasury website (<http://www.treasury.gov/>)⁵⁸.

Issues faced

A key element of the study is in potentially unearthing stocks that are not currently in the forefront of the public consciousness – so narrowing the focus to the biggest players in the U.S. market may result in exclusion of some of the best potential stocks. It is acknowledged that for the sake of practicality there is potential for opportunity loss - however it is also assumed that 500 securities should be a sufficiently large sample for the majority of the constituents to be an unknown quantity to most investors.

A form of survival bias exists where researchers in a study begin analysis with a market that exists from today's perspective, thereby avoiding the selection of companies that have since become bankrupt and no are longer in existence (Damodaran, 2012b). In order to avoid this pitfall as best as possible, the analysis was conducted using the 500 companies that were the historical constituents of the S&P 500 index at the beginning of the study period, that is, March 2010. A stock selected at the beginning of the study period would be kept in the portfolio regardless of whether the company fell out of the S&P 500 or not. Companies that merged during the study period would have the return calculated using the final merger value to shareholders, be this in cash or stock form. Companies that went bankrupt would result in return of zero. The historical constituent data was obtained from Bloomberg Terminal (Bloomberg L.P., 2015f).

⁵⁷ (Board of Governors of the Federal Reserve System (US), 2015)

⁵⁸ ("U.S. Department of the Treasury," n.d.)

6.3 Part I – Screening Process

6.3.1 Methodology

Introduction

The ultimate aim of this initial step in the study was to take the entire market, and narrow down the companies available for selection based upon predetermined criteria. The criteria would be set in such a way that the resultant stocks available for selection would have favourable qualities in value potential, dividend potential or sound financial statistics. At the same time, a number of the criteria serve to identify stocks that have favourable qualities from a behavioural finance perspective, providing support to the overall aim of the study from this level of the research. The purpose of this process is to ensure that stocks selected from this point onwards have firm cause for being up for selection.

Criteria

The next step in furthering this aim is to establish and define the set of criteria to be employed in the screening process. A number of these criteria adopt the approaches used by the previously explored gurus of the financial world, notably in this case Benjamin Graham and Peter Lynch. There were nine criteria established in total.

Criteria 1 - Earnings Yield = 2x AAA Bond Yield

This criteria is a ranking based on the price to earnings ratio. A common indicator of desirable P/E attributes is to have the target stock being lower than that of the market P/E ratio. The general thinking behind this rationale is that, assuming growth and risk attributes are similar across companies in the market, a P/E ratio of lower than the market average can be an indicator that the stock is undervalued, while a P/E ratio of higher than the market average suggests the stock is relatively expensive. The behavioural implication of high and low P/E values is of direct relevance to this study. A low P/E ratio from a behavioural perspective commonly represents a market overreaction to negative information, resulting in mispricing that offers opportunities

for above market returns⁵⁹. Similarly, high P/E ratios can represent an overreaction to positive information, resulting in the below market returns that Lynch warned about when suggesting to steer clear from the “hottest” stocks. Looking in a little deeper, we can see that this overreaction stems from the representative bias, where too much emphasis is placed upon the new positive or negative information, and not enough on the prior or base information, which in this case is the information apparent in the company earnings. Basing criteria on low P/E and similar ratios is a practical method of picking up mispricing signals in the market, and thereby incorporating these behavioural effects into the asset selection process.

The P/E ratio for the S&P 500 in March 2010 was approximately 20, resulting in many eligible securities and a somewhat dulled outcome when reduction is the aim. For this reason, it was decided to base eligibility on a metric proposed by Benjamin Graham⁶⁰ in which the earnings yield, being the ratio of annual earnings to the market price, was compared to the yield on a AAA rated bond. Specifically, in order to be deemed eligible the earnings yield is required to be twice the yield of the AAA bond index. This approach would naturally result in the same ranking structure as an arrangement based upon raw P/E ratios – however it felt that the resultant eligibility criteria would be more intuitive and relevant.

Issues and limitations

The P/E ratio is an often used and misused tool for stock evaluation. When used in isolation, the P/E ratio comes with a few important caveats to consider. The previously assumed uniformity in earnings growth and risk across companies within the market can prove to be a rather substantial assumption. In a related issue, the ratio additionally does not take into consideration the company debt structure. The use of earnings itself as the valuation basis can also be called into question, as creative account procedures can alter the earnings output to a substantial degree. As the P/E ratio can experience these issues when viewed in isolation, the study will introduce additional criteria covering a wider range of aspects to be considered, painting a more complete picture for consideration.

⁵⁹ This concept is explored in some detail in Overreaction, Underreaction, and the Low-P/E Effect (Dreman & Berry, 1995).

⁶⁰ Remembering Benjamin Graham - Teacher and Friend (Rea, 1977), p. 66

With respect to the data source, the P/E ratio is missing 55 of the S&P constituents due to negative 12 month trailing EPS. It is assumed that a contributing factor to this issue is the significant losses incurred by many companies following the onset of the 2008/2009 crisis. Cause aside, this does produce a risk of excluding potentially good companies as a consequence of extenuating circumstances.

Criteria 2 - PEGY Ratio > 1

The PEGY ratio provides examination of the P/E ratio in respect to the company's forecasted earnings and current dividend yield. The PEGY ratio in this regard acts as cover for the missing earnings growth component of the P/E ratio. As previously explored in the framework, there are behavioural aspects to account for when considering forecasted earnings. Aside from the previously discussed herding and anchoring in the analyst forecast, companies with high growth tend to have optimistic earnings projections, which in turn have been noted to distort stock prices (Ciccone, 2003).

Peter Lynch stated that the P/E ratio of any company that is fairly priced will equal its growth rate - further contending that, when also taking the dividend into account, anything less equal is poor, with desirable results being twice or greater the growth and dividend yield combined than the P/E ratio⁶¹. Taking the defined PEGY ratio into account, this results in eligibility being anything less than 1, with 0.5 and lower being the most desirable results.

Issues and limitations

While at face value it does appear that the issue of unaccounted earnings growth is solved through the incorporation of expected growth into the P/E ratio, the matter is unfortunately not that simple. The relationship between earnings growth and value has proven to be non-linear, with an increase in the growth rate having both a positive and negative net effect on the ratio, depending on magnitude (Damodaran, 2012b). Additionally, the outstanding issue of company risk that affects the P/E ratio would similarly continue to affect the PEGY ratio. What this tells us is the ratio has the most

⁶¹ One Up on Wall Street (Lynch & Rothchild, 2000), p. 199

relevance when comparing stocks of a similar growth and risk structure. These issues would need to be borne in mind when making final considerations on the criteria results.

As this criterion is based upon the P/E ratio, the same issue as before is faced with companies being automatically excluded due to negative 12 month trailing EPS. The PEGY ratio is also reliant upon growth earnings data, with absence also giving cause for exclusion. With the two factors combined, a total of 124 companies result in being excluded from eligibility in this category. Automatic exclusion of securities of this number is an issue that warrants further discussion, as it poses a challenge to the stock screening process.

Criteria 3 - Price to Cash Flow > 5

In attempting to alleviate a shortcoming of the P/E ratio while simultaneously expanding the attributes under examination, the cash flows of the companies were also considered against the market prices, as opposed to only the earnings figures. An advantage of the use of cash flow over earnings is in the former being more difficult to manipulate in the accounting process.

The P/CF ratio, being a relative price based metric, necessitates comparison for meaning to be derived from the resultant figure. In the spirit of avoidance of overcomplicating the comparison, the individual stock P/CF figures were evaluated against that of the market P/CF, which for March 2010 was between approximately 9 and 10. While any result below this figure would have been technically acceptable, a threshold of less than 5 was established in order to further narrow the range and tighten the eligibility criteria.

Issues and limitations

As will be the trend in most of the criteria, problems arise when examining the ratios in isolation. The greatest relevance from the P/CF ratio will be gained from comparison to other companies in similar industry sectors and similar stages of growth. These issues require consideration when processing the screening process outcomes.

Data for a total of 16 companies was not available for this category, making the results relatively devoid of major issues or considerations.

Criteria 4 - Price to Book Value > 1.5

In providing an additional alternative to the previously discussed price to earnings and cash flow, the P/BV looks at the price relative to the book value of the company. A low P/BV ratio typically suggests that a company is undervalued. From a behavioural finance perspective, this low P/BV ratio could be the result of an overreaction from the market to recent poor earnings or profitability information, resulting in a potentially undervalued stock. Should the prices have dropped as a result of negative industry wide information, this could further be the result of the representativeness bias, in which the stocks become undervalued through association with the industry sector, while the company's book value remained in good shape.

In his discussion on stock selection for the defensive investor, Benjamin Graham suggests a moderate price to book ratio, recommending a ratio of no more than 1.5⁶². For the purposes of this category, Graham's suggestion has been employed as the eligibility criterion.

Issues and limitations

As discussed previously, like the P/E and P/CF ratio, the P/BV ratio should ideally be examined from an industry specific viewpoint. Certain sectors are more capital intensive than others, leading to issues in comparisons across industries. Additionally, in attempting to identify undervalued stocks, the P/BV ratio would be best viewed in conjunction with the company's return on equity, with a low P/BV ratio and high ROE providing the key indication.

The data set for this category was relatively complete, with data for 11 companies being unavailable.

⁶² The Intelligent Investor (Graham, 2003), p. 374

Criteria 5 - Dividend Yield $> \frac{2}{3} \times \text{AAA Bond Yield}$

Dividend payments represent a key avenue for the return of value to shareholders and as a consequence have been a much lauded attribute of a stock. Peter Lynch, for example, was of the opinion that dividend payments were preferable to the company holding on to the cash, as uncertainty lay in how effectively the retained earnings would be employed⁶³. On the surface, at least, a dividend paying company exudes an appearance of strength. A famously simple yet effective strategy, known as the Dogs of Dow, is based around composing a portfolio with selection of constituents of the Dow Jones Industrial Average based purely on the dividend yield.

For the purposes of this study, and in keeping continuity with the metric selected for the P/E ratio, eligibility based upon comparison to the yield of AAA corporate bond yield was selected for the dividend yield category. The criteria proposed by Graham (Rea, 1977) was to select stocks with a dividend yield of at least two thirds of the AAA corporate bond yield. This would also result in an identical ranking structure than to simply arrange the stocks by dividend yield, but again the eligibility criterion is both more intuitive and provides consistency.

Issues and limitations

The dividend information in the data set represents the total dividends paid out by the company over a 12 month trailing period. Recent decision to withhold the dividend, which could occur for a number of reasons and especially in light of the recent financial turmoil may not be unjustified in the least, would result in automatic exclusion from the criteria. On the other hand, it could be argued that justified or not, this metric is based upon the dividend paying qualities of a stock and ineligibly without deeper consideration is simply the nature of the beast. A total of 130 companies registered no dividends in the past 12 months in the data set. This aside, dividend data was not available for 8 companies, giving an acceptably complete set, all things considered.

⁶³ One Up on Wall Street (Lynch & Rothchild, 2000), p. 204

Criteria 6 - Market Price < $\frac{2}{3}$ × Tangible Book Value per Share

While many of the previously established criteria examine the company from a revenue perspective, it is prudent too to consider the debt and asset characteristics of the company when screening for stocks. The tangible book value per share of a company gives an idea of the value of the assets of a company should they be liquidated. In particular the tangible book value does not account for intangible assets, such as goodwill, brand recognition and trademarks.

Comparing tangible book value to the market price of the stock provides insight into how much above or below the market price is compared to the value of the assets. It is understood that the price would typically exceed that of the book value, as the price incorporates future expected earnings – however it may nevertheless be prudent to consider a limit in the ratio of price to assets to establish a margin of safety. In his outlining of the defensive investor, Benjamin Graham proposed that the market price should not be $1\frac{1}{2}$ times more the book value⁶⁴, when inversely compared means that the market price should ideally be less than $\frac{2}{3}$ of the tangible book value per share.

Issues and Limitations

The prevailing trend in more recent times has seen the rise in value of a company's intangible assets (Corrado, Hulten, & Sichel, 2009), resulting in diminished relevance when considering companies that are intensive in intangible assets such as services based firms and software companies. With the trend in mind, it stands to reason that few companies would qualify under this criterion. With the aim of the narrowing stock selections in mind, the presence of an exclusive metric is not entirely without benefit.

This category required data on the tangible common equity and shares outstanding for the S&P 500 constituents. A total of 17 index members were excluded due to insufficient data on tangible common equity, with no exclusions required for missing shares outstanding as an issue on its own. The data set was therefore complete to an acceptable degree.

⁶⁴ The Intelligent Investor (Graham, 2003), p. 374

Criteria 7 - Current Ratio > 2

As a well established measure of a company's financial health, the current ratio provides a liquidity measure to the list of criteria. The establishment of an all inclusive eligibility criterion across all industry sectors proved to be impractical given the purpose of this category, however due consideration can be applied in the results. It was therefore established that the standard ratio 2:1 with respect to current assets and current liabilities would be employed, resulting in an eligibility requirement that the current ratio be above 2.

Issues and Limitations

As previously explored, liquidity requirements do differ across industry sectors, which could possibly lead to a false sense of security without due consideration for the results.

A relatively large number of constituents were excluded from this category, with a total of 72 being eliminated on the grounds of insufficient data.

Criteria 8 - Total debt < Tangible Book Value

Providing the measure of indebtedness of a company, examination of the total debt to the tangible book value provides a debt based category to the screening process. As serving additionally as a measure of leverage, the category seeks to identify companies that have additional risk attached due to their debt structure, or more specifically seeking companies that do not. While leverage is an effective method in amplifying gains, it is an equally effective method of eroding equity in the occurrence of losses. The eligibility criteria for this category was based on a simple requirement of total debt exceeding the tangible book value – a metric used by Benjamin Graham (Rea, 1977).

Issues and Limitations

The previously explored issues surrounding tangible and intangible assets would be applicable to this criterion.

This category requires both total debt and tangible common equity data, with one or the other resulting in exclusion from eligibility. A total of 40 companies were excluded on

the basis of insufficient data, placing the loss of completeness in the medium range in comparison with the other data sets.

Criteria 9 - Winners and Losers

The aim of the final category was to extract from the data the worst performing S&P 500 stocks over both a 5 and 3 year period. This category was inspired by the work of Werner De Bondt and Richard Thaler who stated that past losers tended to be future winners, due to investors putting too much importance on prior performance of stocks, without accounting for mean reversion (Bondt & Thaler, 1985). It is with this in mind that the intention was to sort and rank the stocks with the lowest 5 and 3 year total return, in the hope that the list would yield additional candidates for stocks that have potential for rebound.

This category also brings with it a behavioural element, as long term losers are likely to be neglected or undervalued stocks. When used in conjunction with other favourable criteria, this could provide evidence of conservatism in the market, where there is an overreaction to prior information on the stocks long term poor performance, and an under reaction to more recent positive indicators.

Issues and Limitations

There is a natural risk element to assuming a long term loser will experience a recovery and turn into an eventual winner. For example, there exists the possibility that the company is within an industry sector experiencing a gradual and irreversible decline into obsolescence. Indeed in running opposite to including losers, John Dorfman's Robot Portfolio eliminates companies with four quarter trailing losses.⁶⁵ However for the purposes of this study, this criterion can provide strong behavioural cues if coupled with other favourable categories, and was not intended to be viewed in isolation.

The natural limitation in this data set would be the absence 5 year and 3 year total return statistics. 24 companies lacked data for the 5 year total return, while the data set on 3 year total return was missing for only 10 companies.

⁶⁵ Dorfman: 2014 less-than-stellar year for Robot Portfolio (Dorfman, 2015)

6.3.2 Results

Each of the previously established 9 stock screening criteria was run on the March 2010 S&P 500 constituent data, producing 9 unique lists of eligible companies. Full results of each of the 9 individual criteria can be found in Appendix V – Part I Screening Results.

The 9 unique lists were then collated to produce a reference list, containing all the stocks that had “ticked the boxes” and the related criteria satisfied. A total of 389 companies satisfied 1 or more of the 9 criteria. The list was ranked on the number of criteria satisfied, from most to fewest. The intention was to produce a ranked list of securities in order of desirability, in terms of the predetermined set of indicators.

Table 1 - Screening Process Results

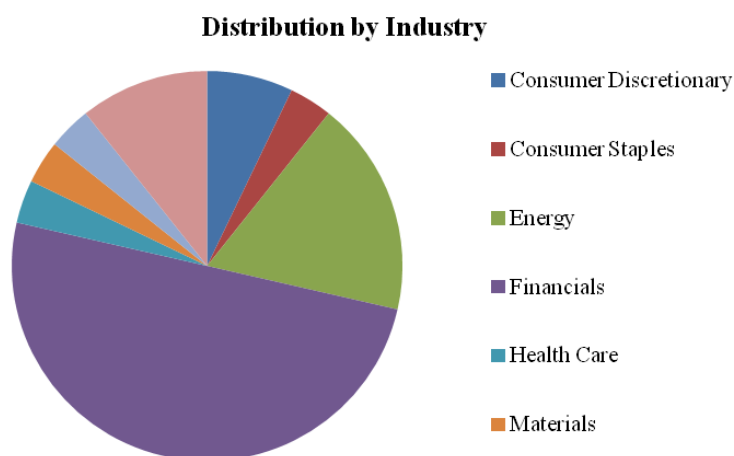
| Name | P/E | PEGY | P/CF | P/BV | Div | TBVPS | CR | Debt | Loser | Total |
|-------------------------------|-----|------|------|------|-----|-------|----|------|-------|-------|
| Ameren Corp | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | 5 |
| Diamond Offshore Drilling Inc | ✓ | ✓ | | | ✓ | | ✓ | ✓ | | 5 |
| Edison International | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | 5 |
| Principal Financial Group Inc | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | 5 |
| Rowan Cos Plc | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | 5 |
| Tesoro Corp | | | ✓ | ✓ | | ✓ | | ✓ | ✓ | 5 |
| Torchmark Corp | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | 5 |
| American International Group | | | ✓ | ✓ | | ✓ | | | ✓ | 4 |
| Assurant Inc | ✓ | ✓ | | ✓ | ✓ | | | | | 4 |
| AT&T Inc | | ✓ | ✓ | ✓ | ✓ | | | | | 4 |
| Chubb Corp/The | ✓ | ✓ | | ✓ | | | | ✓ | | 4 |
| GameStop Corp | ✓ | ✓ | ✓ | ✓ | | | | | | 4 |
| Goldman Sachs Group | ✓ | ✓ | ✓ | ✓ | | | | | | 4 |
| Hartford Financial Services | ✓ | | | ✓ | | | | ✓ | ✓ | 4 |
| Humana Inc | ✓ | ✓ | | ✓ | | | | ✓ | | 4 |
| Lincoln National Corp | ✓ | ✓ | | ✓ | | | | ✓ | | 4 |
| Marshall & Ilsley Corp | | ✓ | ✓ | | | ✓ | | | ✓ | 4 |
| MeadWestvaco Corp | | | ✓ | ✓ | ✓ | | ✓ | | | 4 |
| Nabors Industries Ltd | | | ✓ | ✓ | | | ✓ | ✓ | | 4 |
| NYSE Euronext | | ✓ | | ✓ | ✓ | | | | ✓ | 4 |
| Prudential Financial Inc | ✓ | ✓ | ✓ | ✓ | | | | | | 4 |
| PulteGroup Inc | | | ✓ | ✓ | | | ✓ | | ✓ | 4 |
| SunEdison Inc | | | | ✓ | | | ✓ | ✓ | ✓ | 4 |
| SUPERVALU Inc | ✓ | | ✓ | ✓ | ✓ | | | | | 4 |
| Travelers Cos Inc/The | ✓ | ✓ | | ✓ | | | | ✓ | | 4 |
| Valero Energy Corp | | | ✓ | ✓ | | | | ✓ | ✓ | 4 |
| XL Group PLC | ✓ | | | ✓ | | | | ✓ | ✓ | 4 |
| Zions Bancorporation | | | ✓ | ✓ | | | | ✓ | ✓ | 4 |

Source: Author's calculations⁶⁶

At total of 7 companies satisfied at least 5 criteria, with a total of 28 companies meeting 4 or more indicators, as demonstrated in Table 1.

⁶⁶ See Appendix V – Part I Screening Results for complete list of eligible companies from each criterion

Figure 1 - Screening Results by Industry Sector



Source: Author's calculations

Figure 1 shows the predominant industry sectors in the top 7 companies were utilities, financials and energy, with a relatively even distribution across the three sectors. This trend continued into the top 28 companies, where financials comprised 50% of the list, with energy (18%) and utilities (11%) making up the bulk of the remaining sectors.

Statistics on the criteria itself revealed that the average exclusion rate per criteria was 7.5%, meaning that the data set was on average 92.5% complete. On average, each criterion resulted in 15.22% of the available companies being eligible for selection.

6.2.3 Discussion

The aim of Part I of this research study was to narrow down the field of stocks available for selection, based upon a predetermined set of criteria intended to identify desirable attributes in a company. The first and primary question then is in evaluating how successful the study was in achieving this aim.

A total of 389 (77.80%) companies satisfied at least 1 of the 9 established criteria. While the field has indeed been narrowed, 389 companies is still an infeasible quantity to work with. This result is to be expected, because as more criteria are added to the study, the probability of eligibility is likely to increase. A simple workaround to this issue is to further rank the stocks based on the number of criteria satisfied or

accumulated. Through this method the stocks are arranged into a number of tiers, further narrowing down the stock selection, as seen in Table 2.

Table 2 - Stock Tier Rankings

| Tier | No. Of Companies | Market % |
|------|------------------|----------|
| 5 | 7 | 1,4% |
| 4 | 28 | 5,6% |
| 3 | 95 | 19,0% |
| 2 | 219 | 43,8% |
| 1 | 389 | 77,8% |

Source: Author's calculations

By categorising the results in this fashion we can effectively narrow the field of available companies for selection down to as low as 7 companies out of 500, or 1.4% of the designated market. The field can then be widened to 5.6% into the following tier if necessary, allowing for a degree of flexibility.

The criteria themselves are a collection of established metrics, supported by academics and well respected figures in the finance industry. In addition to this, a number of the criteria have grounding in the teachings in behavioural finance. The Efficient Market Hypothesis tells us that stocks will always be priced at their correct value, however behavioural finance counters that over and under reactions to recent news and information from the market can push the price of a stock away from what is deemed its true value. Criteria such as the P/E and P/BV ratios can act as signal beacons as to when mispricing scenarios such as these occur. Having such ratios as part of the screening process is designed to capture these behavioural signals and collect these stocks together for further examination. On a meta level, screening stocks in this fashion is in itself an effort in avoidance of the availability heuristic to some degree.

The end result is that through the prescribed methodology, the study has successfully narrowed down the field of available stocks based upon established criteria, resulting in a tier ranked table of companies with desirable value and safety attributes. With the asset selection process complete, Part II of the study entails incorporating these results from Part I into the portfolio management process previously outlined, in order to compose a complete portfolio in line with behavioural influences.

Issues encountered

A number of issues regarding the criteria themselves were encountered in the process and warrant further discussion.

There was a running theme throughout the criteria where many ratios and metrics are prone to being erroneously interpreted when viewed in isolation. It is felt that the introduction and rearrangement of the results into the tier system goes some way into solving this issue, as a ranking system based on accumulated criteria inherently rewards use of the ratios in combination with others. Ratios that would have only one satisfied criteria, thus being in danger of having the ratio being qualified in isolation, would fall to the bottom of the ranking and into less desirable territory.

The other notable issue was that of missing data and the resultant automatic exclusion of affected companies. Research employing historical data has inherent risks, especially when the data required is highly specific, as was the case in this study. The statistics revealed that an average of 7.5% of the data was missing in each criterion, or approximately 38 constituents. This figure however cannot be taken at face value without some consideration. Certain data, such as the missing P/E ratios (and consequently PEGY ratios) was unavailable due to negative trailing EPS figures. Companies with extremely low earnings (negative even), would be doubtful candidates for eligibility based on an earning based metric, so it is more likely that few or no companies were excluded from this criteria. The PEGY ratio was indeed the criteria with the most excluded stocks, followed by the Current Ratio. Other data was simply unavailable from the primary data source. Manual retrieval of the missing information from historical financial records was a possible option, however this avenue was deemed infeasible when considering the marginal benefit gained in the research against the vast quantity of time such action would require. All factors considered, it is not felt that the aims or outcome of the research had been compromised by the experienced loss of data completeness.

6.4 Part II – Portfolio Construction

6.4.1 Methodology

Introduction

The primary aim of the second part of the research was to compose a complete portfolio through the determination of an asset allocation strategy, and the incorporation of the results from the screening process to fulfil the allocation requirements. In order to demonstrate the investment strategy approach, it was decided to initially construct two portfolios adopting two differing approaches to employing the results from Part I.

Each portfolio would consist of 8 securities in order to keep security selections relevant. While studies have shown that a higher number of securities are required to fully diversify a portfolio in the US market (Alexeev & Tapon, 2012), this does not serve the primary aim of the study. With diversification not of prime concern, a portfolio consisting of too many securities would run the risk of diluting the impact that each stock would have on the resultant portfolio. It was decided then that 8 securities would be chosen to represent the two portfolios.

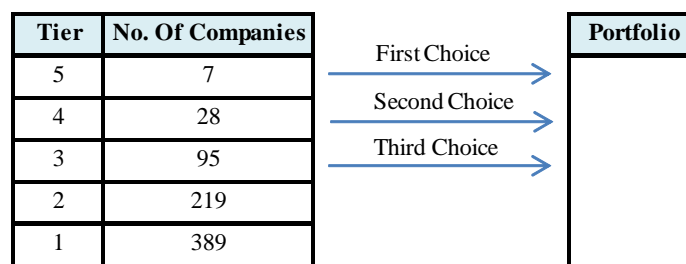
Portfolio I and II demonstrate that there are multiple paths and approaches that investors can take in incorporating behavioural influences into portfolio composition. Portfolio II is the designated portfolio for benchmark testing, as this portfolio represents the primary aim of this part of the research and with Portfolio I being largely for demonstration purposes. Portfolio II will have three variations in stock weighting allocations, in order to produce the necessary results for analysis. The first variation consists of equal weights in each security, the second as a result of the mean variance optimisation process, and the third in accordance with the market capitalisation.

Asset Allocation Strategies

Portfolio I

Portfolio I employed a bottom-down approach, where the desirable attributes of the stock takes precedence over larger economic considerations or variables. In selecting the individual securities, the raw collated outcome of the screening process was used as the basis for selection – the more criteria that a stock satisfied, the higher in ranking the stock was placed. Final selection was based on the ranking of the stock. Should further separation be required in the event of equal ranking, a random selection process⁶⁷ would be employed in order to ensure that no selection criterion was given preference.

Figure 2 - Portfolio I Methodology



Source: Author's calculations

The portfolio construction process for this portfolio ends at this point. Each security is allocated equal weighting in the portfolio – 12.5% ($\frac{1}{8}$) each. The spirit of this approach was to let the screening results speak for themselves with minimal input or interference.

Portfolio II

Both Graham and Lynch noted that while following market trends is within the realm of speculation, fluctuations can be opportune times to uncover value companies. Opting for a top-down approach, Portfolio II took wider economic variables in account and consequently found suitable securities to fulfil the determined requirements. Specifically, Portfolio II aimed to examine the big picture of March 2010 with the

⁶⁷ The randomisation process was achieved through the allocation of a random number between 0 and 1 to each equally ranked company via the “RAND” Excel function. The results were ranked from largest to smallest, with the company with the highest allocated random number being selected.

intention of incorporating the teachings of behavioural finance into the overall direction of the portfolio.

Trending Issues

Provision of a framework on which to base Portfolio II's selections necessitated examination of the trends and economic environment of the time. Three key topics were dominating headlines towards the end of the first quarter in 2010.

- a. Financial crisis – fresh from the calamity that was 2008 and 2009, persistent housing problems and unemployment were still proving to be major issues for financial institutions in the US, and indeed globally. Over in Europe, the Greek and sovereign debt crisis was beginning to occupy headlines.
- b. Automobile Industry – the United States was still reeling from an automotive crisis with roots dating pre 2008 financial crisis, as a result of the large industry players facing tumbling revenue with a misjudged product line up amid rising fuel costs.
- c. US Health Care Debate – the long saga of the Patient Protection and Affordable Care Act was being debated in the Senate by the time early 2010 came about.

Asset Allocation

The three largest trending news topics of the time happened to be largely negative in nature, and consequently casting a negative light on the related companies. These stocks represented industries in turmoil, illuminating danger signs within the public consciousness. In falling prey to the representativeness bias, investors would evaluate the probability of positive returns based upon the recent negative information surrounding the industry, while neglecting the general chance of a company succeeding in the U.S. economy. Additionally, many news stories surrounding the industries and specific players were widely broadcast and were likely to be fresh in public consciousness – allowing easy availability of negatively slanted information pertaining to the sectors. Thus by taking the availability and representativeness heuristic into account, one can adopt a contrarian standpoint that inspires a portfolio that runs away from the herd, instead of alongside.

The designated industry sectors were financial institutions, real estate, healthcare and the automotive industry. With the world still firmly in the grip of the financial crisis and

a seemingly insurmountable mass of debt, financial institutions were most likely not the first available sector that would exude an aura of profit and wealth. Closely related and a driving factor behind the economic woes was the housing crisis, thus the selection of the real estate industry sector. With the U.S. Health Care debates raging on, uncertainty surrounded not only how companies would be obliged to cover their employees, but a shroud of doubt would be cast over the industry as a whole. Lastly with the automotive companies in turmoil, going against the flow and picking a related stock would be within keeping with the philosophy of this portfolio.

Security distribution across industry sectors was designated as follows:

- Financial institutions – 3 stocks
- Housing and real estate – 1 stock
- Healthcare – 3 stocks
- Automotive – 1 stock

With the financial crisis and healthcare uncertainties being the most prominent issues of the time, greater allocation in terms of stock numbers were afforded to these industry sectors. Housing and real estate, while indeed a large issue, was intertwined with the financial crisis and thus seen more as an auxiliary selection to the financial sector allocation. The automotive crisis was a long running issue, dating before the onset of the 2008 financial crisis, and was therefore deemed to have a relatively dulled impact in the public consciousness when taking into account the erosive quality of time.

Securities to fulfil the industry sectors would then be selected from the ranked and tiered results of the screening process. In seeking individual stocks to satisfy the industry sector quotas, the highest tiered companies would receive preference. In the event that the number of qualifying tiered stocks exceeds the required quota, the sub ranking system would be based upon the individual companies P/E ratio ranking⁶⁸.

Mean Variance Optimisation

With the portfolio stock selections completed, the subsequent step would be the employment of the Markowitz mean variance model. With the concept behind Portfolio

⁶⁸ Company P/E ratio rankings based upon Criteria 1 of Part I of this study.

I being to let the stock screening results speak for themselves, to as great a degree as possible, it was deemed counterintuitive to subject the portfolio to further refinement. It was therefore only Portfolio II that would be processed through the mean variance model. The purpose of this side study was to evaluate whether the mean variance model can provide value to Portfolio II, by providing optimal portfolio weights to each stock.

The function of the model is to analyse the portfolio data, providing optimal weighting solutions based upon the individual securities risk and return characteristics. The mean variance model can itself be employed to select stocks from a large array of available securities – however in light of the screening process in Part I already performing this function, the model instead is employed primarily as an optimisation tool. The primary aim of this side section of the research would be to determine whether the mean variance model could add value to the portfolio through the “tightening” of the portfolio’s risk return features.

Constraints

A major challenge faced by the process is the fact that the mean variance model is completely indifferent to both the stock screening process and the general overall aim of the study. Unconstrained, the model will attempt to long and short companies based upon their expected risk and return attributes. This runs contrary to the stock screen process in Part I, where the intention was to single out companies with attractive value and safety qualities, necessitating a buy and hold strategy for the companies to realise their potential. This detail aside, the mean variance model is indeed indifferent to the entire aim of the study, as behavioural considerations, such as the identified vulnerable industries, are also summarily disregarded. For this reason it is necessary to impose constraints upon the model in order to produce practical results.

Two constraints were considered for the mean variance model – the first of which was the constraint that the sum of the weights was equal to 1. This condition acts as a rudimentary budget constraint, simply stating that the portfolio is fully invested. The next and more crucial constraint imposed on the optimisation process was that all the resultant weights have to be positive. Acting as a long-only constraint, this removes the possibility of the model shorting any securities, drawing the model in line with the buy-and-hold requirements of the general investment strategy. While this solved the

issue of the model shorting, it still left the possibility that the model would select zero weights in some stocks if sensitivity issues were encountered.

Mean Variance Inputs

The mean variance process is notoriously sensitive to the model inputs, most specifically the stocks expected return characteristics. As additional stocks are added to a portfolio, the chances of them being highly correlated increases. This is caused by the fact that stock returns tend to be driven by a limited number of common risk factors. This degree of high correlation means that the model will rely on the expected return to differentiate between the stocks, with small changes seeing stocks falling in or out of favour with the mean variance model's optimisation process, potentially altering the output combinations to a large extent (Stewart et al., 2010). As development of reliable inputs is crucial in obtaining useful results from the model, it is appropriate to explore various techniques and methods to refine the expected stock return figures.

James-Stein Estimator

As previously explored, traditional statistical theory tells us that no other estimation rule is better than the observed average. In terms of stock prices, this implies that there is no better estimation of the expected returns than the average of the historical returns. What Stein's Paradox tells us however is that this is not necessarily always the case, with basing estimates on the grand average across multiple observed sample means producing more accurate results. The James-Stein Estimator then is introduced as method to refine the mean variance inputs, by producing a more accurate estimation.

This method entails using the 8 years of available historical stock returns and calculating the average return for each of the selected companies. From this average return, a grand average, or an average of the sample averages, is taken. By incorporating the individual sample variance calculated from the historical data, and the distribution of the sample averages around the grand average, a shrinking factor is produced. The grand average is then used as the basis of the return, and is adjusted according to the sample average return and the shrinking factor. In simple terms, the average of all the stock returns is used as a base. If the stock is showing too much volatility, then this average of all the stocks returns is used without any input from the stocks own return.

As the stock shows less volatility, the stock's own return has more influence on the assumed average return.

The expected return on each stock is then calculated by using the James-Stein Estimator average result in place of the simple average stock returns.

Optimisation

Using the refined inputs and taking into consideration the imposed constraints, the mean variance model will seek to maximise the objective function, previously defined as an investor's utility function. The model uses a risk aversion coefficient to determine the degree to which the hypothetical investor is risk averse. For this study a risk aversion coefficient of 2 has been used, as this is the upper risk tolerance range of the 2 to 4 recommended coefficients for portfolio allocation decisions (Fabozzi, Focardi, & Kolm, 2006⁶⁹). The model will then produce a set of optimal weighting outputs for Portfolio II through maximisation of this objective function.

In order to determine the value effect that the mean variance model has had on the portfolio, testing would be required on both the optimised and un-optimised portfolios. The un-optimised portfolios would be comprised of an equal weight for each security, in this case 12.5% ($\frac{1}{8}$) each. Additionally, a value weighted portfolio will be constructed by allocating the number of stocks in the portfolio in accordance to the company market capitalisation – mirroring the methodology of the S&P 500 benchmark index. The three portfolio variations would then be available for the final testing stage of the study.

At this point comparison of the equal weighted, value weighted and optimised portfolios is possible on a superficial level. The model produces statistics on expected gross return on the portfolio and the standard deviation. These measures of risk and return allow for a preliminary examination of the effects that the mean variance model has brought to the process.

⁶⁹ Page 33 – Risk Aversion Formulation

6.4.2 Results

The screening process in Part I of the study produced a structured list of companies that met the 9 established eligibility criteria. From this list it is possible to proceed in composing the previously established portfolios – Portfolio I and Portfolio II.

Portfolio I

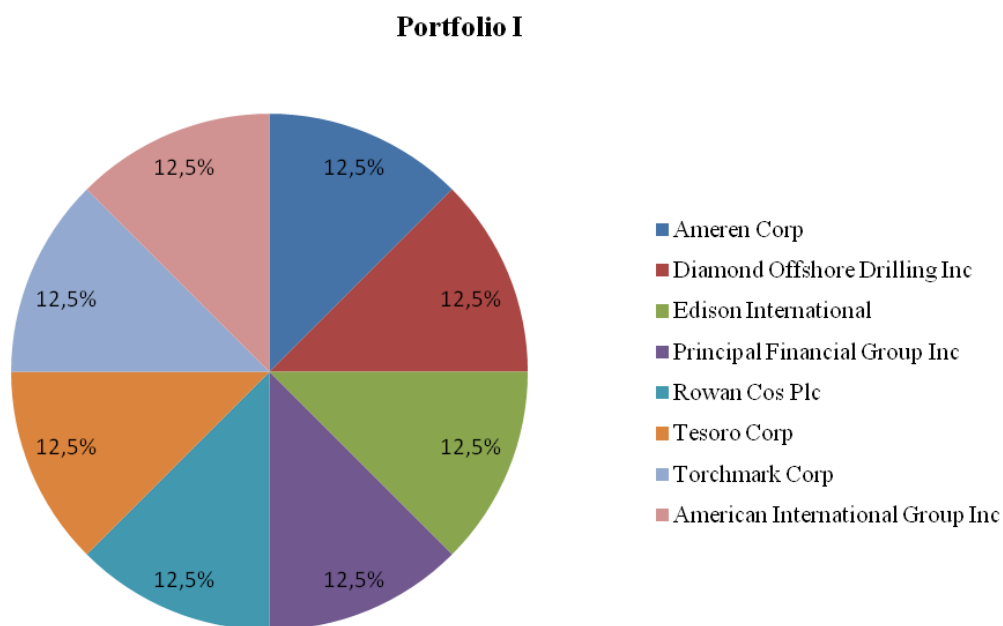
Portfolio I includes the top ranked stocks in terms of number of eligibility criteria satisfied. The results from Part I produce 7 companies meeting 5 criteria, resulting in automatic inclusion. With a further 1 stock required for the portfolio, and 21 available for selection, the remaining stock was picked using the previously defined random process. The qualifying stock under the random process was American International Group Inc. The subsequent composition of Portfolio I can be seen in Table 3 and Figure 3.

Table 3 - Portfolio I Constituents

| Portfolio I | |
|-------------|----------------------------------|
| Ticker | Name |
| AEE UN | Ameren Corp |
| DO UN | Diamond Offshore Drilling Inc |
| EIX UN | Edison International |
| PFG UN | Principal Financial Group Inc |
| RDC UN | Rowan Cos Plc |
| TSO UN | Tesoro Corp |
| TMK UN | Torchmark Corp |
| AIG UN | American International Group Inc |

Source: Author's calculations

Figure 3 - Portfolio I Constituents



Source: Author's calculations

Portfolio I contained companies from the energy, financials and utilities industrial sectors, distributed in shapes of 3, 3 and 2 respectively.

Portfolio II

Portfolio II required securities to fulfil a predetermined distribution across industry sectors. Companies were then selected in the following manner in order to satisfy the previously established requirement. Results of the process can be seen in Table 4.

Table 4 - Portfolio II Constituents

| Portfolio II | | | |
|--------------|-------------------------------|-----------------------|--------------------------------|
| Ticker | Name | Sector | Indicators |
| PFG UN | Principal Financial Group Inc | Financial Institution | P/E, PEGY, PCF, P/Bv, Total Db |
| TMK UN | Torchmark Corp | Financial Institution | P/E, PEGY, PCF, P/Bv, Total Db |
| XL UN | XL Group PLC | Financial Institution | P/E, P/Bv, Loser, Db |
| PHM UN | PulteGroup Inc | Housing and Real Est. | PCF, P/Bv, Loser, Current |
| HUM UN | Humana Inc | Healthcare | P/E, PEGY, P/Bv, Total Db |
| BMJ UN | Bristol-Myers Squibb Co | Healthcare | Dividend, Current, Total Db |
| CI UN | Cigna Corp | Healthcare | P/E, PEGY |
| F UN | Ford Motor Co | Automotive | PCF |

Source: Author's calculations

Rationale

Justification for selection of these companies is detailed by sector as follows.

Financial institution

Principal Financial Group Inc and Torchmark Corp were automatic choices for their high eligibility ranking. With no further financial institutions with 5 criteria, XL Group PLC was chosen for having the most attractive listed P/E ratio amongst the remaining eligible companies with 4 criteria. XL Group in fact registered the lowest P/E rating in the entire data set.

Housing and Real Estate

PulteGroup Inc was the only housing or real estate related firm listed that satisfied at least 4 of the eligibility criteria.

Healthcare

Humana Inc and Bristol-Myers Squibb Co were automatic choices as they were the only healthcare industry participants within the 4 and 3 criteria range respectively. Cigna Corp, while only meeting 2 of the eligibility criteria, had the lowest P/E ratio of the listed healthcare companies, and the 7th lowest of the entire dataset.

Automotive

Ford Motor Co was one of the “big three” car manufactures embroiled in the crisis automotive crisis at the time, along with General Motors and Chrysler. With Ford Motor Co being the only of these companies in the S&P 500, the selection of this company can be justified with the primary purpose Portfolio II in mind –priority being given to the industry sector first, with tiers and rankings of the individual stocks being of secondary significance.

A summary of the eligibility rationale can be seen in Table 5.

Table 5 - Portfolio II Rationale

| Name | Eligibility Justification |
|-------------------------------|--|
| Principal Financial Group Inc | Tier 5 stock with no conflicting peers |
| Torchmark Corp | Tier 5 stock with no conflicting peers |
| XL Group PLC | Tier 4 stock with highest P/E ratio in class |
| PulteGroup Inc | Tier 4 stock with no conflicting peers |
| Humana Inc | Tier 4 stock with no conflicting peers |
| Bristol-Myers Squibb Co | Tier 3 stock with no conflicting peers |
| Cigna Corp | Tier 2 stock with highest P/E ratio in class |
| Ford Motor Co | Tier 1 stock with exceptional circumstance ⁷⁰ |

Source: Author's calculations

Mean Variance Optimisation

The intended historical data range for the mean variance model inputs was a maximum of 20 years worth of monthly returns. Due to the inclusion of Principal Financial Group Inc into the study the data range had to be shortened to 8 years, as the company only became publicly listed in October 2001.

The analysis of the trailing 8 year of monthly historical yielded the results in Table 6.

Table 6 - Mean Variance Asset Statistics

| | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc |
|-----------------------|-------------------------------|----------------|--------------|-------------|------------|---------------|---------------|----------------|
| Annualised mean | 3,27% | 4,56% | -16,68% | 15,50% | 1,70% | -0,35% | -1,35% | -0,28% |
| Annualised σ | 57,82% | 32,22% | 54,37% | 41,46% | 49,48% | 27,24% | 60,71% | 43,09% |
| Annualised σ^2 | 33,43% | 10,38% | 29,56% | 17,19% | 24,49% | 7,42% | 36,86% | 18,57% |

Source: Author's calculations⁷¹

Examination of the data range show that half the selected companies within the portfolio endured negative average returns over the past 8 years, with XL Group PLC setting the lower range at -16.68% and Humana Inc setting the upper with 15.5%. For comparison, the S&P 500 index averaged 0.24% during the same period. Volatility across all stocks was above the S&P 500 average of 16.10%, suggesting that a relatively

⁷⁰ One of the “Big Three“ involved in U.S. automotive crisis of the time

⁷¹ Please refer to the Appendix VI – Additional Model Statistics for correlation and covariance figures

high volatility element throughout the portfolio. This is perhaps not unexpected given the driving factors behind the selection of the companies.

The wide range in sample average results and previously discussed sensitivity of the model appears to make the application of the James-Stein estimation method more significant. Employment of the James-Stein Estimator yielded the results in Table 7.

Table 7 - James-Stein Estimator

| | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc |
|----------------------------|-------------------------------|----------------|--------------|-------------|------------|---------------|---------------|----------------|
| Annualised mean | 3,27% | 4,56% | -16,68% | 15,50% | 1,70% | -0,35% | -1,35% | -0,28% |
| Annualised σ | 57,82% | 32,22% | 54,37% | 41,46% | 49,48% | 27,24% | 60,71% | 43,09% |
| Annualised σ^2 | 33,43% | 10,38% | 29,56% | 17,19% | 24,49% | 7,42% | 36,86% | 18,57% |
| Shrink factor | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 0,84 | 1,00 | 1,00 |
| J-S Estimator (α) | 0,80% | 0,80% | 0,80% | 0,80% | 0,80% | 0,62% | 0,80% | 0,80% |
| J-S Estimator (μ) | 17,51% | 5,99% | 15,58% | 9,39% | 13,04% | 4,33% | 19,23% | 10,08% |

Source: Author's calculations

All companies, with the notable exception of Bristol-Myers, displayed high sample average variance, suggesting less confidence can be placed in the observed sample averages. The rationale behind this is that the more volatile the returns, the less likely the averages are to be accurate, with the grand average of 0.80% then taking precedent. With having the lowest volatility, Bristol Myers was the sole company in which the sample average variance was within such a range that the shrinking ratio allowed influence of the sample average into the grand average estimation.⁷² Even so, with a shrink factor of 0.84 the sample average influence was still dampened at best. Final expected return figures were calculated from the James-Stein Estimation results.

Optimal Weights

Maximisation of the objective function through adjustment of the portfolio weights yields the results in Table 8.

⁷² See James-Stein Estimator explanation in Appendix III for further explanation.

Table 8 - Portfolio II Optimised Weights

| Company | Weight |
|-------------------------------|----------------|
| Principal Financial Group Inc | 1,53% |
| Torchmark Corp | 4,43% |
| XL Group PLC | 5,23% |
| Humana Inc. | 12,12% |
| Cigna Corp | 7,66% |
| Bristol-Myers | 45,85% |
| Ford Motor Co | 4,23% |
| PulteGroup Inc | 18,95% |
| | 100,00% |

Source: Author's calculations

The mean variance model found weights for all of the selected companies in the portfolios. Strong preference was shown to Bristol-Myers, which may not be entirely surprising given the low sample variance and correlation characteristics. Additionally, PulteGroup Inc and Humana Inc received significant weighting.

Value Weights

The final variant of Portfolio II, composed of weights in accordance with the company market capitalisation, appears in Table 9.

Table 9 - Portfolio II Value Weights

| Company | Market Capitalisation | Weight |
|-------------------------------|------------------------|-------------|
| Principal Financial Group Inc | 7.398.814.208 | 6,01% |
| Torchmark Corp | 3.897.692.416 | 3,17% |
| XL Group PLC | 6.357.005.824 | 5,17% |
| Humana Inc. | 8.082.287.616 | 6,57% |
| Cigna Corp | 9.508.411.392 | 7,73% |
| Bristol-Myers | 41.807.888.384 | 33,98% |
| Ford Motor Co | 41.800.175.616 | 33,98% |
| PulteGroup Inc | 4.174.354.688 | 3,39% |
| | 123.026.630.144 | 100% |

Source: Author's calculations⁷³

The methodology of this portfolio weight distribution is in harmony with the S&P 500 benchmark index.

⁷³ Market capitalisation obtained from (Bloomberg L.P., 2015g)

Portfolio II – Final Variations

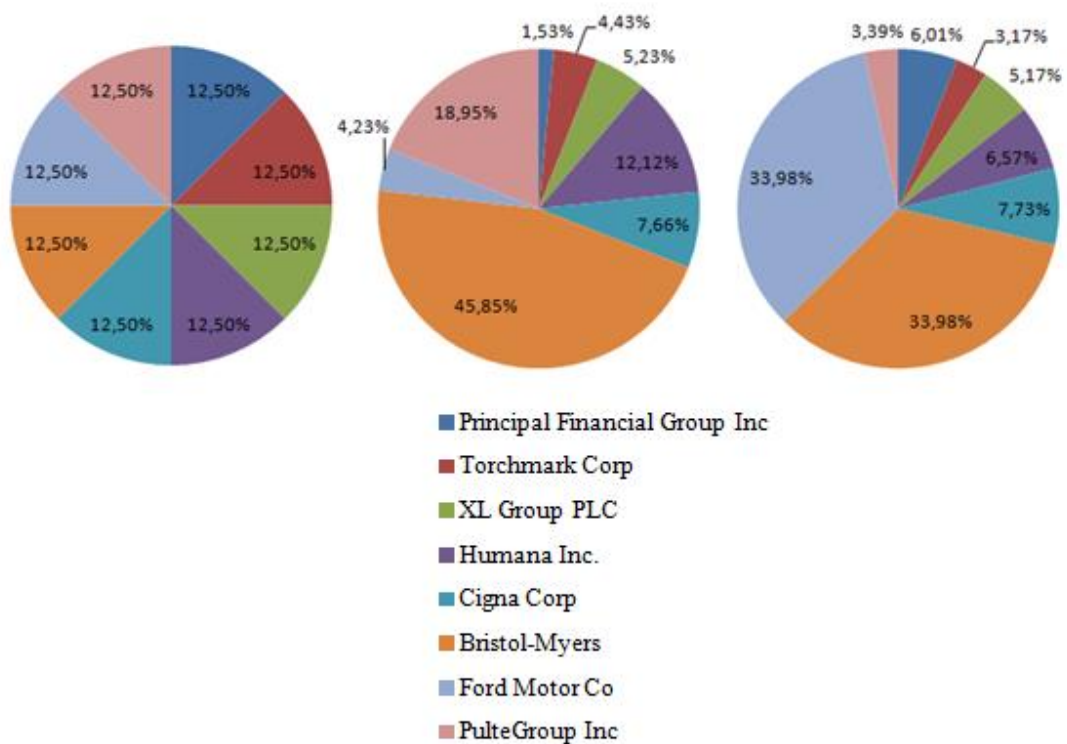
The three portfolios appear in their completed forms in Table 10 and Figure 4.

Table 10 - Portfolio II Variations

| Company | Equal ω | Model ω | Value ω |
|-------------------------------|----------------|----------------|----------------|
| Principal Financial Group Inc | 12,50% | 1,53% | 6,01% |
| Torchmark Corp | 12,50% | 4,43% | 3,17% |
| XL Group PLC | 12,50% | 5,23% | 5,17% |
| Humana Inc. | 12,50% | 12,12% | 6,57% |
| Cigna Corp | 12,50% | 7,66% | 7,73% |
| Bristol-Myers | 12,50% | 45,85% | 33,98% |
| Ford Motor Co | 12,50% | 4,23% | 33,98% |
| PulteGroup Inc | 12,50% | 18,95% | 3,39% |
| | 100,00% | 100,00% | 100,00% |

Source: Author's calculations

Figure 4 - Portfolio II Variations



Source: Author's calculations

Additional statistics obtained from the portfolios can be seen in Table 11.

Table 11 - Mean Variance Statistics

| | Equal ω | Model ω | Value ω |
|------------------|----------------|----------------|----------------|
| Expected return | 11,89% | 8,19% | 12,02% |
| Variance | 31,29% | 23,42% | 32,35% |
| Expected utility | -0,0769 | -0,0278 | -0,08914 |

Source: Author's calculations

The mean variance optimisation process has achieved a greatly reduced portfolio variance compared to the un-optimised variations. This came at the cost, however, of reducing the overall expected return on the portfolio. The resultant utility functions are all negative, with the optimised portfolio naturally being less so. The negative utility function results suggest that an investor with a risk aversion coefficient of 2 would find these portfolios to be too risky in nature to have a desirable outcome.

6.4.3 Discussion

The aim of Part II of this research study was to provide an upper layer of behavioural influence to the portfolios.

Portfolio I is the purest representation of the Part I stock screening process, before this upper behavioural layer was applied. It is certainly worth noting that Portfolio I reflects John Dorfman's robot portfolio to some degree in that he allows the results of his screening criteria to speak for themselves. In addition to the P/E ratio, Dorfman also excludes any stocks exhibiting losses over the past four quarters or any with debts larger than shareholders equity⁷⁴, along with a minimum market capitalisation requirement of USD 500 million.⁷⁵ In essence, the Robot Portfolio is a 4 criteria version of this process, selecting 10 stocks instead of 8.

However, the selection of stocks from the bottom-up approach, as demonstrated in Portfolio I, gave the impression that the ship was being steered from below deck, without any clear vision or sense of direction. In using the top-down approach, it is felt

⁷⁴ Bearing some similarity with the debt based criteria used for this study

⁷⁵ Dorfman: 2014 less-than-stellar year for Robot Portfolio (Dorfman, 2015)

that introducing decisions on this level provided the portfolio with a sense of purpose and direction.

Any additional layer of input on behalf of the investor increases the risk of bias and irrational influence infiltrating the portfolio. It is absolutely imperative, therefore, to ensure that when the top layer of decisions are made, they firstly have foundations in sound reasoning, and secondly that they are executed in the most structured manner possible.

Certain sectors during and in the lead up to March of 2010 were experiencing a crisis of confidence. Operating in an opposite direction to Shiller's (2006) feedback loops, pessimistic views on stocks have a downward pulling effect on the stock price, with the resultant drop in stock prices generating further pessimistic views, et cetera. Shiller also noted that the news media plays a vital role in disseminating these views, be they positive or negative. It was using this as the foundation of reasoning that the research study assessed the period of March 2010 on the basis of the foremost pessimistic news stories of the preceding months, and by extension then the public consciousness. The four primary trends identified were the financial industry, the real estate sector, the healthcare industry and the automotive industry. With investors shying away from stocks representative of these industries, and the negative stock news freshly available in the public consciousness, a strategic level contrarian course could be charted along which the selected stocks could navigate.

With behavioural influence now incorporated in both the top asset allocation and lower asset selection process, allocating securities to fulfil the predetermined industry sectors was a matter of using the results from Part I to execute the strategy devised in Part II. There existed a risk at this juncture to dilute the results from Part I, if a well defined structure was not in place. The distribution system devised earlier in this chapter was aimed at avoiding this potential issue by making use of the P/E ratio based Criteria 1 as a "tie-breaker", in the instance where multiple stocks in the same industry sector with the same tier ranking required separation. It is felt that this structure allowed the results from Part I of the study to retain their potency and intended influence on the research. The one true and notable exception from this process was the selection of Ford Motor Co on the basis that the company was one of the three companies embroiled in a

specific crisis. The impact of this decision will be better evaluated once the results from the forthcoming performance tests have been adequately assessed.

Preliminary Thoughts on the Mean Variance Model

The preliminary indicators obtained from the three variants of Portfolio II provide some insight into process behind the mean variance model. The general results see the model reduce the portfolio volatility, however at the cost of expected return. As noted in the results, it appears that a portfolio of this nature is indeed too risky for what the model would usually consider a portfolio investor, given the negative utility results. Early indications at this point suggest that the model, without substantial modification, may not provide clear value to Portfolio II.

Thoughts on the Utility Function

The utility function employed in the mean variance model optimisation process was a concave function, representing risk aversion. As explored earlier, the curvature of this function measures the change in marginal utility over the change in wealth. A key facet to basing the optimisation process on maximising this utility function is that the model is able to account for the diminishing marginal utility of wealth into the portfolio optimisation process.

With the primary aim of the study being to incorporate behavioural influences into portfolio composition, the question arises of whether the mean variance process could not be influenced further at this point. As mentioned, the function employed defines utility over wealth – however Prospect Theory, on the other hand, proposes that this should instead be defined over gains and losses. This presents an opportunity to explore the possible effect of substituting expected returns for probable gains or losses into the mean variance model. While major alterations to the model and utility function, along with rigorous testing of the results, is beyond the scope of this particular study, it is felt that there is potential to further incorporate behavioural influences, via Prospect Theory, into the asset allocation component of the mean variance model at stage.

Data Issues

A challenge presented itself with regards to the historical data as the inclusion of Principal Financial Group Inc meant that only 8 years of trailing stock prices was available as input for the mean variance model. Preliminary analysis of the stock return and standard deviation figures over this period indicated a sizable variation in average returns, ranging from 15.5% to -16.68%. With the previously discussed model input sensitivity to return characteristics, this naturally posed a challenge in deriving any useful results from the model.

The James-Stein Estimator was then employed to refine the model inputs and alleviate this dilemma. Given that the inputs, in the form of the sample averages, varied greatly between extremes, it is intuitive that the preference should be given to the grand average. Considering the historical data under consideration covers two periods of financial crisis, it is not surprising then that return ranges were high and thus too was volatile. For the mean variance model to produce any meaningful results, reliance on dampened estimation values appears to have been necessary. When producing the expected return figures, ultimately used in the optimisation process, the influence of the sample variance is incorporated, producing a result which does not render the sample data entirely devoid of influence.

6.5 Part III – Performance Testing

6.5.1 Methodology

Introduction

The final step of the study involves testing the composed portfolios against historical data ranging from March 2010 to March 2015. The aim of this part of the research is to determine the effects gained from the approaches and behavioural influences incorporated in Parts I and II, drawing to a conclusion to the primary aim of the overall research study. The concept behind this step was to simulate how the portfolio would have performed should it have been come into being in the beginning of March 2010. As historical price information is available, there is no need for simulation of expected returns.

The weighting approach used in this study was to distribute the weights according to market value of each security. The primary step in this procedure was to determine the market value available for each security by using the weightings determined in Part II. By using a theoretical initial investment of USD 10.000.000 a simple multiplication of the weight to investment provides the amount of funds available to invest in each security. The historically relevant security market price is then applied to provide the number of shares that the investment allocation would have purchased at the beginning of the testing period. This in turn provides the portfolio composition at time zero, or March 2010.

The testing moves forward on a month to month basis. At the end of each month the updated historical stock prices are applied to the portfolio share weightings, providing an updated portfolio market value on each consecutive month. As the stock prices increase or decrease, the market value contribution to the portfolio may drift away from the initial target percentage. In order to avoid having the portfolio composition changing significantly in this way, the portfolio positions require rebalancing. In this study rebalancing of the portfolio weighting occurs on an annual basis. After the end of the 12 month period, the total portfolio market value is again distributed across the initially set weight distributions and applied in accordance to the current market prices of the securities involved. The net effect would be the purchase or sale of stocks in order for the market value distribution to match the original weightings.

After 5 years of consecutive monthly updated portfolio market values and annual rebalancing, the final and current market value of the portfolio is reached. The effect of transaction costs and net taxable gains incurred as a result of the rebalancing process was not taken into account in this study, however in drawing conclusions it will be understood that this is a factor.

The benchmark used for the evaluation of the portfolio was the S&P 500. The index price of the S&P 500 reflects reinvestment of dividends back into itself. The reinvestment is not specific to the stock that paid the dividend, but rather dividends are reinvested over the entire index. Additionally, the S&P 500 undergoes a quarterly share and style rebalancing process. The theoretical initial investment of USD 10.000.000 is then applied to the S&P 500, simulating the market performance over the 5 year period. The market value of the S&P 500 index is tracked on a month to month basis over the 5 year period, allowing for comparative analysis over the course of the testing time frame. At the end of the 5 year testing period, a final market value for the S&P 500 index is attained.

At this point examination of the performance attributes of the equal weighted portfolio, the optimised portfolio and the benchmark index is possible. Comparison to the index allows for a number of performance evaluations, such as beta, alpha and the Treynor ratio. The betas of the portfolios are computed by extracting the variance and covariance from the performance of the portfolios and the S&P 500, attained in the previous monthly performance stage. The beta figures are consequently employed to produce the alpha, or excess risk statistics. In addition to the alpha, the beta is also used to compute the Treynor ratio, providing insight on the reward to volatility measures of the portfolios.

6.5.2 Results

With the given theoretical initial investment amount of USD 10.000.000 and the historically relevant security prices, the composition of Portfolio II in March 2010 appears in Table 12, Table 13 and Table 14.

Table 12 - Portfolio II Equal Weights Composition

| Portfolio II – Equal ω | | | | |
|-------------------------------|-------------------------------|-------|------------|--------------|
| Ticker | Name | Price | No. Shares | Market Value |
| PFG UN Equity | Principal Financial Group Inc | 20,28 | 61.637 | 1.250.000 |
| TMK UN Equity | Torchmark Corp | 19,58 | 63.841 | 1.250.000 |
| XL UN Equity | XL Group PLC | 16,46 | 75.942 | 1.250.000 |
| PHM UN Equity | PulteGroup Inc | 10,57 | 118.259 | 1.250.000 |
| HUM UN Equity | Humana Inc | 45,23 | 27.640 | 1.250.000 |
| BMY UN Equity | Bristol-Myers Squibb Co | 20,13 | 62.099 | 1.250.000 |
| CI UN Equity | Cigna Corp | 34,11 | 36.646 | 1.250.000 |
| F UN Equity | Ford Motor Co | 10,77 | 116.063 | 1.250.000 |
| | | | | 10.000.000 |

Source: Author's calculations

Table 13 - Portfolio II Optimised Weights Composition

| Portfolio II – Optimised ω | | | | |
|-----------------------------------|-------------------------------|-------|------------|--------------|
| Ticker | Name | Price | No. Shares | Market Value |
| PFG UN Equity | Principal Financial Group Inc | 20,28 | 7.524 | 152.593 |
| TMK UN Equity | Torchmark Corp | 19,58 | 22.647 | 443.425 |
| XL UN Equity | XL Group PLC | 16,46 | 31.750 | 522.599 |
| PHM UN Equity | PulteGroup Inc | 10,57 | 179.255 | 1.894.721 |
| HUM UN Equity | Humana Inc | 45,23 | 26.809 | 1.212.459 |
| BMY UN Equity | Bristol-Myers Squibb Co | 20,13 | 227.798 | 4.585.414 |
| CI UN Equity | Cigna Corp | 34,11 | 22.445 | 765.608 |
| F UN Equity | Ford Motor Co | 10,77 | 39.293 | 423.181 |
| | | | | 10.000.000 |

Source: Author's calculations

Table 14 - Portfolio II Value Weights Composition

| Portfolio II - Value ω | | | | |
|-------------------------------|-------------------------------|-------|------------|--------------|
| Ticker | Name | Price | No. Shares | Market Value |
| PFG UN Equity | Principal Financial Group Inc | 20,28 | 29.655 | 601.399 |
| TMK UN Equity | Torchmark Corp | 19,58 | 16.181 | 316.817 |
| XL UN Equity | XL Group PLC | 16,46 | 31.392 | 516.718 |
| PHM UN Equity | PulteGroup Inc | 10,57 | 32.101 | 339.305 |
| HUM UN Equity | Humana Inc | 45,23 | 14.526 | 656.954 |
| BMY UN Equity | Bristol-Myers Squibb Co | 20,13 | 168.822 | 3.398.280 |
| CI UN Equity | Cigna Corp | 34,11 | 22.658 | 772.874 |
| F UN Equity | Ford Motor Co | 10,77 | 315.474 | 3.397.653 |
| | | | | 10.000.000 |

Source: Author's calculations

The three variations of Portfolio II were then run against the historical price data, producing a real world simulation between the periods of March 2010 to March 2015. The portfolio performances over this period appear in Table 15.

Table 15 - Portfolio II Performance Summary

| | S&P 500 | Equal ω | Optimised ω | Value ω |
|--------------|----------------|----------------|--------------------|----------------|
| Year 1 | 22,11% | 22,95% | 10,48% | 21,88% |
| Year 2 | 6,24% | 10,07% | 21,76% | 7,72% |
| Year 3 | 13,18% | 26,77% | 31,19% | 16,63% |
| Year 4 | 23,29% | 31,56% | 35,21% | 33,64% |
| Year 5 | 14,84% | 20,95% | 19,97% | 17,88% |
| Total | 111,71% | 184,03% | 206,56% | 149,21% |
| Beta | | 1,1216 | 0,8067 | 0,9204 |
| Alpha | | 58,75% | 116,42% | 46,38% |
| Treynor | | 163,96% | 255,91% | 161,98% |

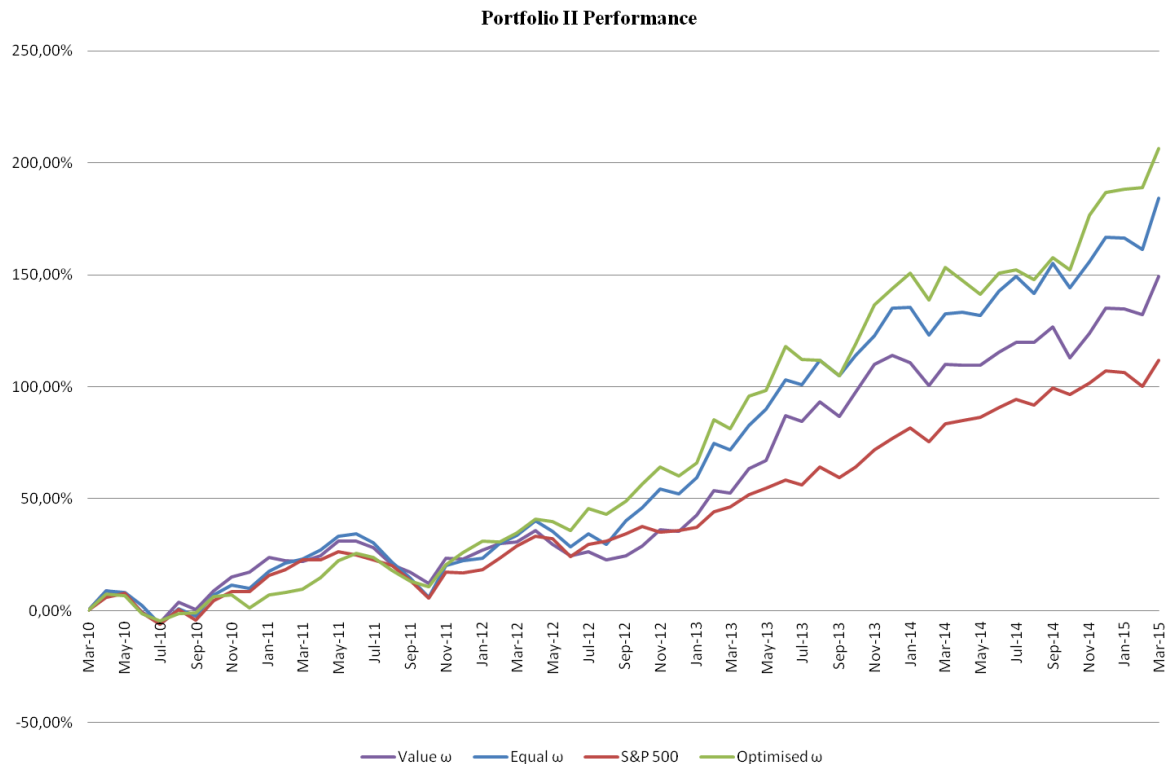
Source: Author's calculations⁷⁶

All three portfolio variations see the total 5 year return figures to be over and above that of the benchmark index, with the excess return and risk adjusted return figure also providing favourable results.

Chart performance of the three variations of Portfolio II against the benchmark S&P 500 index appears in Figure 5.

⁷⁶ Please refer to Appendix VII – Portfolio II Performance for full results

Figure 5 - Portfolio II Performance Summary

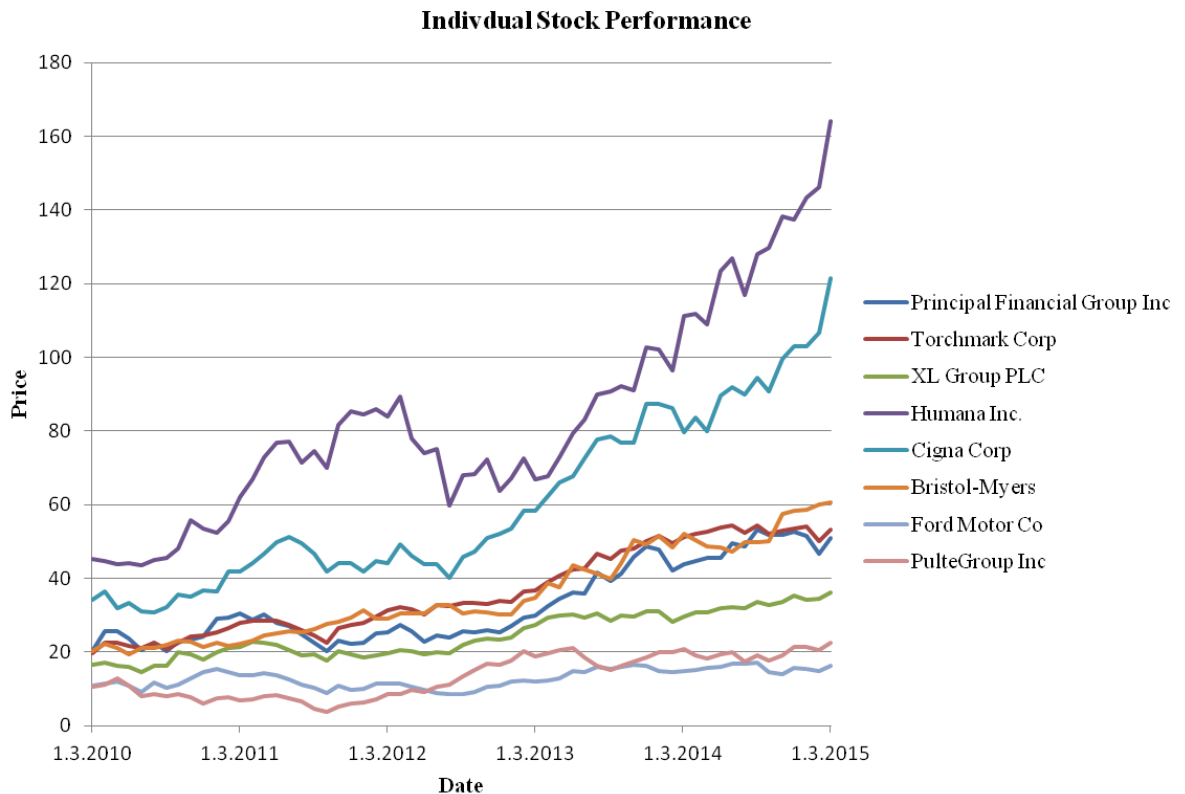


Source: Author's calculations

All three variations of the portfolio track the index relatively closely until after approximately 30 months, where all tend to pull away from the index. This appears to support both Graham and Lynch in their assertion that stock selections can take time blossom into profit. Ultimately the index is outperformed by all three variations of Portfolio II.

Examination of the individual stock price movements appears in Figure 6

Figure 6 - Individual Stock Performance



Source: Author's calculations

The stock price performances translate into the returns displayed in Table 16.

Table 16 - Portfolio II Individual Stock Performance

| | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Pulte Group Inc | Humana Inc. | Bristol-Myers | Cigna Corp | Ford Motor Co |
|--------------|-------------------------------|----------------|----------------|-----------------|----------------|----------------|----------------|---------------|
| 1yr | 48,67% | 37,62% | 30,88% | -31,83% | 34,08% | 12,06% | 23,85% | 33,11% |
| 2yr | -15,00% | 14,54% | -6,90% | 42,26% | 32,92% | 27,60% | 6,70% | -13,11% |
| 3yr | 18,45% | 16,92% | 35,72% | 84,52% | -16,69% | 19,38% | 31,27% | 7,11% |
| 4yr | 42,27% | 34,36% | 9,21% | 13,13% | 54,32% | 44,50% | 33,04% | 25,04% |
| 5yr | 16,38% | 4,73% | 20,05% | 12,25% | 41,49% | 16,52% | 45,10% | 12,25% |
| Total | 150,54% | 171,96% | 118,96% | 112,68% | 262,89% | 200,91% | 256,46% | 51,72% |

Source: Author's calculations

The three healthcare stocks in Humana Inc, Bristol-Myers and Cigna Corp proved to be the true performers within the portfolio, with simply astronomical performance over the 5 year test period. The show-stoppers aside, the performance of, Principle Financial

Group Inc, Torchmark Corp and XL Group PLC and Pulte Group Inc all register returns over the 5 year period above the S&P 500 index benchmark. The only company to trail the benchmark is Ford Motor Co.

6.5.3 Discussion

The primary aim of Part III of this research study was to evaluate the portfolio, and the variants therefore, generated through Parts I and II in a real world environment. In convergence with the overall aim of the research paper, this part would establish and explore the potential benefits to be gained from approaching portfolio composition from a behavioural finance perspective.

The first and foremost observation from the results was that all three variations of Portfolio II provided greater returns over the 5 year testing period than that of the benchmark index. Of the three variations, the optimised model provided the greatest returns, followed by the equal weighted and value weighted variants respectively.

Mean Variance Model Discussion

The aim of this sub-section of the study was to determine if the mean variance model provided any additional value to the portfolio, through optimisation of the portfolio weights. On the surface, the results appear to suggest that this was the case, with the optimised portfolio seeing a total return of 206.56%, with the equal weighted portfolio trailing at 184.03% and finally the market value weighted portfolio rounding off with 149.21%.

Recalling that Jensen's alpha is the goal of any active investor, the result of 116.42% excess return on the market over 5 years is a remarkable result, with the market weighted ratio the lowest at a still admirable 46.38%. With this metric being seen as the result of the active managers decisions, and considering all variants indeed achieved handsome alpha returns, it could be inferred that the stock selection processes prior to the asset allocation phase could be largely attributed to this positive outcome.

Lastly, the risk adjusted return in the form of the Treynor ratio was also the superior of the three, with 255.91%. All three variants did indeed achieve enviable risk adjusted returns, however on the surface it would appear that the mean variance model has achieved lowering the portfolio risk attributes, and hence the superior Treynor ratio result.

The end result of the optimisation process was that the portfolio variance, or risk, has been reduced through the optimisation of the hypothetical investors risk averse utility function. In the preliminary statistics, this reduction came at the cost of expected return, however the real world testing produced results to the contrary. It is perhaps not surprising that the optimised portfolio resulted with a lower risk, demonstrated in the form of beta in this instance, over the 5 year study period, as this was the intention and outcome of the mean variance model weightings. The surprise, however, came in the form of the portfolio's stunning total return figures. The optimised portfolio went heavy into Bristol-Myers due to the stock's low volatility, assigning 45.85% of the portfolio share. It would appear that the exceptional performance of the portfolio was largely due to the performance of Bristol-Myers, although the portfolio did end up with a higher total return over the stock itself. Whether the results of Bristol-Myers and the emphasised inclusion thereof are the result of fortune or design is most unclear at this juncture, and impossible to state without further study.

It is extremely difficult to draw conclusion from this isolated study and claim that the mean variance model can provide value. The primary source of doubt is that the model is capricious in nature, with minor alterations resulting in drastic effect. For this subsection, the study can conclude that value was provided in this circumstance, but strongly concludes too that further testing is required to state so generally with any degree of conviction.

Portfolio II Performance

The primary area of discussion is now the fact that Portfolio II has achieved above-market returns over the testing period. Of the three variants, the weighted portfolio bears the best comparison, as it employs the same methodology in weighting composition as the benchmark index itself. Using this as a basis, we can then deduce

that Portfolio II received a 149.21% total return to the market's 111.71%, with an excess return of 46.38%. The question at hand is then why and how Portfolio II performed as it did.

In order to explore how, we examine the individual stocks which make up the sum of the portfolio. Barring Ford Motor Co, all of the remaining stocks have individually realised greater total returns than the weighted market average. However, evaluation of the individual companies should ideally be viewed in context not only of the market, but also in respect of the particular industry to which they are associated. Part II of the study identified industries that had potential of containing undervalued stocks based upon behavioural finance influenced reasoning. Comparison of these identified industries and their total return for the study period against the index benchmark is open to a degree of interpretation. On one hand, an industry total return above the market could suggest, on a superficial level, that the methods employed in Part II have identified a generally undervalued market. However, Part II was primarily about identifying industries with potential for undervalued stocks, necessitating further unearthing by consequently employing the Part I screening process.

More relevant comparison then would be to compare the individual stock returns over the study period to the industry average, providing magnified scrutiny of the general effectiveness of Part I of the study. With this in mind, we can evaluate each stocks performance in light of their respective industries.

Healthcare

The healthcare company statistics appear in Table 17.

Table 17 - Portfolio II Health Care Industry Sector

| Portfolio II - Health care | | |
|--|--------------|-----------------------------|
| Industry Sector Total Return - 154,09% | | |
| Company Name | Total Return | Indicators |
| Humana Inc. | 262,89% | P/E, PEGY, P/Bv, Total Db |
| Bristol-Myers | 200,91% | Dividend, Current, Total Db |
| Cigna Corp | 256,46% | P/E, PEGY |

Source: Author's calculations⁷⁷

⁷⁷ Healthcare industry data obtained from (S&P Dow Jones Indices LLC, 2015b)

The healthcare industry sector total return for the study period was 154.09%, a figure that has a few implications to consider. Firstly the healthcare sector return was above that of the market index, raising the question of whether the individual stock performance was merely a consequence of being in an industry on the rise, which in itself could be testament to the process of Part II if this was a result of pervasive mispricing. Alleviation of this concern however comes in noting that all three healthcare related stock returns for the study period were well above that of the industry average, suggesting indeed that the behavioural influenced stocks selection criteria in Part I proved effective as well.

Financial sector

Table 18 - Portfolio II Financial Industry Sector

| Portfolio II – Financial Sector | | |
|---------------------------------------|--------------|--------------------------------|
| Industry Sector Total Return – 80,71% | | |
| Company Name | Total Return | Indicators |
| Principal Financial Group Inc | 150,54% | P/E, PEGY, PCF, P/Bv, Total Db |
| Torchmark Corp | 171,96% | P/E, PEGY, PCF, P/Bv, Total Db |
| XL Group PLC | 118,96% | P/E, P/Bv, Loser, Db |

Source: Author's calculations⁷⁸

Examination of the financial sector produces similar results and the same implications. Table 18 shows that all three stocks performed well above the industry average of 80.71%, again providing testament to the Part I stock screening process. The industry total return for financials was below the market index, suggesting that the industry remained in a degree of turmoil over the 5 years to follow. It is very encouraging to observe that the Part I screening process unearthed stocks that produced above market returns while being part of a below market performing industry.

⁷⁸ Financial sector industry data obtained from (S&P Dow Jones Indices LLC, 2015b)

Housing and Real Estate

Table 19 - Portfolio II Housing and Real Estate Industry Sector

| Portfolio II – Housing | | |
|--|--------------|---------------------------|
| Industry Sector ⁷⁹ Total Return – 228,97% | | |
| Company Name | Total Return | Indicators |
| PulteGroup Inc | 112,68% | PCF, P/Bv, Loser, Current |

Source: Author's calculations⁸⁰

Table 19 shows that while the stock's total return for the study period was marginally above that of the market, the industry sector return far exceeded the market over the same horizon, suggesting the top level decision for a housing industry allocation proved effective. The housing industry was severely affected by the U.S. housing crisis, and so from a behavioural perspective one could infer that the prices were dampened well below their true value across the industry, resulting in the rebound witnessed over the subsequent 5 year period. However, in a counterpoint to the previous two instances, the stock screening process did not unearth the top performers in this case, even though above market performance on its own could be argued as being adequate.

Automotive

Table 20 - Portfolio II Automotive Industry Sector

| Portfolio II – Automotive | | |
|---|--------------|------------|
| Industry Sector ⁸¹ Total Return – 75,45% | | |
| Company Name | Total Return | Indicators |
| Ford Motor Co | 51,72% | PCF |

Source: Author's calculations⁸²

As the results in Table 20 clearly demonstrate, Ford Motor Co and the automotive industry fell well short of the market on total return. The poor results were perhaps indicative of the extended period of turbulence experienced by the sector on justifiable grounds. It seems indeed that the greatest exception made in Part II of the study, with

⁷⁹ While technically in the broad consumer discretionary industry sector, to improve relevance the household durables subsector was instead used the basis of comparison for PulteGroup Inc.

⁸⁰ Household durables industry historical prices obtained from (Bloomberg L.P., 2015m)

⁸¹ Also technically belonging to the consumer discretionary industry sector, the comparison was instead made on the automobile subsector for Ford Motor Co.

⁸² Automobile industry historical prices obtained from (Bloomberg L.P., 2015l)

Ford Motor Co, resulted in the worst returns, suggesting little benefit to be gained in straying from the designed process.

The two standout positive aspects were the exceptional performance of the healthcare stocks above and beyond the above market industry returns, and the encouraging above market performance of the selected financial companies in spite of being in an underperforming industry. These are certainly exceptional results and well worth taking note of. The results were not without concern however, as on the negative side the performance of PulteGroup Inc below the industry return was notable, as the process had failed to select the top industry performers as it had in other instances, calling into question the consistency of the process. The standout concern from the results is clearly Ford Motor Co, with both below market and industry returns. The failure of this selection is somewhat explainable, as the fault appears to lie in the inclusion of this security on an exemption basis, as Ford Motor Co. only satisfied 1 of the selection criteria, resulting in a ranking that includes 77.8% of the other S&P 500 constituents. It would then appear that too much emphasis was placed on the top level macro consideration in Part II, and not allowing enough influence from screening process of Part I.

On a whole, the process employed through Parts I and II of the research study resulted in 7 out of 8 of the stocks outperforming the market, with 6 out of 8 out performing their respective industries. Featured guru Peter Lynch was thankful for 6 out of 10 of his stocks performing⁸³, so 6 out of 8 can have no major complaints. These positive individual performances contributed to Portfolio II handily outperforming the market, regardless of weighting variation. From a behavioural perspective, there appears then to be evidence that the approaches employed were able to take advantage of mispricing in the market. This was achieved through the analysis of the company fundamentals from a behavioural perspective, via the financial ratios and stock selection criteria, which ultimately proved effective in identifying signals of mispricing. Additionally the positive alpha results galvanise the idea that there was a positive influence in the active management of this portfolio. From these results, it is reasonable to deduce that the processes in Parts I and II, and behavioural influences incorporated within, provided a positive overall effect to the portfolio in this particular study.

⁸³ One Up on Wall Street (Lynch & Rothchild, 2000), p. 75

7. Conclusion

The ultimate aim of the research was to determine whether any positive effects could be gained from incorporating behavioural finance influences into the portfolio composition process. In attempt to achieve this aim, a behavioural influenced stock screening process and asset allocation strategy was devised and implemented. The resultant portfolios were tested through a study period comprised of historical market data, resulting in above market risk adjusted returns.

Part I of the study introduced a collection of criteria designed to act as behavioural beacons, capturing signals of under or over reaction from the market that materialised itself in the form of prices drifting away from underlying fundamental values. Part II provided behavioural influence from a macro perspective by examination of the prevailing market conditions and identifying industries that were potentially neglected in the public consciousness. Through the representativeness bias, stocks in these industries would be negatively viewed through association alone, resulting in downward pressure on the prices, which through an inverse variant of Shiller's feedback loops, would have perpetuated the negative views even further. The results of the Part III indicated that the methods employed in Part I and II had been successful in producing a portfolio with above market risk adjusted returns, suggesting that these behavioural influences and considerations provided positive effects to the portfolio composition process.

This study appears to have produced similar results to a number of other empirical studies on this topic⁸⁴, leading to the suggestion that pervasive mispricing is evident in the market in the period ranging from March 2010 to March 2015. Evidence of mispricing, and the implied over and under reaction from the market to information, suggest that incorporating these influences into portfolio composition can be of positive benefit. It is additionally apparent that incorporating these influences employed to take advantage of the market under and overreactions was achieved through the methods and approaches of the featured financial gurus Benjamin Graham and Peter Lynch. In echoing the success of John Dorfman's Robot Portfolio, it would be additionally useful

⁸⁴ Overreaction, Underreaction, and the Low-P/E Effect (Dreman & Berry, 1995) and Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios (Basu, 1977)

to employ the methods established in this study over a sufficiently longer study period, in order to be more certain of its conclusions.

The investment world is fraught with market indicators and strategies devoid of sound fundamental basis or reasoning, in what Graham refers to as “cockamamie.” The key in avoiding this pitfall is to ensure the criteria are relevant, provide insight to the company fundamentals, and provide an element of safety. Additionally it is worth noting that this methodology necessitates observance of conditions as well as implementation. It is necessary therefore for the investor to ensure their views are updated to incorporate all market information, as we exist in an ever evolving world.

Swensen (2009) notes that “Marrying the art of seasoned judgement with the science of numeric analysis creates a powerful approach to allocating portfolio assets.”⁸⁵ This has proven to be the case with both Parts I and II of this study, with the aim of uncovering mispricing elements in the market being achieved through examination of quantifiable company fundamental metrics, employed to further behavioural influenced ends. The choice of financial ratios and selection criteria was measured and deliberate, constructing a process in line with both behavioural academic theory and the investment guru teachings. The success of the portfolio can then be attributed to both the art of observing human behaviour, and the science of robust quantitative implementation.

⁸⁵ Pioneering Portfolio Management (Swensen, 2009), p. 99.

Appendix I - Financial Ratio Definitions

Description and explanations sourced from Bloomberg Terminal (Bloomberg L.P., 2015f).

Market Price – The Market Price represents the last price of an equity security provided by the exchange or any other trustworthy source, on a per share basis.

Earnings per Share (EPS)

Equation:
$$\frac{\text{Net Earnings}}{\text{Shares Outstanding}}$$

The Earnings per Share is the allocation of company profit to a share of company stock. The particular EPS employed is the 12 month trailing diluted EPS from continuing operations. This includes only items that are considered to be reoccurring in nature and part of a company's continued operations. This excludes the effect of all onetime extraordinary gains and losses – such as realised gain or loss on investments or restructuring charges.

Net Earnings

Net Earnings, also known as net income or the “bottom line”, is defined as the residual of all revenues gained over all expenses and losses for a period. It is the element that represents the increase in shareholders' equity resulting from the company's operations.

Shares Outstanding

Shares Outstanding are the combined number of primary common share equivalents of all classes outstanding as of the Balance Sheet date. When used in conjunction with Earnings per Share, the weighted average of the shares outstanding over the relevant period is used.

Cash Flow per Share

Equation:
$$\frac{\text{Cash from Operations}}{\text{Shares Outstanding}}$$

Cash flow per share is a measure of a company's financial strength, representing the net cash that a company produces, on a per share basis. The measure used is the 12 month trailing Cash Flow per Share.

Cash from Operations

Cash from Operations, or operating cash flow, is the amount of cash a company generates through its operations. This is defined as the Net Income (after tax earnings), with depreciation and other noncash adjustments added back, along with changes in noncash working capital.

Book Value per Share

Equation:
$$\frac{\text{Total Common Equity}}{\text{Shares Outstanding}}$$

The Book Value per Share is a measure used to determine the level of security associated with each individual share after all the company's debts has been settled. Total Common Equity is the total amount that all common shareholders have invested in the company, or simply the amount of ownership attributed to common stock holders. This is given by the Total Shareholders Equity less the Preferred Equity. Alternatively, this is the Share Capital and APIC (Additional Paid in Capital), added with Retained Earnings and Other Equity.

Dividend per Share

Dividend per Share is the total dividends paid out by the company over a 12 month trailing period, on a per share basis. With some exceptions, this figure generally does not include capital distributions.

Projected EPS Growth

The projected earnings growth rate represents the expected increase in operating earnings per share over the next full business cycle.

Tangible Common Equity

Tangible Common Equity, or total tangible assets, represents the assets which can be liquidated or sold, usually with physical form. As such this definition excludes intangible assets such as goodwill and trademarks. The tangible common equity can be given by the previously defined total common equity, less intangible assets.

Current Assets

Current assets are generally defined as assets that are able to be converted into cash in a short period of time, often defined as one year. Current assets include cash and cash

equivalents, accounts receivable and inventories, marketable securities and other short term investments.

Current Liabilities

Current liabilities are defined as obligations that are due within a short time frame, again often defined as a one year. Current liabilities include accounts payment and short term debt.

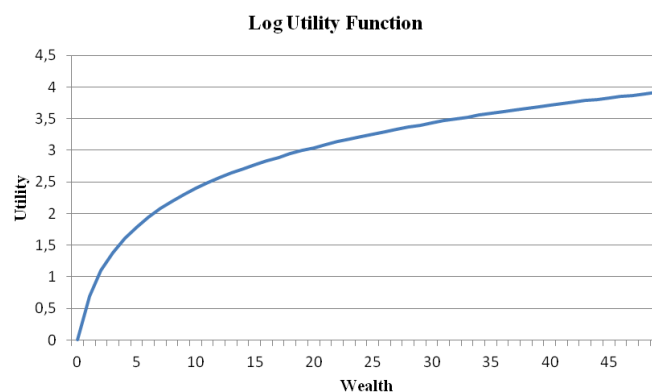
Total Debt

The total debt of a company is the sum of both the current liabilities and long term debt. It is used as representation of the entirety of the debt within the company.

Appendix II – Utility Theory

In economic terms, utility refers to the satisfaction derived from consuming a good or service. Marginal utility is then the additional satisfaction gained by consuming one additional unit of that good or service. In his resolution of the St. Petersburg paradox, Daniel Bernoulli (1954) proposed that it was expected utility rather than expected wealth that was the driving force behind decisions concerning money. In essence, the marginal utility gained from money, or wealth, is determined by the current level of wealth of the consumer. The practical logic is demonstrated in the value of a unit of money having different meaning to a wealthy or poor individual. Bernoulli offered the log utility function to explain the concept of diminishing marginal utility.

Figure 7 - Log Utility Function



Source: Author's calculations

Using this information, it is assumed that investors will base their decisions on a utility function, which traces the amount of utility derived by levels of wealth. Because investors will seek to accomplish their investment goals, they will in turn seek to maximise this utility function.

The curvature of the utility function represents the investor's willingness to take on risk. The concave curvature function represents risk aversion, and the curvature itself being the measure of risk aversion. A useful measure risk aversion in this context known as the Arrow-Pratt measure of relative risk aversion (Arrow, 1965; De Finetti, 1952; Pratt, 1964) is described as the change in marginal utility over the change in wealth. This function is given as
$$RRA = - \frac{\% \text{ change in marginal utility}}{\% \text{ change in wealth}}^{86}$$

⁸⁶ Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 59

Appendix III - Mean Variance Model

This theoretical framework covers topics based on (Copeland et al., 2004) and (Stewart et al., 2010).

Assumptions

The mean variance model requires a number of notable assumptions.

- Investors are risk averse and wealth maximising.
- Asset returns are normally distributed.
- Statistical parameters are stable.
- Markets are frictionless, in that there are no transaction costs or taxes considered.

It is worth noting that these assumptions are not without challenge. The assumption that all investors share similar risk profiles and exhibit rational behaviour at all times is contentious, especially in light of the previously covered section on behavioural finance. Normality of asset returns has been contested by a number of academics, notably Fama (1965) and Mandelbrot (1963, 1967), supported by others (Richardson & Smith, 1993). The common belief is that the normal distribution does not accommodate the presence of outliers to a sufficient degree. The stability of asset correlations has too been challenged, with correlations appearing unstable over time (Longin & Solnik, 1995). Needless to say, the assumption of no tax or transactions costs is not in sync with reality.

Optimisation Process

The initial step in the mean variance process is the preparation of the asset returns from the historical prices. Following the assumption that asset returns are normally distributed, as previously discussed, the log normal asset returns x on asset i at time t can be calculated with the following equation:

Equation 1 - Log Normal Returns

$$x_i(t) = \ln \left[\frac{Price_i(t)}{Price_i(t-1)} \right]$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 92

With the asset returns calculated the following key statistics can be computed.

Table 21 - Key Statistics

| Statistic | Equation |
|---------------------------------|---|
| Mean (\bar{x}) | $\bar{x}_i = \frac{1}{T} \sum_t x_i(t)$ |
| Variance (σ^2) | $\sigma^2 = \frac{1}{T-1} \sum_t [x_i(t) - \bar{x}_i]^2$ |
| Standard Deviation (σ) | $\sigma = \sqrt{\sigma^2}$ |
| Covariance ($\sigma_{i,j}$) | $\sigma_{i,j} = \frac{1}{T} \sum_t [x_i(t) - \bar{x}_i] [x_j(t) - \bar{x}_j]$ |
| Correlation ($\rho_{i,j}$) | $\rho_{i,j} = \frac{\sigma_{i,j}}{\sigma_i \sigma_j}$ |

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 92-93

The above mentioned statistics will be computed for each asset, along with covariance and correlation matrices for all the assets. It is at this point where refinements can be made to the model inputs, in particular to the asset mean or averages.⁸⁷

From the statistics available, it is now possible to calculate the expected return on each asset. If we once again reassert the assumption that the asset returns are normally distributed, the equation for expected return μ on asset i is give by:

Equation 2 - Expected Return

$$\mu_i = \bar{x}_i + \frac{1}{2} \sigma_i^2$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 62

With the individual asset expected returns calculated, it is necessary to compute the portfolio expected return and variance.

Each asset constitutes a certain percentage in the portfolio, known as the asset weight ω . The expected return on the portfolio is simply the sum of the expected asset returns and their relative weight in the portfolio. The equation is thus given by

⁸⁷ Refer to James-Stein Estimator later in Appendix III for details

Equation 3 - Portfolio Expected Return

$$\mu_W = \sum_i \omega_i \mu_i$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 65

In a portfolio of assets we need to consider not only the assets individual variance, but also their relationship with each other. Therefore, when calculating the portfolio variance, we incorporate both variance and covariance into the equation – given by:

Equation 4 - Portfolio Variance

$$\sigma_W^2 = \sum_i \sum_j \omega_i \omega_j \sigma_{ij}$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 65

In practical terms, this is computed using matrix algebra, as follows:

Equation 5 - Portfolio Variance Matrix

$$\sigma_W^2 = [\omega_i \quad \omega_j] \begin{bmatrix} \sigma_{ii} & \sigma_{ij} \\ \sigma_{ji} & \sigma_{jj} \end{bmatrix} \begin{bmatrix} \omega_i \\ \omega_j \end{bmatrix}$$

Source: Financial Theory and Corporate Policy (Copeland et al., 2004), p. 128

At this point the individual asset expected returns, portfolio expected returns and portfolio variance have been defined.

The optimisation process entails optimising a hypothetical investor objective function, which is based on the constant relative risk aversion power utility function, a variant of the previously established relative risk aversion. A risk aversion coefficient λ provides the degree to which the theoretical investor is risk averse. Assuming normal distribution, the objective function is given as:

Equation 6 - Objective Function

$$\mu_W - \lambda \sigma_W^2$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 66

In this equation we have μ_W , the portfolio expected returns and σ_W^2 , the portfolio variance. The risk aversion coefficient λ decreases risk tolerance in the objective function as λ increases, as seen by the influence λ places on the portfolio variance. This equation is then maximised, subject to the portfolio weights, to produce an optimal set of portfolio asset weight combinations.

James-Stein Estimator

The James-Stein Estimator, as explained by (Efron & Morris, 1977) and (Stewart et al., 2010).

Traditional statistical theory tells us that no other estimation rule is better than the observed average. What this essentially implies is that, given a set of data, the best estimation is based upon the average of all observed data. Stein's Paradox concerns a method that can be employed to more accurately predict these estimated values. The method essentially entails basing the estimation on the average of averages, and as such requires a number of sample averages in order to function. The paradox itself lies in the fact that the results of this method contradict the original fundamental estimation rule.

The method begins in having a number of observable sample averages, each average which we shall designate as y . The first step is to determine the average of these sample averages, known as the grand average, designated as \bar{y} . The process entails "shrinking" all the sample averages (y) towards the grand average (\bar{y}). The value produced after the shrinking process is designated as z . To revisit the paradox, this lies in values of z being better estimators than values of y .

The equation for this method, the James-Stein Estimator, is given by:

Equation 7 - James-Stein Estimator

$$z = \bar{y} + \theta(y - \bar{y})$$

Source: Stein's Paradox in Statistics (Efron & Morris, 1977), p. 116

Where θ is the shrinking factor.

The shrinking factor is the definite characteristic of the James-Stein estimator, and ranges between values of 0 and 1. This is the factor by which the sample averages are shrunk towards the grand average. This is given by the following equation:

Equation 8 - Shrinking Factor

$$\theta = \min \left[1, \left(\frac{\sigma^2/T}{\sum (y - \bar{y})^2 / (N - 3)} \right) \right]$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 106

The shrinking factor evaluates the variance of the sample average (σ^2) against the distribution of sample averages around the grand average ($\sum(y - \bar{y})^2$). The additional term $(N - 3)$ introduces the number of sample averages as an influence in the shrinking factor, with the addition of more averages reducing the overall shrinking effect.

What this implies is that a higher sample average variance suggests that less confidence should be placed in the observable sample average and therefore greater confidence on the grand average. At the same time, a lower distribution of sample averages around the grand average suggests that confidence can be placed in the grand average.

Appendix IV – Portfolio Performance Measures

This theoretical framework covers topics based on (Stewart et al., 2010).

Beta

The beta of portfolio A with respect to benchmark index B is given by:

Equation 9 - Beta

$$\beta_A = \frac{\sigma_{AB}}{\sigma_B^2}$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 454

Where σ_{AB} is the covariance between portfolio A and the benchmark index B, and σ_B^2 is the variance of the benchmark index B.

Jensen's Alpha

The excess returns α of portfolio A over benchmark index B is given by:

Equation 10 - Jensen's Alpha

$$\alpha_A = R_A - [R_f + \beta_A(R_B - R_f)]$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 437

Where R_A is the portfolio A returns, R_B is the benchmark returns, R_f is the risk free rate, and β_A is the previously defined beta of portfolio A.

Treynor Ratio

The Treynor ratio for portfolio A is given by:

Equation 11 - Treynor Ratio

$$TR_A = \frac{(R_A - R_f)}{\beta_A}$$

Source: Running Money: Professional Portfolio Management (Stewart et al., 2010), p. 438

Where R_A is the portfolio A returns, R_f is the risk free rate, and β_A is the beta of portfolio A.

Appendix V – Part I Screening Results

Criteria 1 - Earnings Yield = 2x AAA Bond Yield

Table 22 - Criteria 1 Results

| Name | P/E | E/P | Required |
|-------------------------------------|------|--------|----------|
| XL Group PLC | 5,12 | 19,54% | 10,54 |
| Reynolds American Inc | 5,17 | 19,34% | 10,54 |
| Prudential Financial Inc | 5,62 | 17,79% | 10,54 |
| Edison International | 6,22 | 16,07% | 10,54 |
| International Paper Co | 6,29 | 15,89% | 10,54 |
| Goldman Sachs Group Inc/The | 6,75 | 14,81% | 10,54 |
| Cigna Corp | 7,12 | 14,04% | 10,54 |
| Assurant Inc | 7,51 | 13,32% | 10,54 |
| GameStop Corp | 7,53 | 13,29% | 10,54 |
| El Paso LLC | 7,62 | 13,13% | 10,54 |
| Eli Lilly & Co | 7,81 | 12,80% | 10,54 |
| Humana Inc | 7,82 | 12,80% | 10,54 |
| Torchmark Corp | 7,82 | 12,79% | 10,54 |
| Lincoln National Corp | 8,00 | 12,50% | 10,54 |
| Gannett Co Inc | 8,09 | 12,37% | 10,54 |
| Principal Financial Group Inc | 8,19 | 12,21% | 10,54 |
| Chubb Corp/The | 8,30 | 12,04% | 10,54 |
| Unum Group | 8,33 | 12,00% | 10,54 |
| Travelers Cos Inc/The | 8,39 | 11,93% | 10,54 |
| Computer Sciences Corp | 8,49 | 11,77% | 10,54 |
| Coventry Health Care Inc | 8,74 | 11,45% | 10,54 |
| Ameren Corp | 8,82 | 11,34% | 10,54 |
| SUPERVALU Inc | 9,00 | 11,11% | 10,54 |
| Dean Foods Co | 9,03 | 11,07% | 10,54 |
| Diamond Offshore Drilling Inc | 9,04 | 11,06% | 10,54 |
| Rowan Cos Plc | 9,17 | 10,91% | 10,54 |
| Pfizer Inc | 9,21 | 10,86% | 10,54 |
| Public Service Enterprise Group Inc | 9,28 | 10,78% | 10,54 |
| Western Digital Corp | 9,71 | 10,30% | 10,54 |
| Owens-Illinois Inc | 9,74 | 10,27% | 10,54 |

Source: Author's calculations^{88 89}

⁸⁸ Price to earnings ratio obtained from (Bloomberg L.P., 2015j)

⁸⁹ AAA bond yield for 01.03.2010 was 5.27%, from (Board of Governors of the Federal Reserve System (US), 2015)

Criteria 2 - PEGY Ratio > 1

Table 23 - Criteria 2 Results

| Name | P/E | Div Yield | Est Long Term Growth | PEGY |
|-------------------------------|-------|-----------|----------------------|--------|
| Time Warner Cable Inc | 13,66 | 65,32 | 12,75 | 0,1750 |
| Diamond Offshore Drilling Inc | 9,04 | 9,13 | 20,50 | 0,3052 |
| Reynolds American Inc | 5,17 | 6,48 | 6,00 | 0,4143 |
| Prudential Financial Inc | 5,62 | 0,00 | 13,44 | 0,4183 |
| Hudson City Bancorp Inc | 12,05 | 4,46 | 21,33 | 0,4671 |
| GameStop Corp | 7,53 | 0,00 | 14,40 | 0,5226 |
| El Paso LLC | 7,62 | 1,47 | 11,50 | 0,5874 |
| Rowan Cos Plc | 9,17 | 0,00 | 15,50 | 0,5913 |
| T-Mobile US Inc | 12,49 | 0,00 | 19,79 | 0,6311 |
| Goldman Sachs Group Inc/The | 6,75 | 0,89 | 9,77 | 0,6329 |
| Principal Financial Group Inc | 8,19 | 0,00 | 12,70 | 0,6450 |
| Assurant Inc | 7,51 | 1,92 | 9,67 | 0,6478 |
| Viacom Inc | 10,71 | 0,00 | 16,50 | 0,6494 |
| DIRECTV | 20,86 | 0,00 | 31,06 | 0,6715 |
| Southwestern Energy Co | 27,76 | 0,00 | 41,00 | 0,6771 |
| Dean Foods Co | 9,03 | 0,00 | 12,94 | 0,6981 |
| Aflac Inc | 10,30 | 2,24 | 12,35 | 0,7061 |
| Lincoln National Corp | 8,00 | 0,16 | 11,10 | 0,7106 |
| Ameriprise Financial Inc | 12,49 | 1,69 | 15,60 | 0,7222 |
| Whirlpool Corp | 12,35 | 2,00 | 15,00 | 0,7264 |
| Chubb Corp/The | 8,30 | 2,74 | 8,67 | 0,7278 |
| Molson Coors Brewing Co | 10,40 | 2,24 | 12,00 | 0,7303 |
| Fluor Corp | 11,40 | 1,17 | 14,00 | 0,7518 |
| Comcast Corp | 12,72 | 1,78 | 15,04 | 0,7560 |
| Cigna Corp | 7,12 | 0,12 | 9,16 | 0,7682 |
| Murphy Oil Corp | 12,98 | 1,88 | 15,00 | 0,7688 |
| Altria Group Inc | 10,90 | 6,51 | 7,50 | 0,7782 |
| Edison International | 6,22 | 3,74 | 4,26 | 0,7783 |
| Boeing Co/The | 12,08 | 2,62 | 12,80 | 0,7833 |
| Kimberly-Clark Corp | 12,82 | 3,95 | 12,02 | 0,8032 |
| NYSE Euronext | 12,94 | 4,38 | 11,50 | 0,8148 |
| Travelers Cos Inc/The | 8,39 | 2,32 | 7,74 | 0,8339 |
| Dun & Bradstreet Corp/The | 12,74 | 1,95 | 13,20 | 0,8408 |
| RR Donnelley & Sons Co | 13,05 | 5,19 | 10,00 | 0,8587 |
| El du Pont de Nemours & Co | 14,53 | 4,82 | 12,00 | 0,8638 |
| Ameren Corp | 8,82 | 6,15 | 4,00 | 0,8688 |
| CVS Health Corp | 13,44 | 0,89 | 14,56 | 0,8704 |
| Time Warner Inc | 13,60 | 2,53 | 13,02 | 0,8748 |
| Anthem Inc | 10,22 | 0,00 | 11,67 | 0,8762 |
| Apollo Education Group Inc | 14,57 | 0,00 | 16,40 | 0,8885 |
| FMC Technologies Inc | 19,47 | 0,00 | 21,33 | 0,9124 |
| Torchmark Corp | 7,82 | 1,21 | 7,33 | 0,9153 |
| Corning Inc | 12,85 | 1,13 | 12,83 | 0,9204 |
| Humana Inc | 7,82 | 0,00 | 8,48 | 0,9213 |
| NASDAQ OMX Group Inc/The | 11,50 | 0,00 | 12,43 | 0,9255 |
| UnitedHealth Group Inc | 10,53 | 0,09 | 11,26 | 0,9273 |
| AT&T Inc | 11,41 | 6,60 | 5,56 | 0,9384 |
| TECO Energy Inc | 14,46 | 5,14 | 10,15 | 0,9454 |
| Yum! Brands Inc | 14,32 | 3,54 | 11,54 | 0,9492 |
| SanDisk Corp | 18,64 | 0,00 | 19,50 | 0,9561 |
| MetLife Inc | 12,48 | 2,03 | 10,92 | 0,9637 |
| Lockheed Martin Corp | 10,35 | 2,97 | 7,71 | 0,9691 |
| Helmerich & Payne Inc | 16,11 | 0,49 | 16,00 | 0,9769 |
| Western Union Co/The | 12,44 | 0,37 | 12,33 | 0,9788 |
| TJX Cos Inc/The | 14,57 | 1,13 | 13,63 | 0,9876 |
| Aetna Inc | 11,05 | 0,13 | 11,00 | 0,9925 |

Source: Author's calculations^{90 91}

⁹⁰ Dividend yield obtained from (Bloomberg L.P., 2015d)

⁹¹ Estimated long term earnings growth obtained from (Bloomberg L.P., 2015e)

Criteria 3 - Price to Cash Flow > 5

Table 24 - Criteria 3 Results

| Name | P/CF | Name | P/CF |
|--|------|--------------------------------|------|
| American International Group Inc | 0,16 | <i>Continued from below...</i> | |
| Bank of America Corp | 0,95 | Xerox Corp | 3,77 |
| Huntington Bancshares Inc/OH | 1,04 | Aflac Inc | 3,79 |
| E*TRADE Financial Corp | 1,14 | DTE Energy Co | 3,85 |
| JPMorgan Chase & Co | 1,31 | Nabors Industries Ltd | 3,91 |
| Constellation Energy Group Inc | 1,60 | Marathon Oil Corp | 3,92 |
| Goldman Sachs Group Inc/The | 1,67 | Coventry Health Care Inc | 3,95 |
| Discover Financial Services | 1,90 | Torchmark Corp | 3,95 |
| Sprint Communications Inc | 2,00 | Allstate Corp/The | 3,96 |
| Ryder System Inc | 2,03 | Windstream Holdings Inc | 3,97 |
| Integrus Energy Group Inc | 2,14 | Safeway Inc | 3,98 |
| Zions Bancorporation | 2,19 | Prudential Financial Inc | 4,03 |
| International Paper Co | 2,21 | CenturyLink Inc | 4,07 |
| KeyCorp | 2,28 | CMS Energy Corp | 4,11 |
| NRG Energy Inc | 2,32 | Whirlpool Corp | 4,16 |
| Qwest Communications International Inc | 2,36 | JC Penney Co Inc | 4,17 |
| T-Mobile US Inc | 2,36 | Wells Fargo & Co | 4,23 |
| Fifth Third Bancorp | 2,45 | GameStop Corp | 4,24 |
| Tesoro Corp | 2,47 | AT&T Inc | 4,28 |
| Goodyear Tire & Rubber Co/The | 2,48 | Gannett Co Inc | 4,30 |
| NiSource Inc | 2,51 | NextEra Energy Inc | 4,30 |
| Verizon Communications Inc | 2,61 | Ford Motor Co | 4,41 |
| SUPERVALU Inc | 2,65 | XTO Energy Inc | 4,43 |
| CenterPoint Energy Inc | 2,68 | Tyson Foods Inc | 4,47 |
| Marshall & Ilsley Corp | 2,69 | PulteGroup Inc | 4,51 |
| Ameren Corp | 2,76 | Valero Energy Corp | 4,51 |
| Hartford Financial Services Group Inc/Th | 2,79 | TECO Energy Inc | 4,54 |
| RR Donnelley & Sons Co | 2,88 | Eversource Energy | 4,58 |
| Principal Financial Group Inc | 2,95 | Questar Corp | 4,65 |
| Time Warner Cable Inc | 3,18 | MeadWestvaco Corp | 4,70 |
| Frontier Communications Corp | 3,24 | Comcast Corp | 4,71 |
| Regions Financial Corp | 3,31 | Macy's Inc | 4,77 |
| Nicor Inc | 3,38 | Progress Energy Inc | 4,77 |
| AES Corp/VA | 3,38 | Legg Mason Inc | 4,79 |
| Loews Corp | 3,48 | Exelon Corp | 4,81 |
| Edison International | 3,57 | FirstEnergy Corp | 4,82 |
| First Horizon National Corp | 3,57 | Consolidated Edison Inc | 4,82 |
| El Paso LLC | 3,58 | Jabil Circuit Inc | 4,86 |
| Pinnacle West Capital Corp | 3,60 | Allegheny Energy Inc | 4,86 |
| Genworth Financial Inc | 3,62 | Cardinal Health Inc | 4,88 |
| Chesapeake Energy Corp | 3,75 | Kroger Co/The | 4,98 |
| Dean Foods Co | 3,75 | Xcel Energy Inc | 4,99 |

Source: Author's calculations⁹²

⁹² Price to cash flow ratio obtained from (Bloomberg L.P., 2015i)

Criteria 4 - Price to Book Value > 1.5

Table 25 - Criteria 4 Results

| Name | P/B | Name | P/B |
|---|------|----------------------------------|------|
| American International Group Inc | 0,15 | Torchmark Corp | 1,15 |
| Marshall & Ilsley Corp | 0,53 | Progress Energy Inc | 1,15 |
| Tesoro Corp | 0,54 | ConocoPhillips | 1,16 |
| Regions Financial Corp | 0,56 | Sears Holdings Corp | 1,17 |
| Sprint Communications Inc | 0,56 | DTE Energy Co | 1,17 |
| Genworth Financial Inc | 0,63 | Xerox Corp | 1,18 |
| Citigroup Inc | 0,63 | BB&T Corp | 1,18 |
| Hartford Financial Services Group Inc/The | 0,64 | Bank of New York Mellon Corp/The | 1,18 |
| Capital One Financial Corp | 0,64 | Consolidated Edison Inc | 1,19 |
| Zions Bancorporation | 0,66 | SUPERVALU Inc | 1,19 |
| SunTrust Banks Inc | 0,67 | Integrus Energy Group Inc | 1,19 |
| Valero Energy Corp | 0,68 | MeadWestvaco Corp | 1,20 |
| Lincoln National Corp | 0,71 | Sunoco Inc | 1,21 |
| Legg Mason Inc | 0,73 | Computer Sciences Corp | 1,22 |
| Assurant Inc | 0,74 | CareFusion Corp | 1,22 |
| Bank of America Corp | 0,74 | Nabors Industries Ltd | 1,23 |
| XL Group PLC | 0,75 | American Electric Power Co Inc | 1,23 |
| Ameren Corp | 0,76 | Host Hotels & Resorts Inc | 1,25 |
| NRG Energy Inc | 0,76 | Allegheny Energy Inc | 1,25 |
| KeyCorp | 0,77 | Invesco Ltd | 1,25 |
| Prologis | 0,80 | Constellation Brands Inc | 1,26 |
| NASDAQ OMX Group Inc/The | 0,81 | Lennar Corp | 1,26 |
| Constellation Energy Group Inc | 0,82 | First Horizon National Corp | 1,28 |
| Unum Group | 0,83 | Eversource Energy | 1,28 |
| E*TRADE Financial Corp | 0,83 | SunEdison Inc | 1,29 |
| NiSource Inc | 0,86 | Carnival Corp | 1,29 |
| Pepco Holdings Inc | 0,87 | Thermo Fisher Scientific Inc | 1,29 |
| T-Mobile US Inc | 0,93 | Archer-Daniels-Midland Co | 1,29 |
| Loews Corp | 0,93 | Quanta Services Inc | 1,29 |
| Cincinnati Financial Corp | 0,93 | National Oilwell Varco Inc | 1,29 |
| Huntington Bancshares Inc/OH | 0,94 | PulteGroup Inc | 1,30 |
| Marathon Oil Corp | 0,94 | Hudson City Bancorp Inc | 1,30 |
| Coventry Health Care Inc | 0,95 | M&T Bank Corp | 1,31 |
| Boston Scientific Corp | 0,95 | Xcel Energy Inc | 1,32 |
| MetLife Inc | 0,96 | Ryder System Inc | 1,32 |
| Fifth Third Bancorp | 0,98 | SCANA Corp | 1,33 |
| Prudential Financial Inc | 0,98 | Beam Suntory Inc | 1,33 |
| Duke Energy Corp | 0,99 | Goldman Sachs Group Inc/The | 1,33 |
| Rowan Cos Plc | 1,00 | Vulcan Materials Co | 1,34 |
| CBS Corp | 1,00 | CVS Health Corp | 1,34 |
| Principal Financial Group Inc | 1,00 | Kimco Realty Corp | 1,35 |
| Travelers Cos Inc/The | 1,01 | CMS Energy Corp | 1,35 |
| Allstate Corp/The | 1,02 | JM Smucker Co/The | 1,35 |
| Discover Financial Services | 1,02 | Sempra Energy | 1,35 |
| Time Warner Inc | 1,03 | AutoNation Inc | 1,36 |
| People's United Financial Inc | 1,03 | Leucadia National Corp | 1,36 |
| Morgan Stanley | 1,03 | SLM Corp | 1,36 |
| CME Group Inc/IL | 1,04 | Wells Fargo & Co | 1,37 |
| NYSE Euronext | 1,04 | Aetna Inc | 1,37 |
| Fidelity National Information Services I | 1,04 | JC Penney Co Inc | 1,38 |
| JPMorgan Chase & Co | 1,05 | Murphy Oil Corp | 1,39 |
| Alcoa Inc | 1,05 | FirstEnergy Corp | 1,39 |
| Comerica Inc | 1,07 | Humana Inc | 1,40 |
| Molson Coors Brewing Co | 1,08 | Tellabs Inc | 1,42 |
| Chubb Corp/The | 1,08 | Graham Holdings Co | 1,42 |
| GameStop Corp | 1,09 | Tyson Foods Inc | 1,42 |
| CenturyLink Inc | 1,10 | General Electric Co | 1,45 |
| Edison International | 1,10 | AT&T Inc | 1,45 |
| Ameriprise Financial Inc | 1,11 | Berkshire Hathaway Inc | 1,45 |
| Comcast Corp | 1,12 | Republic Services Inc | 1,45 |
| Pinnacle West Capital Corp | 1,12 | Hess Corp | 1,47 |
| Anthem Inc | 1,12 | Twenty-First Century Fox Inc | 1,48 |
| PNC Financial Services Group Inc/The | 1,13 | Sealed Air Corp | 1,49 |

Source: Author's calculations⁹³

⁹³ Price to book value ratio obtained from (Bloomberg L.P., 2015h)

Criteria 5 - Dividend Yield $> \frac{2}{3} \times \text{AAA Bond Yield}$

Table 26 - Criteria 5 Results

| Name | Dividend Yield | Required | Name | Dividend Yield | Required |
|--|----------------|----------|-------------------------------------|----------------|----------|
| Time Warner Cable Inc | 65,32 | 3,51 | PPL Corp | 4,77 | 3,51 |
| Frontier Communications Corp | 12,90 | 3,51 | Exelon Corp | 4,72 | 3,51 |
| Windstream Holdings Inc | 9,72 | 3,51 | Xcel Energy Inc | 4,69 | 3,51 |
| Diamond Offshore Drilling Inc | 9,13 | 3,51 | Ventas Inc | 4,61 | 3,51 |
| CenturyLink Inc | 8,07 | 3,51 | Philip Morris International Inc | 4,58 | 3,51 |
| NiSource Inc | 7,58 | 3,51 | Dominion Resources Inc/VA | 4,57 | 3,51 |
| Prologis | 7,40 | 3,51 | Spectra Energy Corp | 4,55 | 3,51 |
| Avery Dennison Corp | 7,04 | 3,51 | Equity Residential | 4,54 | 3,51 |
| Qwest Communications International Inc | 7,00 | 3,51 | Sunoco Inc | 4,53 | 3,51 |
| AT&T Inc | 6,60 | 3,51 | Pfizer Inc | 4,51 | 3,51 |
| Altria Group Inc | 6,51 | 3,51 | BB&T Corp | 4,46 | 3,51 |
| Reynolds American Inc | 6,48 | 3,51 | Hudson City Bancorp Inc | 4,46 | 3,51 |
| Pepco Holdings Inc | 6,45 | 3,51 | SUPERVALU Inc | 4,44 | 3,51 |
| Verizon Communications Inc | 6,45 | 3,51 | Carnival Corp | 4,43 | 3,51 |
| Progress Energy Inc | 6,40 | 3,51 | AvalonBay Communities Inc | 4,39 | 3,51 |
| Health Care REIT Inc | 6,37 | 3,51 | Nicor Inc | 4,38 | 3,51 |
| HCP Inc | 6,34 | 3,51 | NYSE Euronext | 4,38 | 3,51 |
| Pitney Bowes Inc | 6,21 | 3,51 | Public Service Enterprise Group Inc | 4,37 | 3,51 |
| Ameren Corp | 6,15 | 3,51 | Marsh & McLennan Cos Inc | 4,28 | 3,51 |
| Integrus Energy Group Inc | 6,07 | 3,51 | Paychex Inc | 4,09 | 3,51 |
| Cincinnati Financial Corp | 5,73 | 3,51 | Merck & Co Inc | 4,08 | 3,51 |
| Pinnacle West Capital Corp | 5,73 | 3,51 | Mondelez International Inc | 4,04 | 3,51 |
| Eli Lilly & Co | 5,71 | 3,51 | PG&E Corp | 4,00 | 3,51 |
| Duke Energy Corp | 5,70 | 3,51 | NextEra Energy Inc | 3,99 | 3,51 |
| FirstEnergy Corp | 5,63 | 3,51 | Kimberly-Clark Corp | 3,95 | 3,51 |
| CenterPoint Energy Inc | 5,59 | 3,51 | Genuine Parts Co | 3,92 | 3,51 |
| Consolidated Edison Inc | 5,46 | 3,51 | ConocoPhillips | 3,91 | 3,51 |
| Southern Co/The | 5,40 | 3,51 | Entergy Corp | 3,86 | 3,51 |
| Lorillard Inc | 5,28 | 3,51 | MeadWestvaco Corp | 3,85 | 3,51 |
| Leggett & Platt Inc | 5,28 | 3,51 | General Electric Co | 3,84 | 3,51 |
| RR Donnelley & Sons Co | 5,19 | 3,51 | Federated Investors Inc | 3,82 | 3,51 |
| TECO Energy Inc | 5,14 | 3,51 | People's United Financial Inc | 3,82 | 3,51 |
| Kimco Realty Corp | 5,14 | 3,51 | Franklin Resources Inc | 3,74 | 3,51 |
| Bristol-Myers Squibb Co | 5,13 | 3,51 | Edison International | 3,74 | 3,51 |
| SCANA Corp | 5,11 | 3,51 | Eversource Energy | 3,67 | 3,51 |
| Microchip Technology Inc | 4,94 | 3,51 | Chevron Corp | 3,65 | 3,51 |
| American Electric Power Co Inc | 4,83 | 3,51 | HJ Heinz Co | 3,64 | 3,51 |
| El du Pont de Nemours & Co | 4,82 | 3,51 | Caterpillar Inc | 3,63 | 3,51 |
| Vornado Realty Trust | 4,79 | 3,51 | M&T Bank Corp | 3,60 | 3,51 |
| DTE Energy Co | 4,78 | 3,51 | Yum! Brands Inc | 3,54 | 3,51 |

Source: Author's calculations^{94 95}

⁹⁴ Dividend yield obtained from (Bloomberg L.P., 2015d)

⁹⁵ AAA bond yield for 01.03.2010 was 5.27%, from (Board of Governors of the Federal Reserve System (US), 2015)

Criteria 6 - Market Price < $\frac{2}{3}$ × Tangible Book Value per Share

Table 27 - Criteria 6 Results

| Name | Price | Tangible Common Equity | Shares Outstanding | Tangible Book Value Per Share | Required |
|----------------------------------|-------|------------------------|--------------------|-------------------------------|-----------|
| American International Group Inc | 25,78 | 16.679.583.744 | 135.070.912 | 123,49 | 82,33 |
| Berkshire Hathaway Inc | 81,91 | 97.129.996.288 | 1.551.174 | 62.617,09 | 41.744,72 |
| Tesoro Corp | 11,84 | 2.785.999.872 | 140.427.584 | 19,84 | 13,23 |
| Marshall & Ilsley Corp | 7,06 | 6.229.156.864 | 525.370.208 | 11,86 | 7,90 |

Source: Author's calculations^{96 97}

Criteria 9 - Winners and Losers

Table 28 - Criteria 9 Results

| Name | 5 year Total Return | Name | 3 year Total Return |
|--|---------------------|--|---------------------|
| American International Group Inc | -97,96% | American International Group Inc | -98,03% |
| Citigroup Inc | -91,61% | E*TRADE Financial Corp | -92,81% |
| E*TRADE Financial Corp | -87,82% | Citigroup Inc | -92,74% |
| Sprint Communications Inc | -84,16% | Sprint Communications Inc | -82,92% |
| Eastman Kodak Co | -80,51% | KeyCorp | -79,41% |
| SLM Corp | -76,67% | Marshall & Ilsley Corp | -79,29% |
| Boston Scientific Corp | -76,24% | Regions Financial Corp | -78,38% |
| Gannett Co Inc | -75,78% | Office Depot Inc | -77,27% |
| Marshall & Ilsley Corp | -74,95% | Zions Bancorporation | -76,98% |
| KeyCorp | -74,81% | SunEdison Inc | -76,43% |
| Regions Financial Corp | -74,59% | Prologis | -75,90% |
| Huntington Bancshares Inc/OH | -74,02% | Huntington Bancshares Inc/OH | -75,76% |
| Electronic Arts Inc | -74,01% | SLM Corp | -74,37% |
| PulteGroup Inc | -71,01% | Eastman Kodak Co | -73,68% |
| XL Group PLC | -70,43% | Tesoro Corp | -73,58% |
| Lennar Corp | -70,28% | Legg Mason Inc | -72,79% |
| Zions Bancorporation | -69,65% | Hartford Financial Services Group Inc/Th | -70,98% |
| Fifth Third Bancorp | -67,28% | Monster Worldwide Inc | -70,83% |
| Dell Inc | -66,41% | XL Group PLC | -69,67% |
| Legg Mason Inc | -65,73% | Gannett Co Inc | -69,44% |
| New York Times Co/The | -63,53% | SunTrust Banks Inc | -68,95% |
| SunTrust Banks Inc | -61,43% | Valero Energy Corp | -67,82% |
| Office Depot Inc | -61,37% | Kimco Realty Corp | -66,54% |
| Harman International Industries Inc | -61,08% | Fifth Third Bancorp | -66,15% |
| Hartford Financial Services Group Inc/Th | -61,06% | Electronic Arts Inc | -66,13% |
| First Horizon National Corp | -59,76% | Lennar Corp | -63,82% |
| Prologis | -58,56% | NYSE Euronext | -63,35% |
| DR Horton Inc | -57,93% | First Horizon National Corp | -63,17% |
| Lexmark International Inc | -56,53% | PulteGroup Inc | -62,83% |
| Bank of America Corp | -56,01% | Motorola Solutions Inc | -62,73% |

Source: Author's calculations^{98 99}

⁹⁶ Tangible common equity obtained from (Bloomberg L.P., 2015n)

⁹⁷ Shares outstanding obtained from (Bloomberg L.P., 2015k)

⁹⁸ 5 Year total return obtained from (Bloomberg L.P., 2015b)

⁹⁹ 3 Year total return obtained from (Bloomberg L.P., 2015a)

Criteria 7 - Current Ratio > 2

Table 29 - Criteria 7 Results

| Name | Current Ratio | Required | Name | Current Ratio | Required |
|-------------------------------------|---------------|----------|--|---------------|----------|
| Google Inc | 10,62 | 2,00 | Continued from below... | | |
| Lennar Corp | 8,55 | 2,00 | General Electric Co | 2,68 | 2,00 |
| Fastenal Co | 8,22 | 2,00 | Yahoo! Inc | 2,67 | 2,00 |
| Microchip Technology Inc | 7,79 | 2,00 | CF Industries Holdings Inc | 2,67 | 2,00 |
| Celgene Corp | 7,77 | 2,00 | Beam Suntory Inc | 2,65 | 2,00 |
| Titanium Metals Corp | 7,72 | 2,00 | Becton Dickinson and Co | 2,64 | 2,00 |
| QLogic Corp | 6,67 | 2,00 | Dover Corp | 2,60 | 2,00 |
| Analog Devices Inc | 6,29 | 2,00 | Genzyme Corp | 2,59 | 2,00 |
| FLIR Systems Inc | 5,47 | 2,00 | Gilead Sciences Inc | 2,57 | 2,00 |
| Xilinx Inc | 5,41 | 2,00 | Applied Materials Inc | 2,57 | 2,00 |
| CR Bard Inc | 5,30 | 2,00 | Apple Inc | 2,55 | 2,00 |
| Novellus Systems Inc | 5,24 | 2,00 | Broadcom Corp | 2,54 | 2,00 |
| DR Horton Inc | 5,02 | 2,00 | Expeditors International of Washington I | 2,52 | 2,00 |
| Amgen Inc | 4,89 | 2,00 | Robert Half International Inc | 2,51 | 2,00 |
| Scripps Networks Interactive Inc | 4,66 | 2,00 | Black & Decker Corp/The | 2,51 | 2,00 |
| Forest Laboratories Inc | 4,63 | 2,00 | Newmont Mining Corp | 2,51 | 2,00 |
| QUALCOMM Inc | 4,60 | 2,00 | EMD Millipore Corp | 2,51 | 2,00 |
| Textron Inc | 4,45 | 2,00 | Hasbro Inc | 2,51 | 2,00 |
| Tiffany & Co | 4,42 | 2,00 | Priceline Group Inc/The | 2,50 | 2,00 |
| Cintas Corp | 4,24 | 2,00 | Freeport-McMoRan Inc | 2,48 | 2,00 |
| Nucor Corp | 4,22 | 2,00 | Hormel Foods Corp | 2,47 | 2,00 |
| KLA-Tencor Corp | 4,22 | 2,00 | BJ Services Co | 2,46 | 2,00 |
| Intuitive Surgical Inc | 4,18 | 2,00 | SunEdison Inc | 2,45 | 2,00 |
| Diamond Offshore Drilling Inc | 4,17 | 2,00 | VF Corp | 2,41 | 2,00 |
| Altera Corp | 4,17 | 2,00 | Mattel Inc | 2,41 | 2,00 |
| Stryker Corp | 4,06 | 2,00 | Visa Inc | 2,41 | 2,00 |
| Urban Outfitters Inc | 4,05 | 2,00 | St Jude Medical Inc | 2,40 | 2,00 |
| Zimmer Holdings Inc | 3,96 | 2,00 | JM Smucker Co/The | 2,40 | 2,00 |
| Baker Hughes Inc | 3,86 | 2,00 | Pall Corp | 2,39 | 2,00 |
| Texas Instruments Inc | 3,85 | 2,00 | NetApp Inc | 2,39 | 2,00 |
| Weyerhaeuser Co | 3,84 | 2,00 | L Brands Inc | 2,36 | 2,00 |
| Allergan Inc/United States | 3,83 | 2,00 | Medtronic PLC | 2,35 | 2,00 |
| Bemis Co Inc | 3,82 | 2,00 | Computer Sciences Corp | 2,33 | 2,00 |
| Total System Services Inc | 3,67 | 2,00 | International Flavors & Fragrances Inc | 2,33 | 2,00 |
| Corning Inc | 3,59 | 2,00 | Akamai Technologies Inc | 2,33 | 2,00 |
| Nabors Industries Ltd | 3,58 | 2,00 | eBay Inc | 2,32 | 2,00 |
| Cognizant Technology Solutions Corp | 3,57 | 2,00 | National Oilwell Varco Inc | 2,30 | 2,00 |
| JDS Uniphase Corp | 3,50 | 2,00 | Kohl's Corp | 2,29 | 2,00 |
| NIKE Inc | 3,49 | 2,00 | Linear Technology Corp | 2,29 | 2,00 |
| CareFusion Corp | 3,48 | 2,00 | Rockwell Automation Inc | 2,27 | 2,00 |
| Cisco Systems Inc | 3,48 | 2,00 | Leggett & Platt Inc | 2,27 | 2,00 |
| Biogen Idec Inc | 3,47 | 2,00 | Snap-on Inc | 2,27 | 2,00 |
| First Solar Inc | 3,42 | 2,00 | Monsanto Co | 2,22 | 2,00 |
| Smith International Inc | 3,41 | 2,00 | Bristol-Myers Squibb Co | 2,21 | 2,00 |
| SanDisk Corp | 3,35 | 2,00 | National Semiconductor Corp | 2,21 | 2,00 |
| Patterson Cos Inc | 3,25 | 2,00 | 3M Co | 2,20 | 2,00 |
| Allegheny Technologies Inc | 3,20 | 2,00 | AK Steel Holding Corp | 2,20 | 2,00 |
| Quanta Services Inc | 3,19 | 2,00 | Western Digital Corp | 2,20 | 2,00 |
| NVIDIA Corp | 3,16 | 2,00 | DaVita HealthCare Partners Inc | 2,20 | 2,00 |
| Wynn Resorts Ltd | 3,15 | 2,00 | Gap Inc/The | 2,19 | 2,00 |
| Tellabs Inc | 3,11 | 2,00 | Xerox Corp | 2,18 | 2,00 |
| PulteGroup Inc | 3,11 | 2,00 | Eastman Chemical Co | 2,17 | 2,00 |
| Ralph Lauren Corp | 3,11 | 2,00 | Agilent Technologies Inc | 2,17 | 2,00 |
| RadioShack Corp | 3,08 | 2,00 | International Game Technology | 2,13 | 2,00 |
| Precision Castparts Corp | 3,04 | 2,00 | Discovery Communications Inc | 2,13 | 2,00 |
| Halliburton Co | 2,99 | 2,00 | Archer-Daniels-Midland Co | 2,12 | 2,00 |
| Waters Corp | 2,97 | 2,00 | Tyson Foods Inc | 2,11 | 2,00 |
| Coach Inc | 2,97 | 2,00 | Harman International Industries Inc | 2,10 | 2,00 |
| Oracle Corp | 2,96 | 2,00 | FMC Corp | 2,10 | 2,00 |
| Alpha Appalachia Holdings Inc | 2,95 | 2,00 | Juniper Networks Inc | 2,09 | 2,00 |
| Adobe Systems Inc | 2,93 | 2,00 | Estee Lauder Cos Inc/The | 2,08 | 2,00 |
| Molex Inc | 2,90 | 2,00 | L-3 Communications Holdings Inc | 2,08 | 2,00 |
| Hospira Inc | 2,86 | 2,00 | Cummins Inc | 2,06 | 2,00 |
| Genuine Parts Co | 2,86 | 2,00 | Cameron International Corp | 2,05 | 2,00 |
| Plum Creek Timber Co Inc | 2,84 | 2,00 | Windstream Holdings Inc | 2,05 | 2,00 |
| Amphenol Corp | 2,82 | 2,00 | JC Penney Co Inc | 2,05 | 2,00 |
| Bed Bath & Beyond Inc | 2,80 | 2,00 | EMC Corp/MA | 2,05 | 2,00 |
| Intel Corp | 2,79 | 2,00 | Microsoft Corp | 2,04 | 2,00 |
| Thermo Fisher Scientific Inc | 2,76 | 2,00 | Cliffs Natural Resources Inc | 2,04 | 2,00 |
| WW Grainger Inc | 2,74 | 2,00 | MeadWestvaco Corp | 2,03 | 2,00 |
| DENTSPLY International Inc | 2,74 | 2,00 | United States Steel Corp | 2,03 | 2,00 |
| Goodrich Corp | 2,74 | 2,00 | Varian Medical Systems Inc | 2,02 | 2,00 |
| Rowan Cos Plc | 2,73 | 2,00 | Nordstrom Inc | 2,01 | 2,00 |
| Abercrombie & Fitch Co | 2,70 | 2,00 | Illinois Tool Works Inc | 2,00 | 2,00 |
| Teradyne Inc | 2,69 | 2,00 | Pactiv LLC | 2,00 | 2,00 |

Source: Author's calculations¹⁰⁰

¹⁰⁰ Current ratio obtained from (Bloomberg L.P., 2015c)

Criteria 8 - Total debt < Tangible Book Value

Table 30 - Criteria 8 Results

| Name | Total debt | Tang Common Equ. | Name | Total debt | Tang Common Equ. |
|-------------------------------------|---------------|------------------|--|----------------|------------------|
| Robert Half International Inc | 1.892.000 | 710.081.984 | Gilead Sciences Inc | 1.155.442.944 | 4.842.288.128 |
| CF Industries Holdings Inc | 4.700.000 | 1.728.000.000 | Jabil Circuit Inc | 1.184.519.040 | 1.317.676.032 |
| Stryker Corp | 18.000.000 | 5.003.599.872 | Cameron International Corp | 1.254.466.048 | 2.478.180.096 |
| MasterCard Inc | 21.598.000 | 2.779.827.968 | Denbury Resources Inc | 1.306.375.936 | 1.802.720.000 |
| NVIDIA Corp | 24.450.000 | 2.174.838.016 | Murphy Oil Corp | 1.353.220.992 | 7.305.374.208 |
| Coach Inc | 25.076.000 | 1.571.645.184 | Diamond Offshore Drilling Inc | 1.499.554.048 | 3.630.641.920 |
| Compumware Corp | 35.000.000 | 204.812.000 | Principal Financial Group Inc | 1.686.200.064 | 6.113.399.808 |
| Varian Medical Systems Inc | 36.633.000 | 1.093.961.984 | Becton Dickinson and Co | 1.693.284.992 | 3.707.928.064 |
| Automatic Data Processing Inc | 41.800.000 | 2.776.399.872 | Range Resources Corp | 1.707.832.960 | 2.378.588.928 |
| DeVry Education Group Inc | 44.732.000 | 332.150.016 | Baker Hughes Inc | 1.800.000.000 | 5.671.000.064 |
| Yahoo! Inc | 50.000.000 | 8.497.063.936 | Tesoro Corp | 1.840.999.936 | 2.785.999.872 |
| Monster Worldwide Inc | 50.010.000 | 163.543.008 | Best Buy Co Inc | 1.880.999.936 | 2.652.999.936 |
| Visa Inc | 53.000.000 | 2.380.999.936 | EQT Corp | 1.954.200.064 | 2.151.030.016 |
| FLIR Systems Inc | 58.022.000 | 882.238.016 | FedEx Corp | 1.958.000.000 | 11.930.999.808 |
| Abercrombie & Fitch Co | 71.213.000 | 1.827.917.056 | Leucadia National Corp | 1.970.370.944 | 4.286.624.000 |
| CH Robinson Worldwide Inc | 77.258.000 | 699.862.976 | Corning Inc | 2.004.000.000 | 14.867.000.320 |
| Jacobs Engineering Group Inc | 114.087.000 | 1.584.578.944 | Monsanto Co | 2.004.999.936 | 5.644.000.256 |
| Novellus Systems Inc | 114.160.000 | 1.033.894.016 | Noble Energy Inc | 2.036.999.936 | 5.399.000.064 |
| Genzyme Corp | 124.600.000 | 3.967.026.944 | Humana Inc | 2.052.630.016 | 3.539.610.880 |
| Fluor Corp | 127.529.000 | 3.217.477.120 | Kohl's Corp | 2.068.000.000 | 7.648.999.936 |
| Quanta Services Inc | 130.034.000 | 1.474.802.944 | Cardinal Health Inc | 2.111.900.032 | 2.876.100.096 |
| Teradyne Inc | 143.256.992 | 512.387.008 | Progressive Corp/The | 2.177.200.128 | 5.748.599.808 |
| CR Bard Inc | 149.800.000 | 1.279.800.064 | Intel Corp | 2.220.999.936 | 36.400.001.024 |
| First Solar Inc | 174.958.000 | 2.366.023.936 | Ameriprise Financial Inc | 2.248.999.936 | 7.869.000.192 |
| Apollo Education Group Inc | 192.804.000 | 725.084.032 | Qwestar Corp | 2.348.900.096 | 3.432.300.032 |
| Priceline Group Inc/The | 195.863.008 | 798.918.976 | Walgreens Boots Alliance Inc | 2.379.000.064 | 13.153.999.872 |
| QUALCOMM Inc | 199.000.000 | 16.721.000.448 | Health Care REIT Inc | 2.414.021.888 | 3.380.965.888 |
| Akamai Technologies Inc | 199.755.008 | 1.221.101.952 | Discover Financial Services | 2.428.101.120 | 6.826.423.808 |
| Applied Materials Inc | 212.947.008 | 5.437.716.992 | Sunoco Inc | 2.464.000.000 | 2.556.999.936 |
| Total System Services Inc | 218.400.000 | 796.414.016 | Sears Holdings Corp | 2.504.999.936 | 4.834.999.808 |
| Tellabs Inc | 252.800.000 | 1.584.499.968 | McKesson Corp | 2.511.000.064 | 2.748.000.000 |
| JDS Uniphase Corp | 258.600.000 | 568.899.968 | Unum Group | 2.549.600.000 | 8.298.500.096 |
| Precision Castparts Corp | 289.100.000 | 2.343.699.968 | Aflac Inc | 2.599.000.064 | 8.416.999.936 |
| Molex Inc | 291.052.992 | 1.946.395.008 | XL Group PLC | 2.634.089.984 | 7.584.983.040 |
| Ralph Lauren Corp | 298.300.000 | 1.732.700.032 | Peabody Energy Corp | 2.752.300.032 | 3.749.700.096 |
| Franklin Resources Inc | 322.656.992 | 5.127.832.064 | Micron Technology Inc | 2.760.999.936 | 4.861.000.192 |
| Microchip Technology Inc | 339.000.000 | 1.418.713.984 | Pioneer Natural Resources Co | 2.761.010.944 | 3.226.928.896 |
| People's United Financial Inc | 340.700.000 | 3.585.499.904 | Occidental Petroleum Corp | 2.796.000.000 | 29.080.999.936 |
| LSI Corp | 350.000.000 | 533.161.984 | EOG Resources Inc | 2.796.999.936 | 9.998.042.112 |
| Hormel Foods Corp | 350.000.000 | 1.470.800.000 | Zions Bancorporation | 2.983.633.920 | 3.061.296.896 |
| Xilinx Inc | 354.460.000 | 1.915.953.024 | Nucor Corp | 3.087.948.032 | 4.684.582.912 |
| Amazon.com Inc | 359.000.000 | 4.023.000.064 | EMC Corp/MA | 3.100.290.048 | 5.153.873.920 |
| Analog Devices Inc | 381.424.992 | 2.506.178.048 | Southwest Airlines Co | 3.515.000.064 | 5.465.999.872 |
| Graham Holdings Co | 399.219.008 | 830.369.984 | Charles Schwab Corp/The | 3.884.999.936 | 4.521.999.872 |
| SunEdison Inc | 416.600.000 | 1.836.600.064 | Motorola Solutions Inc | 3.900.999.936 | 6.359.000.064 |
| FMC Technologies Inc | 420.100.000 | 675.500.032 | Nabors Industries Ltd | 3.940.768.000 | 5.003.390.976 |
| Western Digital Corp | 444.000.000 | 3.768.999.936 | Chubb Corp/The | 3.975.000.064 | 15.166.999.552 |
| salesforce.com inc | 450.198.016 | 960.038.016 | Baxter International Inc | 4.151.000.064 | 4.853.000.192 |
| Altera Corp | 500.000.000 | 1.085.336.064 | Hess Corp | 4.466.999.808 | 12.158.999.552 |
| Genuine Parts Co | 500.000.000 | 2.449.797.888 | Halliburton Co | 4.574.000.128 | 7.628.000.256 |
| BJ Services Co | 509.753.984 | 2.539.992.064 | Newmont Mining Corp | 4.808.999.936 | 10.702.999.552 |
| Public Storage | 518.888.992 | 5.315.725.824 | Constellation Energy Group Inc | 4.916.899.840 | 8.421.899.776 |
| Cliffs Natural Resources Inc | 525.000.000 | 2.353.400.064 | Apache Corp | 5.067.716.096 | 15.589.368.832 |
| WW Grainger Inc | 525.408.000 | 1.605.154.048 | Lowe's Cos Inc | 5.080.000.000 | 19.068.999.680 |
| Starbucks Corp | 549.500.032 | 3.020.199.936 | Bristol-Myers Squibb Co | 5.104.999.936 | 6.760.000.000 |
| Flowerserve Corp | 566.728.000 | 806.508.032 | Lincoln National Corp | 5.400.000.000 | 7.880.999.936 |
| NIKE Inc | 570.300.032 | 8.555.400.192 | Schlumberger Ltd | 5.480.000.000 | 13.029.000.192 |
| Sigma-Aldrich Corp | 576.499.968 | 1.156.000.000 | Host Hotels & Resorts Inc | 5.837.000.192 | 6.088.999.936 |
| Harman International Industries Inc | 579.721.984 | 961.036.032 | Hartford Financial Services Group Inc/Th | 5.839.000.064 | 13.701.000.192 |
| AK Steel Holding Corp | 606.499.968 | 843.500.032 | Allstate Corp/The | 5.910.000.128 | 15.816.999.936 |
| FMC Corp | 643.900.032 | 866.899.968 | Microsoft Corp | 5.994.999.808 | 30.569.000.960 |
| Lexmark International Inc | 648.899.968 | 1.013.600.000 | Travelers Cos Inc/The | 6.527.000.064 | 23.382.999.040 |
| RadioShack Corp | 669.400.000 | 1.009.400.000 | Norfolk Southern Corp | 7.152.999.936 | 10.353.000.448 |
| Cummins Inc | 674.000.000 | 3.180.999.936 | Devon Energy Corp | 7.279.000.064 | 9.639.999.488 |
| Office Depot Inc | 722.585.024 | 741.651.008 | Valero Energy Corp | 7.400.000.000 | 14.497.999.872 |
| Pall Corp | 725.201.024 | 848.150.016 | Archer-Daniels-Midland Co | 7.864.999.936 | 14.241.000.448 |
| Whole Foods Market Inc | 734.065.024 | 1.382.134.016 | CSX Corp | 8.008.000.000 | 8.846.000.128 |
| KLA-Tencor Corp | 745.475.008 | 1.760.487.936 | Genworth Financial Inc | 8.014.000.128 | 10.017.999.872 |
| Mattel Inc | 751.950.016 | 1.702.520.960 | Marathon Oil Corp | 8.531.999.744 | 20.487.999.488 |
| Cintas Corp | 786.336.000 | 1.051.208.000 | Loews Corp | 9.484.999.680 | 16.042.999.808 |
| O'Reilly Automotive Inc | 790.748.032 | 1.941.552.000 | Exxon Mobil Corp | 9.605.000.192 | 110.569.000.000 |
| Cabot Oil & Gas Corp | 805.000.000 | 1.812.514.048 | Home Depot Inc/The | 9.681.999.872 | 18.222.000.128 |
| Rowan Cos Plc | 852.412.032 | 3.110.370.048 | Union Pacific Corp | 9.848.000.512 | 16.940.999.680 |
| National Oilwell Varco Inc | 883.000.000 | 4.572.000.256 | Carnival Corp | 10.046.999.552 | 17.237.999.616 |
| CONSOL Energy Inc | 941.152.000 | 1.785.548.032 | XTO Energy Inc | 10.487.000.064 | 15.754.000.384 |
| Assurant Inc | 980.217.984 | 3.832.218.880 | Chevron Corp | 10.513.999.872 | 87.296.000.000 |
| Nicor Inc | 992.300.032 | 1.037.699.968 | McDonald's Corp | 10.578.400.256 | 11.608.699.904 |
| TIJ Cos Inc/The | 993.424.000 | 2.760.740.096 | Coca-Cola Co/The | 11.859.000.320 | 11.971.000.320 |
| Southwestern Energy Co | 998.700.032 | 2.331.225.088 | Anadarko Petroleum Corp | 12.748.000.256 | 14.565.999.616 |
| SanDisk Corp | 1.009.721.984 | 3.852.221.952 | Johnson & Johnson | 14.540.999.680 | 19.402.999.808 |
| Torchmark Corp | 1.029.356.992 | 2.975.372.032 | Cisco Systems Inc | 15.194.000.384 | 24.427.999.232 |
| Allegheny Technologies Inc | 1.071.100.032 | 1.804.400.000 | MetLife Inc | 22.620.000.256 | 25.973.999.616 |
| NetApp Inc | 1.089.496.064 | 1.615.970.048 | ConocoPhillips | 28.653.000.704 | 58.005.999.616 |
| Biogen Idec Inc | 1.099.969.024 | 3.211.831.040 | Berkshire Hathaway Inc | 37.909.000.192 | 97.129.996.288 |
| Zimmer Holdings Inc | 1.127.600.000 | 1.997.200.000 | Wal-Mart Stores Inc | 41.320.001.536 | 54.622.998.528 |

Source: Author's calculations^{101 102}

¹⁰¹ Total debt obtained from (Bloomberg L.P., 2015o)

¹⁰² Tangible common equity obtained from (Bloomberg L.P., 2015n)

Appendix VI – Additional Model Statistics

Correlation Statistics

Table 31 - Correlation Statistics

| | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc |
|-------------------------------|-------------------------------|----------------|--------------|-------------|------------|---------------|---------------|----------------|
| Principal Financial Group Inc | 1,0000 | 0,7959 | 0,5028 | 0,5142 | 0,5136 | 0,1931 | 0,4819 | 0,2486 |
| Torchmark Corp | 0,7959 | 1,0000 | 0,4753 | 0,4561 | 0,4500 | 0,3767 | 0,4046 | 0,2762 |
| XL Group PLC | 0,5028 | 0,4753 | 1,0000 | 0,2921 | 0,4491 | 0,1991 | 0,6251 | 0,2944 |
| Humana Inc. | 0,5142 | 0,4561 | 0,2921 | 1,0000 | 0,4204 | 0,2084 | 0,2953 | 0,2674 |
| Cigna Corp | 0,5136 | 0,4500 | 0,4491 | 0,4204 | 1,0000 | 0,1634 | 0,4879 | 0,2590 |
| Bristol-Myers | 0,1931 | 0,3767 | 0,1991 | 0,2084 | 0,1634 | 1,0000 | 0,2043 | 0,1001 |
| Ford Motor Co | 0,4819 | 0,4046 | 0,6251 | 0,2953 | 0,4879 | 0,2043 | 1,0000 | 0,3052 |
| PulteGroup Inc | 0,2486 | 0,2762 | 0,2944 | 0,2674 | 0,2590 | 0,1001 | 0,3052 | 1,0000 |

Source: Author's calculations

Covariance Statistics

Table 32 - Covariance Statistics

| | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc |
|-------------------------------|-------------------------------|----------------|--------------|-------------|------------|---------------|---------------|----------------|
| Principal Financial Group Inc | 0,3308 | 0,1467 | 0,1564 | 0,1220 | 0,1454 | 0,0301 | 0,1674 | 0,0613 |
| Torchmark Corp | 0,1467 | 0,1028 | 0,0824 | 0,0603 | 0,0710 | 0,0327 | 0,0783 | 0,0380 |
| XL Group PLC | 0,1564 | 0,0824 | 0,2925 | 0,0652 | 0,1196 | 0,0292 | 0,2042 | 0,0682 |
| Humana Inc. | 0,1220 | 0,0603 | 0,0652 | 0,1701 | 0,0853 | 0,0233 | 0,0735 | 0,0473 |
| Cigna Corp | 0,1454 | 0,0710 | 0,1196 | 0,0853 | 0,2423 | 0,0218 | 0,1450 | 0,0546 |
| Bristol-Myers | 0,0301 | 0,0327 | 0,0292 | 0,0233 | 0,0218 | 0,0734 | 0,0334 | 0,0116 |
| Ford Motor Co | 0,1674 | 0,0783 | 0,2042 | 0,0735 | 0,1450 | 0,0334 | 0,3647 | 0,0790 |
| PulteGroup Inc | 0,0613 | 0,0380 | 0,0682 | 0,0473 | 0,0546 | 0,0116 | 0,0790 | 0,1837 |

Source: Author's calculations

Appendix VII – Portfolio II Performance

Portfolio II – Optimised Weights

Table 33 - Portfolio II Optimised Weights

| T | | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers Co | Ford Motor | PulteGroup Inc | Market Val |
|---|------------------|-------------------------------|----------------|--------------|-------------|-------------|------------------|-------------|----------------|--------------|
| | w | 1,53% | 4,43% | 5,23% | 12,12% | 7,66% | 45,85% | 4,23% | 18,95% | |
| 0 | Price | 20,28 | 19,58 | 16,46 | 45,23 | 34,11 | 20,13 | 10,77 | 10,57 | |
| | Position | 7.524 | 22.647 | 31.750 | 26.809 | 22.445 | 227.798 | 39.293 | 179.255 | |
| | Mkt Val | \$152.593 | \$443.425 | \$522.599 | \$1.212.460 | \$765.608 | \$4.585.414 | \$423.182 | \$1.894.721 | \$10.000.000 |
| 1 | Price Month 1 | 25,52 | 22,60 | 17,12 | 44,69 | 36,46 | 22,19 | 11,53 | 10,98 | \$10.740.159 |
| | Price Month 2 | 25,53 | 22,61 | 16,12 | 43,69 | 31,95 | 21,04 | 11,94 | 12,78 | \$10.656.187 |
| | Price Month 3 | 23,76 | 21,76 | 15,95 | 44,00 | 33,36 | 19,29 | 10,76 | 10,88 | \$9.873.787 |
| | Price Month 4 | 20,48 | 20,97 | 14,59 | 43,64 | 30,96 | 20,99 | 9,24 | 8,08 | \$9.550.846 |
| | Price Month 5 | 22,38 | 22,48 | 16,15 | 44,93 | 30,66 | 20,98 | 11,71 | 8,57 | \$9.857.769 |
| | Price Month 6 | 20,14 | 20,90 | 16,32 | 45,66 | 32,11 | 21,95 | 10,35 | 7,85 | \$9.902.733 |
| | Price Month 7 | 22,65 | 22,58 | 19,83 | 48,01 | 35,66 | 23,08 | 11,22 | 8,55 | \$10.630.970 |
| | Price Month 8 | 23,45 | 24,34 | 19,37 | 55,70 | 35,04 | 22,91 | 12,96 | 7,66 | \$10.722.641 |
| | Price Month 9 | 24,28 | 24,42 | 18,00 | 53,55 | 36,69 | 21,49 | 14,62 | 6,11 | \$10.131.979 |
| | Price Month 10 | 29,02 | 25,38 | 20,07 | 52,31 | 36,54 | 22,55 | 15,40 | 7,34 | \$10.710.098 |
| | Price Month 11 | 29,21 | 26,54 | 21,09 | 55,39 | 41,88 | 21,71 | 14,63 | 7,70 | \$10.816.482 |
| | Price Year end | 30,54 | 27,79 | 21,48 | 62,12 | 41,93 | 22,26 | 13,80 | 6,74 | \$10.967.697 |
| | Year End Mkt Val | \$229.792 | \$629.356 | \$681.982 | \$1.665.371 | \$941.130 | \$5.069.653 | \$542.238 | \$1.208.176 | \$10.967.697 |
| 2 | Rebalanced | 5.480 | 17.500 | 26.684 | 21.407 | 20.026 | 225.978 | 33.633 | 308.319 | |
| | Price Month 1 | 28,62 | 28,39 | 22,74 | 66,83 | 44,17 | 23,07 | 13,67 | 7,23 | \$11.478.619 |
| | Price Month 2 | 30,08 | 28,58 | 22,58 | 72,73 | 46,72 | 24,53 | 14,19 | 7,94 | \$12.229.006 |
| | Price Month 3 | 27,87 | 28,38 | 21,88 | 76,95 | 49,77 | 25,11 | 13,68 | 8,24 | \$12.551.550 |
| | Price Month 4 | 27,11 | 27,46 | 20,43 | 77,20 | 51,31 | 25,58 | 12,65 | 7,48 | \$12.365.925 |
| | Price Month 5 | 24,63 | 25,94 | 19,07 | 71,48 | 49,65 | 25,31 | 11,20 | 6,71 | \$11.787.862 |
| | Price Month 6 | 22,60 | 24,54 | 19,34 | 74,42 | 46,63 | 26,27 | 10,20 | 4,69 | \$11.322.855 |
| | Price Month 7 | 20,21 | 22,38 | 17,57 | 69,93 | 41,84 | 27,71 | 8,87 | 3,86 | \$11.057.450 |
| | Price Month 8 | 22,98 | 26,37 | 20,32 | 81,62 | 44,23 | 28,18 | 10,71 | 5,06 | \$12.051.985 |
| | Price Month 9 | 22,13 | 27,44 | 19,27 | 85,27 | 44,12 | 29,19 | 9,72 | 5,97 | \$12.588.941 |
| | Price Month 10 | 22,56 | 27,96 | 18,58 | 84,47 | 41,90 | 31,44 | 9,87 | 6,16 | \$13.092.229 |
| | Price Month 11 | 25,04 | 29,51 | 19,05 | 85,83 | 44,72 | 29,05 | 11,43 | 7,27 | \$13.084.666 |
| | Price Year end | 25,36 | 31,30 | 19,55 | 83,98 | 44,00 | 28,98 | 11,40 | 8,61 | \$13.474.927 |
| | Year End Mkt Val | \$138.973 | \$547.762 | \$521.671 | \$1.797.812 | \$881.149 | \$6.549.518 | \$383.414 | \$2.654.629 | \$13.474.927 |
| 3 | Rebalanced | 8.108 | 19.090 | 36.020 | 19.454 | 23.447 | 213.187 | 50.021 | 296.530 | |
| | Price Month 1 | 27,24 | 32,21 | 20,49 | 89,42 | 49,18 | 30,41 | 11,49 | 8,64 | \$14.085.570 |
| | Price Month 2 | 25,55 | 31,57 | 20,32 | 78,01 | 46,16 | 30,37 | 10,43 | 9,61 | \$13.987.328 |
| | Price Month 3 | 22,84 | 30,24 | 19,29 | 73,86 | 43,84 | 30,34 | 9,76 | 9,14 | \$13.589.068 |
| | Price Month 4 | 24,39 | 32,76 | 19,99 | 75,13 | 43,93 | 32,72 | 8,87 | 10,45 | \$14.551.978 |
| | Price Month 5 | 23,80 | 32,34 | 19,62 | 59,76 | 40,22 | 32,71 | 8,54 | 11,03 | \$14.293.242 |
| | Price Month 6 | 25,52 | 33,27 | 21,96 | 67,99 | 45,70 | 30,33 | 8,68 | 13,36 | \$14.888.400 |
| | Price Month 7 | 25,25 | 33,38 | 22,93 | 68,31 | 47,10 | 31,01 | 9,17 | 15,13 | \$15.656.587 |
| | Price Month 8 | 25,81 | 32,98 | 23,61 | 72,32 | 50,92 | 30,86 | 10,42 | 16,93 | \$16.409.824 |
| | Price Month 9 | 25,45 | 33,89 | 23,22 | 63,69 | 52,19 | 30,28 | 10,70 | 16,41 | \$16.009.319 |
| | Price Month 10 | 26,93 | 33,68 | 24,02 | 67,08 | 53,38 | 30,24 | 12,10 | 17,73 | \$16.593.519 |
| | Price Month 11 | 29,28 | 36,42 | 26,57 | 72,68 | 58,25 | 33,90 | 12,19 | 20,25 | \$18.511.594 |
| | Price Year end | 29,85 | 36,74 | 27,45 | 66,72 | 58,37 | 34,68 | 11,87 | 18,73 | \$18.140.102 |
| | Year End Mkt Val | \$242.022 | \$701.361 | \$988.759 | \$1.297.990 | \$1.368.579 | \$7.393.641 | \$593.744 | \$5.554.005 | \$18.140.102 |
| 4 | Rebalanced | 9.273 | 21.894 | 34.536 | 32.964 | 23.793 | 239.840 | 64.672 | 183.505 | |
| | Price Month 1 | 32,36 | 39,10 | 29,18 | 67,82 | 62,32 | 38,64 | 12,37 | 19,76 | \$19.575.694 |
| | Price Month 2 | 34,33 | 40,70 | 29,99 | 72,72 | 66,11 | 37,58 | 12,90 | 20,50 | \$19.823.889 |
| | Price Month 3 | 36,22 | 42,30 | 30,27 | 79,27 | 67,84 | 43,53 | 14,86 | 21,08 | \$21.803.413 |
| | Price Month 4 | 35,83 | 42,71 | 29,33 | 83,07 | 72,43 | 42,28 | 14,66 | 18,52 | \$21.228.516 |
| | Price Month 5 | 41,49 | 46,73 | 30,33 | 89,84 | 77,77 | 41,23 | 16,09 | 16,24 | \$21.176.178 |
| | Price Month 6 | 39,15 | 45,29 | 28,60 | 90,65 | 78,62 | 39,75 | 15,44 | 15,07 | \$20.498.843 |
| | Price Month 7 | 41,23 | 47,56 | 29,96 | 92,14 | 76,80 | 44,13 | 16,09 | 16,21 | \$21.921.604 |
| | Price Month 8 | 45,70 | 48,01 | 29,71 | 90,97 | 76,92 | 50,45 | 16,41 | 17,33 | \$23.671.587 |
| | Price Month 9 | 48,75 | 50,08 | 31,09 | 102,66 | 87,38 | 49,36 | 16,38 | 18,43 | \$24.364.316 |
| | Price Month 10 | 47,73 | 51,61 | 31,09 | 102,17 | 87,41 | 51,40 | 14,80 | 20,06 | \$25.060.597 |
| | Price Month 11 | 42,18 | 49,63 | 28,06 | 96,31 | 86,24 | 48,33 | 14,46 | 20,01 | \$23.871.359 |
| | Price Year end | 43,90 | 51,18 | 29,68 | 111,32 | 79,52 | 52,00 | 14,88 | 20,67 | \$25.341.653 |
| | Year End Mkt Val | \$407.093 | \$1.120.524 | \$1.025.014 | \$3.669.441 | \$1.892.050 | \$12.472.172 | \$962.318 | \$3.793.042 | \$25.341.653 |
| 5 | Rebalanced | 8.809 | 21.956 | 44.621 | 27.602 | 24.399 | 223.456 | 72.071 | 232.295 | |
| | Price Month 1 | 44,79 | 51,97 | 30,67 | 111,84 | 83,70 | 50,24 | 15,08 | 18,95 | \$24.749.032 |
| | Price Month 2 | 45,62 | 52,76 | 30,77 | 108,89 | 80,01 | 48,78 | 15,73 | 18,16 | \$24.143.805 |
| | Price Month 3 | 45,55 | 53,70 | 31,86 | 123,49 | 89,75 | 48,44 | 16,02 | 19,31 | \$25.064.843 |
| | Price Month 4 | 49,49 | 54,36 | 32,28 | 127,00 | 91,94 | 47,24 | 16,79 | 19,95 | \$25.219.596 |
| | Price Month 5 | 48,71 | 52,49 | 31,80 | 116,99 | 90,01 | 49,67 | 16,70 | 17,47 | \$24.785.735 |
| | Price Month 6 | 53,23 | 54,29 | 33,71 | 128,01 | 94,57 | 49,70 | 17,08 | 19,02 | \$25.759.959 |
| | Price Month 7 | 51,76 | 52,12 | 32,87 | 129,83 | 90,66 | 50,22 | 14,51 | 17,53 | \$25.201.529 |
| | Price Month 8 | 51,66 | 52,84 | 33,58 | 138,36 | 99,54 | 57,50 | 13,95 | 19,04 | \$27.637.943 |
| | Price Month 9 | 52,55 | 53,63 | 35,20 | 137,48 | 102,86 | 58,35 | 15,57 | 21,46 | \$28.661.009 |
| | Price Month 10 | 51,57 | 54,17 | 34,22 | 143,40 | 102,88 | 58,69 | 15,34 | 21,38 | \$28.825.869 |
| | Price Month 11 | 46,60 | 50,07 | 34,34 | 146,21 | 106,79 | 59,92 | 14,71 | 20,51 | \$28.898.258 |
| | Price Year end | 50,81 | 53,25 | 36,04 | 164,12 | 121,59 | 60,57 | 16,34 | 22,48 | \$30.656.024 |
| | Year End Mkt Val | \$447.562 | \$1.169.162 | \$1.608.142 | \$4.530.050 | \$2.966.626 | \$13.534.858 | \$1.177.635 | \$5.221.989 | \$30.656.024 |
| | Rebalanced | 9.207 | 25.528 | 44.453 | 22.648 | 19.303 | 232.077 | 79.395 | 258.383 | |

Source: Author's calculations¹⁰³

¹⁰³ Historical stock prices obtained from ("Yahoo Finance," n.d.)

Portfolio II – Equal Weights

Table 34 - Portfolio II Equal Weights

| T | | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc | Market Val |
|---|------------------|-------------------------------|----------------|--------------|-------------|-------------|---------------|---------------|----------------|--------------|
| 0 | ω | 12,50% | 12,50% | 12,50% | 12,50% | 12,50% | 12,50% | 12,50% | 12,50% | |
| | Price | 20,28 | 19,58 | 16,46 | 45,23 | 34,11 | 20,13 | 10,77 | 10,57 | |
| | Position | 61.637 | 63.841 | 75.942 | 27.640 | 36.646 | 62.099 | 116.063 | 118.259 | |
| | Mkt Val | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$1.250.000 | \$10.000.000 |
| 1 | Price Month 1 | 25,52 | 22,60 | 17,12 | 44,69 | 36,46 | 22,19 | 11,53 | 10,98 | \$10.901.943 |
| | Price Month 2 | 25,53 | 22,61 | 16,12 | 43,69 | 31,95 | 21,04 | 11,94 | 12,78 | \$10.822.964 |
| | Price Month 3 | 23,76 | 21,76 | 15,95 | 44,00 | 33,36 | 19,29 | 10,76 | 10,88 | \$10.237.047 |
| | Price Month 4 | 20,48 | 20,97 | 14,59 | 43,64 | 30,96 | 20,99 | 9,24 | 8,08 | \$9.381.418 |
| | Price Month 5 | 22,38 | 22,48 | 16,15 | 44,93 | 30,66 | 20,98 | 11,71 | 8,57 | \$10.081.634 |
| | Price Month 6 | 20,14 | 20,90 | 16,32 | 45,66 | 32,11 | 21,95 | 10,35 | 7,85 | \$9.746.725 |
| | Price Month 7 | 22,65 | 22,58 | 19,83 | 48,01 | 35,66 | 23,08 | 11,22 | 8,55 | \$10.724.063 |
| | Price Month 8 | 23,45 | 24,34 | 19,37 | 55,70 | 35,04 | 22,91 | 12,96 | 7,66 | \$11.126.276 |
| | Price Month 9 | 24,28 | 24,42 | 18,00 | 53,55 | 36,69 | 21,49 | 14,62 | 6,11 | \$11.001.130 |
| | Price Month 10 | 29,02 | 25,38 | 20,07 | 52,31 | 36,54 | 22,55 | 15,40 | 7,34 | \$11.773.503 |
| | Price Month 11 | 29,21 | 26,54 | 21,09 | 55,39 | 41,88 | 21,71 | 14,63 | 7,70 | \$12.118.978 |
| | Price Year end | 30,54 | 27,79 | 21,48 | 62,12 | 41,93 | 22,26 | 13,80 | 6,74 | \$12.322.007 |
| | Year End Mkt Val | \$1.882.396 | \$1.774.132 | \$1.631.227 | \$1.716.934 | \$1.536.573 | \$1.382.005 | \$1.601.671 | \$797.067 | \$12.322.007 |
| | Rebalanced | 50.434 | 55.425 | 71.706 | 24.795 | 36.734 | 69.209 | 111.612 | 228.524 | |
| 2 | Price Month 1 | 28,62 | 28,39 | 22,74 | 66,83 | 44,17 | 23,07 | 13,67 | 7,23 | \$12.701.966 |
| | Price Month 2 | 30,08 | 28,58 | 22,58 | 72,73 | 46,72 | 24,53 | 14,19 | 7,94 | \$13.335.939 |
| | Price Month 3 | 27,87 | 28,38 | 21,88 | 76,95 | 49,77 | 25,11 | 13,68 | 8,24 | \$13.431.235 |
| | Price Month 4 | 27,11 | 27,46 | 20,43 | 77,20 | 51,31 | 25,58 | 12,65 | 7,48 | \$13.044.531 |
| | Price Month 5 | 24,63 | 25,94 | 19,07 | 71,48 | 49,65 | 25,31 | 11,20 | 6,71 | \$12.178.927 |
| | Price Month 6 | 22,60 | 24,54 | 19,34 | 74,42 | 46,63 | 26,27 | 10,20 | 4,69 | \$11.473.495 |
| | Price Month 7 | 20,21 | 22,38 | 17,57 | 69,93 | 41,84 | 27,71 | 8,87 | 3,86 | \$10.580.648 |
| | Price Month 8 | 22,98 | 26,37 | 20,32 | 81,62 | 44,23 | 28,18 | 10,71 | 5,06 | \$12.028.485 |
| | Price Month 9 | 22,13 | 27,44 | 19,27 | 85,27 | 44,12 | 29,19 | 9,72 | 5,97 | \$12.223.181 |
| | Price Month 10 | 22,56 | 27,96 | 18,58 | 84,47 | 41,90 | 31,44 | 9,87 | 6,16 | \$12.338.746 |
| | Price Month 11 | 25,04 | 29,51 | 19,05 | 85,83 | 44,72 | 29,05 | 11,43 | 7,27 | \$12.982.788 |
| | Price Year end | 25,36 | 31,30 | 19,55 | 83,98 | 44,00 | 28,98 | 11,40 | 8,61 | \$13.360.149 |
| | Year End Mkt Val | \$1.279.003 | \$1.734.791 | \$1.401.858 | \$2.082.346 | \$1.616.290 | \$2.005.889 | \$1.272.381 | \$1.967.590 | \$13.360.149 |
| | Rebalanced | 65.852 | 53.355 | 85.423 | 19.885 | 37.955 | 57.621 | 146.493 | 193.963 | |
| 3 | Price Month 1 | 27,24 | 32,21 | 20,49 | 89,42 | 49,18 | 30,41 | 11,49 | 8,64 | \$14.018.633 |
| | Price Month 2 | 25,55 | 31,57 | 20,32 | 78,01 | 46,16 | 30,37 | 10,43 | 9,61 | \$13.547.847 |
| | Price Month 3 | 22,84 | 30,24 | 19,29 | 73,86 | 43,84 | 30,34 | 9,76 | 9,14 | \$12.849.009 |
| | Price Month 4 | 24,39 | 32,76 | 19,99 | 75,13 | 43,93 | 32,72 | 8,87 | 10,45 | \$13.434.470 |
| | Price Month 5 | 23,80 | 32,34 | 19,62 | 59,76 | 40,22 | 32,71 | 8,54 | 11,03 | \$12.958.777 |
| | Price Month 6 | 25,52 | 33,27 | 21,96 | 67,99 | 45,70 | 30,33 | 8,68 | 13,36 | \$14.028.477 |
| | Price Month 7 | 25,25 | 33,38 | 22,93 | 68,31 | 47,10 | 31,01 | 9,17 | 15,13 | \$14.613.174 |
| | Price Month 8 | 25,81 | 32,98 | 23,61 | 72,32 | 50,92 | 30,86 | 10,42 | 16,93 | \$15.435.147 |
| | Price Month 9 | 25,45 | 33,89 | 23,22 | 63,69 | 52,19 | 30,28 | 10,70 | 16,41 | \$15.210.327 |
| | Price Month 10 | 26,93 | 33,68 | 24,02 | 67,08 | 53,38 | 30,24 | 12,10 | 17,73 | \$15.936.491 |
| | Price Month 11 | 29,28 | 36,42 | 26,57 | 72,68 | 58,25 | 33,90 | 12,19 | 20,25 | \$17.464.261 |
| | Price Year end | 29,85 | 36,74 | 27,45 | 66,72 | 58,37 | 34,68 | 11,87 | 18,73 | \$17.183.195 |
| | Year End Mkt Val | \$1.965.696 | \$1.960.271 | \$2.344.860 | \$1.326.781 | \$2.215.431 | \$1.998.365 | \$1.738.870 | \$3.632.921 | \$17.183.195 |
| | Rebalanced | 71.956 | 58.462 | 78.248 | 32.192 | 36.798 | 61.932 | 180.952 | 114.677 | |
| 4 | Price Month 1 | 32,36 | 39,10 | 29,18 | 67,82 | 62,32 | 38,64 | 12,37 | 19,76 | \$18.271.522 |
| | Price Month 2 | 34,33 | 40,70 | 29,99 | 72,72 | 66,11 | 37,58 | 12,90 | 20,50 | \$18.982.511 |
| | Price Month 3 | 36,22 | 42,30 | 30,27 | 79,27 | 67,84 | 43,53 | 14,86 | 21,08 | \$20.298.033 |
| | Price Month 4 | 35,83 | 42,71 | 29,33 | 83,07 | 72,43 | 42,28 | 14,66 | 18,52 | \$20.104.462 |
| | Price Month 5 | 41,49 | 46,73 | 30,33 | 89,84 | 77,77 | 41,23 | 16,09 | 16,24 | \$21.171.818 |
| | Price Month 6 | 39,15 | 45,29 | 28,60 | 90,65 | 78,62 | 39,75 | 15,44 | 15,07 | \$20.497.830 |
| | Price Month 7 | 41,23 | 47,56 | 29,96 | 92,14 | 76,80 | 44,13 | 16,09 | 16,21 | \$21.387.116 |
| | Price Month 8 | 45,70 | 48,01 | 29,71 | 90,97 | 76,92 | 50,45 | 16,41 | 17,33 | \$22.260.396 |
| | Price Month 9 | 48,75 | 50,08 | 31,09 | 102,66 | 87,38 | 49,36 | 16,38 | 18,43 | \$23.522.957 |
| | Price Month 10 | 47,73 | 51,61 | 31,09 | 102,17 | 87,41 | 51,40 | 14,80 | 20,06 | \$23.551.993 |
| | Price Month 11 | 42,18 | 49,63 | 28,06 | 96,31 | 86,24 | 48,33 | 14,46 | 20,01 | \$22.310.370 |
| | Price Year end | 43,90 | 51,18 | 29,68 | 111,32 | 79,52 | 52,00 | 14,88 | 20,67 | \$23.266.588 |
| | Year End Mkt Val | \$3.158.887 | \$2.992.093 | \$2.322.392 | \$3.583.495 | \$2.926.177 | \$3.220.607 | \$2.692.565 | \$2.370.373 | \$23.266.588 |
| | Rebalanced | 66.249 | 56.825 | 97.989 | 26.127 | 36.573 | 55.927 | 195.452 | 140.703 | |
| 5 | Price Month 1 | 44,79 | 51,97 | 30,67 | 111,84 | 83,70 | 50,24 | 15,08 | 18,95 | \$23.332.680 |
| | Price Month 2 | 45,62 | 52,76 | 30,77 | 108,89 | 80,01 | 48,78 | 15,73 | 18,16 | \$23.164.630 |
| | Price Month 3 | 45,55 | 53,70 | 31,86 | 123,49 | 89,75 | 48,44 | 16,02 | 19,31 | \$24.257.193 |
| | Price Month 4 | 49,49 | 54,36 | 32,28 | 127,00 | 91,94 | 47,24 | 16,79 | 19,95 | \$24.942.239 |
| | Price Month 5 | 48,71 | 52,49 | 31,80 | 116,99 | 90,01 | 49,67 | 16,70 | 17,47 | \$24.174.072 |
| | Price Month 6 | 53,23 | 54,29 | 33,71 | 128,01 | 94,57 | 49,70 | 17,08 | 19,02 | \$25.511.856 |
| | Price Month 7 | 51,76 | 52,12 | 32,87 | 129,83 | 90,66 | 50,22 | 14,51 | 17,53 | \$24.430.472 |
| | Price Month 8 | 51,66 | 52,84 | 33,58 | 138,36 | 99,54 | 57,50 | 13,95 | 19,04 | \$25.592.256 |
| | Price Month 9 | 52,55 | 53,63 | 35,20 | 137,48 | 102,86 | 58,35 | 15,57 | 21,46 | \$26.658.023 |
| | Price Month 10 | 51,57 | 54,17 | 34,22 | 143,40 | 102,88 | 58,69 | 15,34 | 21,38 | \$26.646.066 |
| | Price Month 11 | 46,60 | 50,07 | 34,34 | 146,21 | 106,79 | 59,92 | 14,71 | 20,51 | \$26.135.292 |
| | Price Year end | 50,81 | 53,25 | 36,04 | 164,12 | 121,59 | 60,57 | 16,34 | 22,48 | \$28.402.657 |
| | Year End Mkt Val | \$3.366.103 | \$3.025.952 | \$3.531.536 | \$4.287.889 | \$4.446.970 | \$3.387.528 | \$3.193.683 | \$3.162.995 | \$28.402.657 |
| | Rebalanced | 69.875 | 66.673 | 98.511 | 21.633 | 29.199 | 58.615 | 217.279 | 157.933 | |

Source: Author's calculations¹⁰⁴

¹⁰⁴ Historical stock prices obtained from ("Yahoo Finance," n.d.)

Portfolio II – Value Weights

Table 35 - Portfolio II Value Weights

| T | | Principal Financial Group Inc | Torchmark Corp | XL Group PLC | Humana Inc. | Cigna Corp | Bristol-Myers | Ford Motor Co | PulteGroup Inc | Market Val |
|---|------------------|-------------------------------|----------------|--------------|-------------|-------------|---------------|---------------|----------------|--------------|
| 0 | w | 6,01% | 3,17% | 5,17% | 6,57% | 7,73% | 33,98% | 33,98% | 3,39% | |
| | Price | 20,28 | 19,58 | 16,46 | 45,23 | 34,11 | 20,13 | 10,77 | 10,57 | |
| | Position | 29.655 | 16.181 | 31.392 | 14.526 | 22.658 | 168.822 | 315.474 | 32.101 | |
| | Mkt Val | \$601.399 | \$316.817 | \$516.718 | \$656.954 | \$772.874 | \$3.398.280 | \$3.397.653 | \$339.305 | \$10.000.000 |
| 1 | Price Month 1 | 25,52 | 22,60 | 17,12 | 44,69 | 36,46 | 22,19 | 11,53 | 10,98 | \$10.871.414 |
| | Price Month 2 | 25,53 | 22,61 | 16,12 | 43,69 | 31,95 | 21,04 | 11,94 | 12,78 | \$10.715.808 |
| | Price Month 3 | 23,76 | 21,76 | 15,95 | 44,00 | 33,36 | 19,29 | 10,76 | 10,88 | \$9.952.853 |
| | Price Month 4 | 20,48 | 20,97 | 14,59 | 43,64 | 30,96 | 20,99 | 9,24 | 8,08 | \$9.458.638 |
| | Price Month 5 | 22,38 | 22,48 | 16,15 | 44,93 | 30,66 | 20,98 | 11,71 | 8,57 | \$10.392.435 |
| | Price Month 6 | 20,14 | 20,90 | 16,32 | 45,66 | 32,11 | 21,95 | 10,35 | 7,85 | \$10.062.011 |
| | Price Month 7 | 22,65 | 22,58 | 19,83 | 48,01 | 35,66 | 23,08 | 11,22 | 8,55 | \$10.876.218 |
| | Price Month 8 | 23,45 | 24,34 | 19,37 | 55,70 | 35,04 | 22,91 | 12,96 | 7,66 | \$11.501.831 |
| | Price Month 9 | 24,28 | 24,42 | 18,00 | 53,55 | 36,69 | 21,49 | 14,62 | 6,11 | \$11.726.182 |
| | Price Month 10 | 29,02 | 25,38 | 20,07 | 52,31 | 36,54 | 22,55 | 15,40 | 7,34 | \$12.389.630 |
| | Price Month 11 | 29,21 | 26,54 | 21,09 | 55,39 | 41,88 | 21,71 | 14,63 | 7,70 | \$12.239.285 |
| | Price Year end | 30,54 | 27,79 | 21,48 | 62,12 | 41,93 | 22,26 | 13,80 | 6,74 | \$12.209.095 |
| | Year End Mkt Val | \$905.658 | \$449.660 | \$674.307 | \$902.358 | \$950.062 | \$3.757.152 | \$4.353.538 | \$216.359 | \$12.209.095 |
| | Rebalanced | 24.042 | 13.919 | 29.370 | 12.912 | 22.504 | 186.429 | 300.596 | 61.463 | |
| 2 | Price Month 1 | 28,62 | 28,39 | 22,74 | 66,83 | 44,17 | 23,07 | 13,67 | 7,23 | \$12.463.119 |
| | Price Month 2 | 30,08 | 28,58 | 22,58 | 72,73 | 46,72 | 24,53 | 14,19 | 7,94 | \$13.101.546 |
| | Price Month 3 | 27,87 | 28,38 | 21,88 | 76,95 | 49,77 | 25,11 | 13,68 | 8,24 | \$13.120.669 |
| | Price Month 4 | 27,11 | 27,46 | 20,43 | 77,20 | 51,31 | 25,58 | 12,65 | 7,48 | \$12.816.108 |
| | Price Month 5 | 24,63 | 25,94 | 19,07 | 71,48 | 49,65 | 25,31 | 11,20 | 6,71 | \$12.051.678 |
| | Price Month 6 | 22,60 | 24,54 | 19,34 | 74,42 | 46,63 | 26,27 | 10,20 | 4,69 | \$11.715.943 |
| | Price Month 7 | 20,21 | 22,38 | 17,57 | 69,93 | 41,84 | 27,71 | 8,87 | 3,86 | \$11.228.289 |
| | Price Month 8 | 22,98 | 26,37 | 20,32 | 81,62 | 44,23 | 28,18 | 10,71 | 5,06 | \$12.350.348 |
| | Price Month 9 | 22,13 | 27,44 | 19,27 | 85,27 | 44,12 | 29,19 | 9,72 | 5,97 | \$12.304.839 |
| | Price Month 10 | 22,56 | 27,96 | 18,58 | 84,47 | 41,90 | 31,44 | 9,87 | 6,16 | \$12.717.859 |
| | Price Month 11 | 25,04 | 29,51 | 19,05 | 85,83 | 44,72 | 29,05 | 11,43 | 7,27 | \$12.984.632 |
| | Price Year end | 25,36 | 31,30 | 19,55 | 83,98 | 44,00 | 28,98 | 11,40 | 8,61 | \$13.053.405 |
| | Year End Mkt Val | \$609.715 | \$435.660 | \$574.182 | \$1.084.377 | \$990.194 | \$5.403.286 | \$3.426.796 | \$529.196 | \$13.053.405 |
| | Rebalanced | 30.955 | 13.213 | 34.501 | 10.211 | 22.929 | 153.052 | 389.043 | 51.441 | |
| 3 | Price Month 1 | 27,24 | 32,21 | 20,49 | 89,42 | 49,18 | 30,41 | 11,49 | 8,64 | \$13.584.808 |
| | Price Month 2 | 25,55 | 31,57 | 20,32 | 78,01 | 46,16 | 30,37 | 10,43 | 9,61 | \$12.964.164 |
| | Price Month 3 | 22,84 | 30,24 | 19,29 | 73,86 | 43,84 | 30,34 | 9,76 | 9,14 | \$12.442.599 |
| | Price Month 4 | 24,39 | 32,76 | 19,99 | 75,13 | 43,93 | 32,72 | 8,87 | 10,45 | \$12.647.681 |
| | Price Month 5 | 23,80 | 32,34 | 19,62 | 59,76 | 40,22 | 32,71 | 8,54 | 11,03 | \$12.269.031 |
| | Price Month 6 | 25,52 | 33,27 | 21,96 | 67,99 | 45,70 | 30,33 | 8,68 | 13,36 | \$12.435.086 |
| | Price Month 7 | 25,25 | 33,38 | 22,93 | 68,31 | 47,10 | 31,01 | 9,17 | 15,13 | \$12.882.741 |
| | Price Month 8 | 25,81 | 32,98 | 23,61 | 72,32 | 50,92 | 30,86 | 10,42 | 16,93 | \$13.602.691 |
| | Price Month 9 | 25,45 | 33,89 | 23,22 | 63,69 | 52,19 | 30,28 | 10,70 | 16,41 | \$13.525.261 |
| | Price Month 10 | 26,93 | 33,68 | 24,02 | 67,08 | 53,38 | 30,24 | 12,10 | 17,73 | \$14.264.688 |
| | Price Month 11 | 29,28 | 36,42 | 26,57 | 72,68 | 58,25 | 33,90 | 12,19 | 20,25 | \$15.355.066 |
| | Price Year end | 29,85 | 36,74 | 27,45 | 66,72 | 58,37 | 34,68 | 11,87 | 18,73 | \$15.265.652 |
| | Year End Mkt Val | \$924.021 | \$485.430 | \$947.050 | \$681.297 | \$1.338.350 | \$5.308.066 | \$4.617.944 | \$963.493 | \$15.265.652 |
| | Rebalanced | 30.756 | 13.164 | 28.736 | 15.031 | 20.213 | 149.581 | 436.962 | 27.655 | |
| 4 | Price Month 1 | 32,36 | 39,10 | 29,18 | 67,82 | 62,32 | 38,64 | 12,37 | 19,76 | \$16.359.057 |
| | Price Month 2 | 34,33 | 40,70 | 29,99 | 72,72 | 66,11 | 37,58 | 12,90 | 20,50 | \$16.707.322 |
| | Price Month 3 | 36,22 | 42,30 | 30,27 | 79,27 | 67,84 | 43,53 | 14,86 | 21,08 | \$18.690.491 |
| | Price Month 4 | 35,83 | 42,71 | 29,33 | 83,07 | 72,43 | 42,28 | 14,66 | 18,52 | \$18.461.770 |
| | Price Month 5 | 41,49 | 46,73 | 30,33 | 89,84 | 77,77 | 41,23 | 16,09 | 16,24 | \$19.332.020 |
| | Price Month 6 | 39,15 | 45,29 | 28,60 | 90,65 | 78,62 | 39,75 | 15,44 | 15,07 | \$18.683.248 |
| | Price Month 7 | 41,23 | 47,56 | 29,96 | 92,14 | 76,80 | 44,13 | 16,09 | 16,21 | \$19.772.033 |
| | Price Month 8 | 45,70 | 48,01 | 29,71 | 90,97 | 76,92 | 50,45 | 16,41 | 17,33 | \$21.009.856 |
| | Price Month 9 | 48,75 | 50,08 | 31,09 | 102,66 | 87,38 | 49,36 | 16,38 | 18,43 | \$21.411.200 |
| | Price Month 10 | 47,73 | 51,61 | 31,09 | 102,17 | 87,41 | 51,40 | 14,80 | 20,06 | \$21.053.975 |
| | Price Month 11 | 42,18 | 49,63 | 28,06 | 96,31 | 86,24 | 48,33 | 14,46 | 20,01 | \$20.048.436 |
| | Price Year end | 43,90 | 51,18 | 29,68 | 111,32 | 79,52 | 52,00 | 14,88 | 20,67 | \$21.009.508 |
| | Year End Mkt Val | \$1.350.201 | \$673.729 | \$852.885 | \$1.673.183 | \$1.607.352 | \$7.778.544 | \$6.501.994 | \$571.621 | \$21.009.508 |
| | Rebalanced | 28.782 | 13.005 | 36.577 | 12.399 | 20.420 | 137.295 | 479.725 | 34.488 | |
| 5 | Price Month 1 | 44,79 | 51,97 | 30,67 | 111,84 | 83,70 | 50,24 | 15,08 | 18,95 | \$20.968.435 |
| | Price Month 2 | 45,62 | 52,76 | 30,77 | 108,89 | 80,01 | 48,78 | 15,73 | 18,16 | \$20.978.455 |
| | Price Month 3 | 45,55 | 53,70 | 31,86 | 123,49 | 89,75 | 48,44 | 16,02 | 19,31 | \$21.540.375 |
| | Price Month 4 | 49,49 | 54,36 | 32,28 | 127,00 | 91,94 | 47,24 | 16,79 | 19,95 | \$21.992.963 |
| | Price Month 5 | 48,71 | 52,49 | 31,80 | 116,99 | 90,01 | 49,67 | 16,70 | 17,47 | \$21.969.095 |
| | Price Month 6 | 53,23 | 54,29 | 33,71 | 128,01 | 94,57 | 49,70 | 17,08 | 19,02 | \$22.662.098 |
| | Price Month 7 | 51,76 | 52,12 | 32,87 | 129,83 | 90,66 | 50,22 | 14,51 | 17,53 | \$21.290.661 |
| | Price Month 8 | 51,66 | 52,84 | 33,58 | 138,36 | 99,54 | 57,50 | 13,95 | 19,04 | \$22.393.471 |
| | Price Month 9 | 52,55 | 53,63 | 35,20 | 137,48 | 102,86 | 58,35 | 15,57 | 21,46 | \$23.522.820 |
| | Price Month 10 | 51,57 | 54,17 | 34,22 | 143,40 | 102,88 | 58,69 | 15,34 | 21,38 | \$23.473.605 |
| | Price Month 11 | 46,60 | 50,07 | 34,34 | 146,21 | 106,79 | 59,92 | 14,71 | 20,51 | \$23.233.294 |
| | Price Year end | 50,81 | 53,25 | 36,04 | 164,12 | 121,59 | 60,57 | 16,34 | 22,48 | \$24.920.922 |
| | Year End Mkt Val | \$1.462.391 | \$692.538 | \$1.318.227 | \$2.034.941 | \$2.482.826 | \$8.316.014 | \$7.838.699 | \$775.286 | \$24.920.922 |
| | Rebalanced | 29.497 | 14.827 | 35.730 | 9.976 | 15.841 | 139.818 | 518.192 | 37.615 | |

Source: Author's calculations¹⁰⁵

¹⁰⁵ Historical stock prices obtained from ("Yahoo Finance," n.d.)

References

- Alexeev, V. V., & Tapon, F. (2012). Equity portfolio diversification: how many stocks are enough? Evidence from five developed markets. *Evidence from Five Developed Markets* (November 28, 2012). *FIRN Research Paper*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2182295
- Arrow, K. J. (1965). *Aspects of the theory of risk-bearing* /. Helsinki : Yrjö Jahnssonin Säätiö.
- Barberis, N., & Thaler, R. H. (2002). *A Survey of Behavioral Finance* (SSRN Scholarly Paper No. ID 327880). Rochester, NY: Social Science Research Network. Retrieved from <http://papers.ssrn.com/abstract=327880>
- Basu, S. (1977). Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis. *Journal of Finance*, 32(3), 663–82.
- Bernoulli, D. (1954). Exposition of a New Theory on the Measurement of Risk. *Econometrica*, 22(1), 23–36. <http://doi.org/10.2307/1909829>
- Bloomberg L.P. (2015a). *3 Year total return for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015b). *5 Year total return for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015c). *Current ratio for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015d). *Dividend yield for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015e). *Estimated long term earnings growth rate for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015f). *List of historical S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.

- Bloomberg L.P. (2015g). *Market capitalisation for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015h). *Price to book value ratio for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015i). *Price to cash flow ratio for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015j). *Price to earnings ratio for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015k). *Shares outstanding for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015l). *S&P 500 Automobile industry index historical prices*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015m). *S&P 500 Household durables industry index historical prices*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015n). *Tangible common equity for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Bloomberg L.P. (2015o). *Total debt for S&P 500 member constituents as of 01/03/2010*. Retrieved from Bloomberg database.
- Board of Governors of the Federal Reserve System (US). (2015). Moody's Seasoned Aaa Corporate Bond Yield©. Retrieved from <https://research.stlouisfed.org/fred2/series/AAA/>
- Bondt, W. F. M. D., & Thaler, R. (1985). Does the Stock Market Overreact? *The Journal of Finance*, 40(3), 793–805. <http://doi.org/10.2307/2327804>
- Ciccone, S. (2003). Does Analyst Optimism About Future Earnings Distort Stock Prices? *The Journal of Behavioral Finance*, 4(2), 59–64.
- Copeland, T. E., Weston, J. F., & Shastri, K. (2004). *Financial Theory and Corporate Policy* (4 edition). Boston, MA: Prentice Hall.

- Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and US economic growth. *Review of Income and Wealth*, 55(3), 661–685.
- Cote, J., & Goodstein, J. (1999). A Breed Apart? Security Analysts and Herding Behavior. *Journal of Business Ethics*, 18(3), 305–314.
- Damodaran, A. (2012a). *Investment Philosophies: Successful Strategies and the Investors Who Made Them Work* (2 edition). Hoboken, N.J: Wiley.
- Damodaran, A. (2012b). *Investment Valuation: Tools and Techniques for Determining the Value of any Asset, University Edition* (3 edition). Hoboken, New Jersey: Wiley.
- De Finetti, B. (1952). *Sulla preferibilità*. CEDAM.
- Dorfman, J. (2015, January 6). Dorfman: 2014 less-than-stellar year for Robot Portfolio. Retrieved May 10, 2015, from <http://triblive.com/business/johndorfman/7500737-74/robot-stocks-earnings>
- Dreman, D. N., & Berry, M. A. (1995). Overreaction, Underreaction, and the Low-P/E Effect. *Financial Analysts Journal*, 51(4), 21–30. <http://doi.org/10.2469/faj.v51.n4.1917>
- Efron, B., & Morris, C. (1977). Stein's Paradox in Statistics. *Scientific American*, 236(5), 119–127. <http://doi.org/10.1038/scientificamerican0577-119>
- Fabozzi, F. J., Focardi, S. M., & Kolm, P. N. (2006). *Financial Modeling of the Equity Market: From CAPM to Cointegration*. John Wiley & Sons.
- Fabozzi, F. J., Modigliani, F. P., & Jones, F. J. (2009). *Foundations of Financial Markets and Institutions* (4 edition). Boston, MA: Prentice Hall.
- Fama, E. F. (1965). The Behavior of Stock-Market Prices. *The Journal of Business*, 38(1), 34–105.
- Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, 25(2), 383–417. <http://doi.org/10.2307/2325486>
- Fama, E. F. (1997). *Market Efficiency, Long-Term Returns, and Behavioral Finance* (SSRN Scholarly Paper No. ID 15108). Rochester, NY: Social Science Research Network. Retrieved from <http://papers.ssrn.com/abstract=15108>

- Finance | - SLN2311 - About historical prices. (n.d.). Retrieved April 12, 2015, from <https://help.yahoo.com/kb/finance/historical-prices-sln2311.html>
- Graham, B. (2003). *The Intelligent Investor: The Definitive Book on Value Investing. A Book of Practical Counsel* (7th edition). New York: HarperCollins Publishers.
- Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), 263–91.
- Longin, F., & Solnik, B. (1995). Is the correlation in international equity returns constant: 1960–1990? *Journal of International Money and Finance*, 14(1), 3–26.
- Lynch, P., & Rothchild, J. (2000). *One Up On Wall Street: How To Use What You Already Know To Make Money In The Market* (2nd edition). New York: Simon & Schuster.
- Mandelbrot, B. (1963). New Methods in Statistical Economics. *Journal of Political Economy*, 71(5), 421–440.
- Mandelbrot, B. (1967). The Variation of Some Other Speculative Prices. *The Journal of Business*, 40(4), 393–413.
- Markowitz, H. (1952a). Portfolio Selection. *The Journal of Finance*, 7(1), 77–91.
<http://doi.org/10.2307/2975974>
- Markowitz, H. (1952b). The Utility of Wealth. *Journal of Political Economy*, 60(2), 151–158.
- Markowitz, H. (1959). *Portfolio Selection: Efficient Diversification of Investments*. John Wiley & Sons, New-York.
- Poteshman, A. M. (2001). *Underreaction, Overreaction, and Increasing Misreaction to Information in the Options Market* (SSRN Scholarly Paper No. ID 262018). Rochester, NY: Social Science Research Network. Retrieved from <http://papers.ssrn.com/abstract=262018>
- Pratt, J. W. (1964). Risk Aversion in the Small and in the Large. *Econometrica*, 32(1/2), 122–136. <http://doi.org/10.2307/1913738>
- Rea, James B. (1977). Remembering Benjamin Graham — Teacher and Friend. *The Journal of Portfolio Management*, 3(4), 66–72. <http://doi.org/10.3905/jpm.1977.66>

- Richardson, M., & Smith, T. (1993). A Test for Multivariate Normality in Stock Returns. *The Journal of Business*, 66(2), 295–321.
- Sharpe, W. F. (1991). The Arithmetic of Active Management. *Financial Analysts Journal*, 47(1), 7–9. <http://doi.org/10.2469/faj.v47.n1.7>
- Shiller, R. J. (2003). From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives*, 17(1), 83–104. <http://doi.org/10.1257/089533003321164967>
- Shiller, R. J. (2006). *Irrational Exuberance* (2 edition). New York: Crown Business.
- Shleifer, A. (2000). *Inefficient Markets: An Introduction to Behavioral Finance*. Clarendon Lectures in Economics.
- Solnik, B. (1995). *International Investments* (3rd edition). San Diego, Calif. u.a.: Addison-Wesley Publishing Company.
- S&P Dow Jones Indices LLC. (2015a). S&P Dow Jones Indices: S&P U.S. Indices Methodology. Retrieved from http://us.spindices.com/documents/methodologies/methodology-sp-us-indices.pdf?force_download=true
- S&P Dow Jones Indices LLC. (2015b). S&P Dow Jones Indices: U.S. Equity - Sector and Industry. Retrieved from <http://us.spindices.com/index-family/us-equity/sector-industry>
- Stevenson, A. (2010). *Oxford Dictionary of English*. Oxford University Press.
- Stewart, S., Piros, C., & Heisler, J. (2010). *Running Money: Professional Portfolio Management* (1 edition). New York, NY: McGraw-Hill/Irwin.
- Swensen, D. F. (2009). *Pioneering Portfolio Management: An Unconventional Approach to Institutional Investment, Fully Revised and Updated* (Rev Upd edition). New York: Free Press.
- Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, 185(4157), 1124–1131. <http://doi.org/10.1126/science.185.4157.1124>
- U.S. Department of the Treasury. (n.d.). Retrieved from <http://www.treasury.gov/>
- Yahoo Finance. (n.d.). Retrieved May 13, 2015, from <http://finance.yahoo.com/>