FACULTY OF FINANCE & ACCOUNTING
Copenhagen Business School

Master's thesis
Analysis of stock performance based on fundamental indicators

Authors: Anders Heegaard & Peter Brøndum Riis Sørensen

CPR nr.: Anders Heegaard

CPR nr.: Peter Brøndum Riis Sørensen

Academic advisor: Hans Kjær

Submitted: 23/09/13

Pages: 122

Characters (with spaces): 312,862

Anders Heegaard Peter Brøndum Riis Sørensen

Executive summary

The objective of this thesis is to examine the validity of enterprise value/earnings before interest and tax (EV/EBIT) and return on invested capital (RoIC) as a screening tool to select stocks. The various ways of improving the selection process is an integral part of investing, and therefore this subject is deemed highly current and relevant. The thesis is divided into four parts. The first part is an analysis of the approach chosen to select stocks. The second part is the theoretical foundation behind the measures and the risk incurred. Subsequently, a test of the approach and an analysis of the results are presented. Finally, the findings are evaluated and discussed, resulting in the fourth part, which determines the framework for the screening tool.

In the first part the thesis, the approach was examined as well as the underlying investment philosophy. It was found that the strategy rests on the belief that if investors can invest in quality companies at "cheap" prices, superior results should be achieved. To determine the quality of a company, Return on Tangible Capital (ROC) was used, and to determine the price, EV/EBIT was used in the original approach developed by American investor Joel Greenblatt.

The second part finds that EV/EBIT is the best price measure as the measure eliminates the effect of leverage, has a solid focus on the cash flows to the enterprise created from core operations, and is theoretically equivalent to other valuation techniques such as the discounted cash flow mode and the price to earnings ratio. Furthermore, RoIC was found to be the preferred quality measure as the measure captures the value that is created by core operations, and was overwhelmingly supported by academic research as an indicator for the quality of a business. Moreover, it is considered a good measure for economic value as it is related to Economic Value Added (EVA). This outweighed accounting issues related to the measure and the fact that it was not the measure used in the original test.

Based on the chosen measures, the testing and analysis were carried out. Based on the test, the third part of this thesis found that ranking stocks solely on both RoIC and EV/EBIT is a valid approach to identify portfolios of stock that provide great and abysmal returns, respectively, as the best ranked stocks had a performance that vastly outperformed the market, whereas the lowest ranked portfolios of stocks significantly underperformed. Furthermore, the analysis finds that ranking stocks based on a combination of EV/EBIT and RoIC provides a better overall result as significantly more can be concluded across the different portfolios. However, the analysis proved that the strategy does not provide as great absolute performances for the best portfolios as is the case when using EV/EBIT and RoIC. Based on these findings, part four presents a discussion of the results and concludes that based on the overall findings, it is believed that a model based on EV/EBIT and RoIC can provide some valuable insights and can be considered a good starting point in terms of which stocks should be singled out. Nonetheless, the analysis also showed that a strategy based purely on this approach is not feasible as the performance of the various decentiles has been found to be significantly affected by a few stocks.

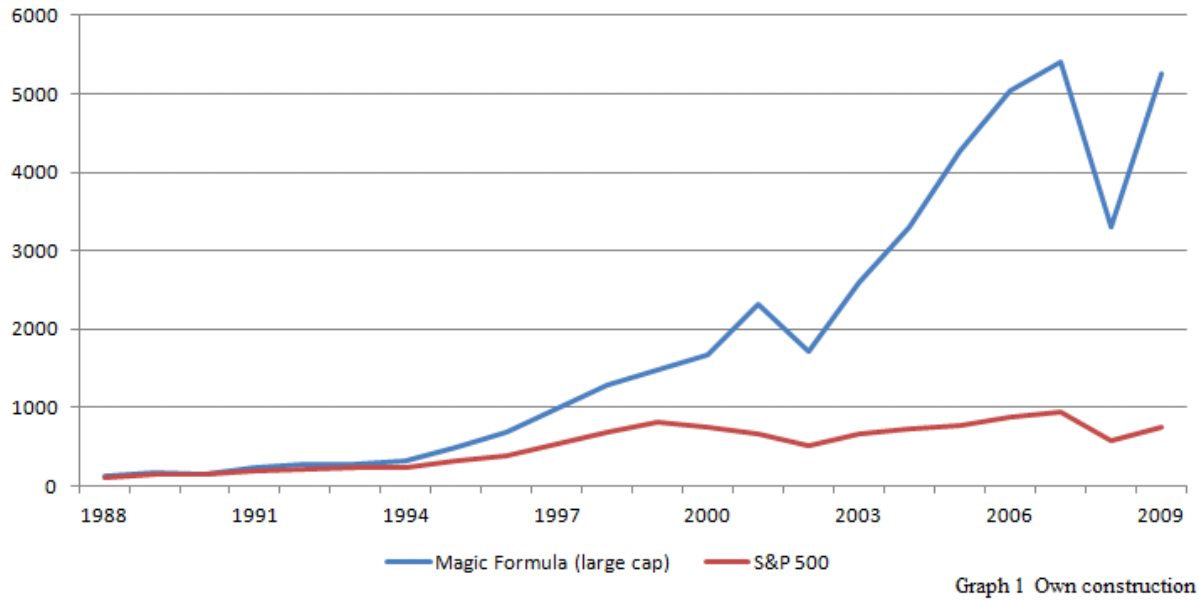
Table of Contents

1. Introduction 4
1.1 Motivation 5
1.2 Problem Statement 6
1.3 Methodology 7
1.4 Structure of the Thesis 11
1.5 Demarcation 11
1.6 Critique of Sources 14
1.7 The Magic Formula 15
2 Theoretical Framework 16
2.1 Price Measures 16
2.2 Price Earnings as a Measure 18
2.3 Drivers of the Price to Earnings Ratio 18
2.4 Ability to Create Cash Flows 19
2.5 Growth Rate 20
2.6 Uncertainty of Future Cash Flows (Risk) 21
2.7 What Earnings to Use? 22
2.8 P/E Across Different Sectors 23
2.9 Is Price to Earnings A Valid Measure? 23
2.10 EV/EBIT as a Measure 24
2.11 Fundamental Drivers of EV/EBIT 25
2.12 Advantages of EV/EBIT 27
2.2 Return on Invested Capital 29
2.21 NOPAT 29
2.22 Invested Capital 30
2.23 The Decomposition of RoIC 31
2.3 Accounting Issues 35
2.31 Accounting Issues Related to EBIT 35
2.32 Accounting Issues Related to Invested Capital 41
2.33 Accounting Issues Related to Enterprise Value 46
2.4 Risk 47
3. Analysis 55
3.1 Analysis of Return on Invested Capital 55
3.11 Returns 55
3.12 Risk Measures 57
3.13 Risk 57
3.14 Risk-Adjusted Returns 59
3.15 Top & Bottom Performers 61
3.16 Decomposition of Portfolios 62
3.17 Summary of Analysis of Return on Invested Capital 65
3.2 Analysis of EV/EBIT 66
3.21 Analysis of Pricing Measures 66
3.23 Risk 69
3.24 Risk-Adjusted Returns 70
3.25 Top & Bottom Performers 72
3.26 Decomposition of Portfolios 72

3.27 Summary of Analysis of EV/EBIT 75
3.3 Analysis of EV/EBIT & RoIC 76
3.31 Returns 76
3.32 Returns in Different Times 80
3.33 Risk Measures 80
3.34 Risk-Adjusted Returns 82
3.35 Top and bottom performers 85
3.36 Decomposition of Return 86
3.37 Decomposition of Portfolios 89
3.38 Summary of Analysis of EV/EBIT & RoIC 92
3.4 Sectors 92
3.41 Annualized Return & Standard Deviation of the Returns 93
3.43 Summary of the Analysis of EV/EBIT & RoIC on GIC sectors 97
4. Discussion 97
4.1 Return on Invested Capital 98
4.2 EV/EBIT 102
4.3 EV/EBIT & RoIC 106
5. Conclusion 114
6. Perspectives 117
7. Suggestions for Future Research 118
8. Reflections and Final Remarks 118
9. Bibliography 119

1. Introduction

The paper at hand is an analysis of an investment strategy developed by Joel Greenblatt, an American investor who runs the fund, Gotham Asset Management.[1] Joel Greenblatt devised an investment strategy, which he calls "The Magical Formula" in his book "The Little Book that Beats the Market." The overarching idea behind the "Magic Formula" is to combine the strategies of two of the greatest investors of all time - namely, Warren Buffet and Benjamin Graham.[2] Benjamin Graham's strategy was primarily value oriented, and he is often referred to as the father of value investing. Benjamin Graham did not put much emphasis on the quality of the company, and the basis of his strategy was basically to buy stocks cheap. This was exemplified in the way by which he bought companies that sold below the value of their net current assets. Warren Buffett, a pupil of Graham, on the other hand, was also very concerned about the quality of the company,[3] which is evident in his statement: *"It's far better to buy a wonderful company at a fair price than a fair company at a wonderful price."*[4] Based on these two investment philosophies, Greenblatt developed the "Magic Formula" which aims to combine the main elements from both strategies in regard to buying quality companies at discounted prices. The formula considers P/E or EV/EBIT as a measure to describe how expensive a stock is (the lower the better) and return on invested capital (RoIC) to describe the quality of the company (the higher the better). This is in line with Graham and Buffett's measures for determining cheap and quality companies[5].



Graph 1 Own construction

[1] http://www.valuewalk.com/joel-greenblatt-resource-page-bio-books-quotes-interviews-videos/
[2] http://www.forbes.com/2010/04/16/formula-s-&-p-500-intelligent-investing-greenblatt.html
[3] More on the two strategies of the two in Secondary Exhibits "Introduction"
[4] http://www.berkshirehathaway.com/letters/1989.html
[5] Secondary Exhibits "Introduction"

By using these two measures, Greenblatt created an investment strategy that has significantly outperformed the market historically.[6] More specifically, the strategy has outperformed the S&P 500 index by 10.2 percentage points annually during a 21-year period from 1988-2009.[7&8] However, Greenblatt only examines the return characteristics of the strategy. As such, we find it relevant to analyze the extent to which the ”Magic Formula” can be used as a screening tool for stock picking. In doing so, the intent is to analyze the characteristics of different portfolios created by the strategy, and analyze whether these are favorable for investors.

1.1 Motivation

The decision to write this thesis on performance evaluation of stock picking strategies is based on the authors' interest in the subject, which was awakened by Greenblatts book, “The Little Book That Still Beats the Market”. After reading the book, it was realized that it would be interesting to examine the “Magic Formula” in greater detail for two reasons. Firstly, it was deemed relevant to analyze the returns of the strategy in order to examine the underlying cause of these returns. Furthermore, there are thousands of listed companies and a massive information overflow available to investors. Accordingly, it seemed appropriate to analyze whether the strategy can be used as a tool to condense the amount of stocks that need further investigation. In particular, the link between the strategy and investment philosophies by Buffett and Graham is considered decidedly appealing, which formed the underlying basis for the choice of the focal analytical object. The starting point for this thesis will be Greenblatts “Magic Formula”. Since the publication of Greenblatts strategy, a wide array of tests has been conducted in order to assess the validity of the Magic Formula. Moreover, the strategy has been tested in other markets and countries, and the results generally seem to be similar to Greenblatts findings.[9] As the results violate the efficient market hypothesis,[10] there have been a number of papers assessing whether the outperformance is due to excessive risk, data mining, or if the strategy genuinely creates alpha. The results show that although there is an outperformance, it is not statistically significant when adjusting the returns for risk by using the Capital Asset Pricing Model (CAPM) or similar models.[11]

The aim of this thesis is somewhat different from the above. The intent is not to test whether the strategy actually violates the efficient market hypothesis, but rather to analyze the results of this strategy, and ultimately determine whether it can be a stated as a valid screening tool for investment managers. To the best knowledge of the authors, this has not yet been done before.

---

[6] The market consists of both & equally weighted 3,500 stock universe & the market weighted S&P 500 (Joel Greenblatt, The Little Book That Still Beats the Market, p. 59
[7] Joel Greenblatt, The Little Book That Still Beats the Market, p. 155
[8] The strategy doesn't include utilities & financial companies
[9] James Montier, The little note that beats the market, p. 10
[10] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 341-354
[11] Nicklas Selender & Victor Person, Back testing the ”Magic Formula” in the Nordic region, p. 1

1.2 Problem Statement

The following thesis aims to examine and analyze the feasibility of RoIC and EV/EBIT as a screening tool to select stocks. The intent is to gain an understanding of the characteristics of these measures with a distinct focus on the underlying drivers as well as the relationship between the measures and the valuation of companies. The overall approach will be to analyze the findings in an extensive data analysis of the screening tool while relating the findings to the theory of price measures, quality measures, and risk.

The above is encapsulated in the following overarching research question, which will be the guiding question of this thesis:

To which extent can an investment strategy based on price measures and return measures be used as a screening tool for stock selection?

The overarching research question creates a dual focus for the thesis with a perspective on both the price measures and quality measures of companies, respectively. The former and the latter are descriptive as they analyze the relation between the measures and the valuation of firms. However, the analysis is analytical as the purpose is to understand, evaluate, and ascertain the usefulness of the three screening tools. The aim is to accomplish this by performing an analysis of the screening tools with an emphasis on the embodied risks as well as the extent to which the findings are caused by few stocks or whether the screening tool identifies similar performing securities. This is further encapsulated in the following *operational* research questions:

- What is the ”Magic Formula”?
  The analysis is inspired by and based on the investment strategy by Joel Greenblatt. Therefore, the aim is to gain further understanding of this strategy to perform the analysis based on this strategy.
- What price measures should be selected?
  The strategy is based on the combination of a price measure and a return measure. As such, an analysis of the most widely used price measures is considered ideal as well as determining which measure is most advantageous to use as a screening tool.
- What return measures should be selected?
  With the above argument in mind, an analysis of return measures is needed. The analysis will in particular focus on the relationship between return measure and the valuation of the companies.
- How do the portfolios perform adjusted for risk?

To make the returns of the portfolios comparable, the risks of the different portfolios must be taken into account. Thereby, it will be possible to conclude whether the performance is caused by excessive risk taking and whether alpha is generated.

- How "risky" are the different portfolios?
  Due to the fact that the analysis seeks to determine the usefulness of the strategy as a screening tool, it is considered advantageous to analyze whether the results are caused by a few stocks or if the results are due to the selection of similar performing stocks. In order to access the riskiness of the portfolios, an assessment will be conducted in order to determine which risk measures are most advantageous to use.
- What are the characteristics of the portfolios created by the strategy?
  There is a need for an analysis of the characteristics of the portfolios created by the strategy to conclude the usefulness of the strategy as a screening tool.

Finally, a discussion of the implications of the findings from the six operational research questions in regard to the usefulness of the strategy as a screening tool will take place.

1.3 Methodology

Methodological considerations must be addressed in order to conduct empirical research properly.[12] These considerations will be addressed in the subsequent section, followed by a general discussion and review of the tools used to conduct the analysis and the collation of information. Despite the nature of this thesis being both quantitative and qualitative, the methodology is based on the deductive investment strategy created by Greenblatt. Deductive reasoning centers on specific examples that are tested from general propositions, which leads to a confirmation (or rejection) of the original hypothesis.[13] This is in contrast to inductive reasoning that constructs or evaluates general propositions that are derived from specific examples or case studies.[14] To further elaborate, the inductive reasoning entails collecting data and gathering empirical evidence, after which a general theory can be proposed. The deductive approach usually addresses areas that to a large extent are explained by existing theory and literature. For instance, there is a general consensus regarding the valuation of companies, and therefore a deductive approach is well suited; hence, this is the chosen research method. The thesis is inductive in the sense that it draws upon existing theory related to price and return measures, and deductive in the way that it tests the relevance of the three screening tools. Using mixed methods, and thereby combining both deductive and induc-

[12] Dan Herms, Logical Basis of Hypothesis Testing in Scientific Research , p.1
[13] Dan Herms, Logical Basis of Hypothesis Testing in Scientific Research , p.1
[14] Dan Herms, Logical Basis of Hypothesis Testing in Scientific Research , p.3

tive approaches and quantitative and qualitative elements, allows for the *"…opportunity to compensate for inherent method weaknesses, capitalize on inherent method strengths, and offset inevitable method biases"*.[15]
For this project, data collation has been conducted in a number of ways. Through articles and relevant books, a fundamental understanding of the stock picking process based on EV/EBIT and RoIC was established. Subsequently, it was decided to put these findings to the test. Consequently, the proposition was tested on the American S&P 500 index. The reasoning for selecting the S&P 500 index is that this is the most widely used index in the world[16] with more than $ 5.5 trillion benchmarked towards the index.[17] Due to the fact that the S&P 500 index is such a world-renowned index, an extensive amount of data is available, and it is accessible for longer periods of time. This was particularly important in order to ensure that the data used was correct and reliable.
The data used for the project has been collected from two primary sources. The constituents of the S&P 500 were attained by using Compustat which was accessible through Copenhagen Business School's online resources. Furthermore, the function "Index Fundamentals Annually" was used via Compustat's "Monthly Updates on North America" where the constituents of the S&P 500 were determined by selecting the start date each year as January 1st and the end date as December 31st. Compustat was selected based on the fact that the service was readily accessible, and because Compustat is owned by McGraw-Hill Financial which also owns the rights to the S&P 500 Index.[18] Therefore, this service was deemed the most reliable source of data. The financial data was collected from Bloomberg. There were two primary reasons for this; Firstly, both authors are experienced and familiar with Bloomberg, which is expected make the process smoother, and thereby also likely to increase the quality of the retrieved data. Secondly, Bloomberg is widely renowned as one of the most trusted providers of financial data, and as a result, this firm reputation was deemed likely to improve the quality of the data.[19] Another advantage of using Bloomberg is that it enabled a full set of data available at the given time for analysis. Other services might have been able to extract a larger data range, however, it would not have been possible to analyze the actual data without further resources. This is considered essential to the fulfillment of the objectives and primary intents of this thesis as one of the main goals is to analyze the investment strategy as a selection tool, and thus it was deemed necessary to analyze the characteristics of the different portfolios.

In addition to the tests on the S&P 500 index, Bloomberg's backtesting function was used to further analyze other indices. The purpose of these tests was merely to examine whether the findings from the original test are applicable in other regions and indices.

[15] Michael R. Harwell, Research Design in Qualitative/Quantitative/Mixed Methods, p. 151
[16] Secondary Exhibit "1.3 Method" 1
[17] http://www.st&ard&poors.com/indices/sp-500/en/us/?indexId=spusa-500-usduf--p-us-l--
[18] McGraw-Hill Annual report 2012, p. 8
[19] http://www.nytimes.com/2009/11/15/business/media/15bloom.html?pagewanted=2&_r=2&hp/&

The data has been analyzed in the following manner: ten portfolios have been constructed, which have been termed decentiles. The portfolios were created by ranking the companies in the S&P 500 index based on return on invested capital in a descending order as well as ranking the companies based on EV/EBIT in an ascending order. Based on these, the two rankings were added together and subsequently divided the sum by two. For example: if a company had the highest RoIC and the ninth lowest EV/EBIT multiple, the score of the company would be 5 (9+1 divided by 2). In circumstances where the data was not available, such companies have been excluded from the analysis, which in turn influences the sample size, and thereby the reliability of the results.[20] After computing the average of the two rankings, the portfolios were constructed. The portfolio named decentile 1 consists of the companies with the 10% highest rankings. The portfolio named decentile 2 consists of companies with a ranking between top 10% and top 20%, and so forth in a descending manner.

To ensure the quality of the calculated returns, each stock return has been calculated, including reinvested dividends.[21] Furthermore, all of the data used in the analysis has the same starting point in January to ensure the validity of the analysis. Trailing earnings have been applied to calculate EBIT in EV/EBIT and RoIC.[22] The portfolio returns have then been calculated as an equal weighted average of the returns of the individual stocks within the portfolio. Moreover, the findings of the combined ranking have been analyzed based on a holding period of six months, one year and three years, respectively. The underlying reasoning for this is to analyze the characteristics of the portfolios with diverse holding periods. Due to the scope of the paper, the analysis of EV/EBIT and RoIC was merely conducted on a yearly basis. The starting point was selected to be January with data ranging from 1992-2012. The timeframe 1992-2012 was selected as this was considered the time period containing the most reliable data. January was chosen as the main starting point as it contained more data due to the fact that the data was extracted from January 1st to December 31st. However, for the combined ranking, an annual analysis was also conducted, starting in every other month to ensure that the findings are not biased by seasonal factors.

To adjust for risk, several measures have been applied, and some of these are partially dependent on the risk-free rate. Initially, the one-year Treasury Bills were preferred as the risk-free rate as scholars such as Damodaran, Plenborg, etc. recommend that the holding period equals the maturity of the risk-free rate.[23] However, due to the fact that the Federal Reserve discontinued issuing one-year Treasury Bills in July 2001,[24] the annualized return of the 3-month Treasury Bills, calculated by the renowned NYU professor, Aswath Damodaran, were used in-

[20] See page 11 for further information on the standard error
[21] Secondary Exhibit "1.3 Method" 2
[22] See 2.10 EV/EBIT as a measure & 2.2 Return on Invested Capital for implications hereof
[23] Aswath DamodaranDamodaran, Estimating Risk-free Rates, p. 3
[24] http://research.stlouisfed.org/fred2/categories/116

stead.[25] As it is assumed that Treasury Bills are risk-free, there is no default risk, and thus only time risk can cause differences.[26] However, it is believed that the impact of this difference is insignificant due to the short time period. The reason for choosing American treasuries as opposed to London Interbank Offered Rate (LIBOR), or other commonly used risk-free rates,[27] is that treasuries are stated in United States Dollar (USD), and thus take inflation into account as the rates are in the same currency as the underlying cash flows of the business.[28]

One of the risk-measures used in the thesis is beta. As the stocks used in the analysis consist of an equal weighted S&P 500 index where the financial and utility sectors[29] are excluded, it is not deemed sensible to calculate the beta towards the S&P 500 index. As a result, the market return used to calculate the beta for the individual stocks is the average of all the stocks in the universe (the S&P 500 Index excluding the utility and financial sectors). The reason for excluding the financial and utility sectors is described in greater depth in the demarcation (See page 15).

Beta measures have not been used to adjust for risk for the test within the GIC sectors as the number of stocks within each sector is considered too low. More specifically, it is not deemed suitable to speak of a market portfolio of telecommunications services stocks consisting of only eight stocks, especially when the power of diversification is taken into consideration, and as a result Jensen's Alpha has not been calculated on a sector level.[30]

In select tests, a minimum required return was applied. For the analysis, the return for the equal weighted S&P 500 index was used, not including the financial and utility sectors. Additionally, for the analysis of GIC sectors, the minimum target return is set as the average return of the stocks within the sector. The reason for choosing this approach is that the minimum required return must be what investors would have achieved had they instead invested in an index fund and not e.g. the risk-free rate.

Furthermore, the excess returns of the decentiles are decomposed in two categories – sector pick and stock pick. As such, the returns of the decentiles have been explicated based on their sector exposure compared with the average as well as the annualized performance of the selected stocks. When illustrating these findings, the alpha caused by the sector exposure and the stock pick has been added.

[25] http://pages.stern.nyu.edu/~adamodar/
[26] Michael Christensen, Obligations Investering, p. 90-94
[27] John C. Hull, Options, Futures & Other Derivatives, p. 56
[28] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 237
[29] The reasons for this exclusion is explained in 1.5 Demarcation
[30] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 166

In the analysis, outliers[31] for the Calmar ratio and the Omega ratio have been excluded as anomalies create a few very unusual results that distort the analysis. The analysis also includes regression analysis of the relationship between the rankings of the stocks, the decentiles, and the returns. A 95% confidence interval has been plied.[32]

It should be noted that in the thesis the term "the market" will be used repeatedly. When referring to the "the market" this will mean the S&P 500 index excluding the financial and utility sector if not explicitly stated otherwise.

1.4 Structure of the Thesis

The thesis overall consists of 5 parts, divided into eleven larger sections as shown in the figure of the Methodology and the Theoretical Framework, which provides the foundation for the following analysis and equips the reader with a structural understanding of the individual elements. The last 5 parts consist of a discussion of the analysis, before providing an overall Perspective on our findings and a final Conclusion.

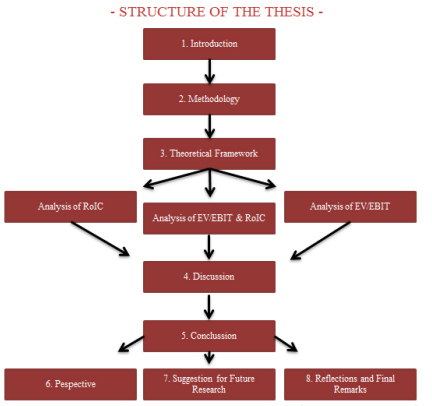


Figure 1.4 Own construction

1.5 Demarcation

Financial and insurance companies have been excluded from the tests as the nature of the business makes it difficult to define both debt and reinvestments.[33] Furthermore, these industries are heavily regulated, and as a result, it is debatable to which extent RoIC is a good measure of the performance of the industry.[34] Additionally, it is near impossible to value operations separately from interest income and expenses as these are the main categories of a bank's core operations.[35] Debt for financial firms is rather viewed as raw material than as a source of capital, and capital at financial service firms is more narrowly defined as including only equity capital. This definition of capital is reinforced by the regulatory authorities that only include equity or equity-like financing in regulatory capital.[36] Moreover, interest income and expenses should be included in the operating earnings for

[31] Alan Agresti & Christine Franklin, Statistics The Art & Science of Learning From Data, p. 50
[32] Alan Agresti & Christine Franklin, Statistics The Art & Science of Learning From Data, p. 410
[33] Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset, p. 581
[34] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 745
[35] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 745
[36] Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset, p. 581

financial firms.[37] Therefore, it is deemed reasonable to exclude these firms, which is also in line with Greenblatts approach.

In addition, utility companies have been excluded in the analysis. There are several reasons for this decision: firstly, the utility sector is – like the financial sector - heavily regulated, which severely affects the relationship between return on invested capital and earnings.[38] Furthermore, due to the scale of their assets, they are more exposed to the impact of chosen depreciation method. Moreover, the sector is exposed to the old plant trap. In general, companies in the utility sector must make major investments in fixed assets that last for many years. As a result, companies that invest on an ongoing basis in assets are penalized for this in general competent management style. As a result, RoIC is not sufficient as a measurement for their performance. Also, many utility companies use a range of derivatives to manage the commodity, currency, and interest rate risks to which they are operationally exposed.[39] As a result, EBIT is not a great proxy for net operating profit before tax as it was the case with financials firms.

The most commonly used methods to determine the value of a company is the discounted cash flow models (DCF) and relative valuations using multiples. In this thesis, the purpose is to examine Greenblatts strategy, and as a result, the focus is on relative valuations (multiples). It has been decided to omit the use of DCF valuations as it would be beyond the scope of this paper to carry out a test where DCF valuations of more than a 500 companies a year over a 20 year period would have to be conducted. This is not considered a major hindrance as the valuations attained by this would be highly subjective as opposed to multiples that are publicly available, and thus constitute objective measures.

Quite a few demarcations in regards to accounting issues have been made, mainly because Bloomberg is used as the primary source of data. First of all, it has been decided to focus on US Generally Accepted Accounting Principles (US GAAP) as the analytical objects constitute companies in America that are legally subject to US GAAP accounting rules.[40] Therefore, other accounting principles, such as International Financial Reporting Standards (IFRS), have not been focused upon. Furthermore, Petersen & Plenborg's posit has been disregarded, namely that when comparing financial statements, there are four criteria that should be taken into consideration. These are explained in greater detail in section 2.3 Accounting Issues.[41]

[37] Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset, p. 582
[38] PWC, Financial reporting in the power & utilities industry, p. 8
[39] PWC, Financial reporting in the power & utilities industry, p. 30
[40] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 20
[41] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 333

In addition, changes in accounting rules are not taken into account since this is outside the scale and scope of the paper. Furthermore, adjusting the accounting entries revenue and cost of goods sold although valid arguments (See 2.3 Accounting Issues) have been deprioritized due to the scope of the thesis.[42] Moreover, relevant facts regarding differentiated treatment have been disregarded in terms of the amortization of goodwill and depreciation make companies that grow organically, and companies that grow through M&As, incomparable. Furthermore, although it is acknowledged that companies disguise operating expenses, it is believed that with the scope and scale of this paper in mind, EBIT is a fair proxy for actual operating earnings. This is considered beyond the scope of this project as it would require analyzing 20 years of financial statements for thousands of companies. Furthermore, it is not considered particularly relevant as the objective of this thesis is to research whether the model can be used as method for screening stocks, which implies not being able to adjust earnings properly.

Liabilities and assets that are kept off balance as well as accounting fraud is further disregarded in this thesis. The impact hereof is acknowledged, however, it is not deemed possible to take those into account. In regard to the enterprise value, a primary focus is applied to the market value of the liabilities, i.e. the equity and debt, and therefore a detailed description of the problems associated with estimating the market value of the assets based on financial data is not included.

In the analysis of risk, only six risk measures are used and constitute the following: the Sharpe ratio, the Modigliani-squared ratio, the Adjusted Sharpe ratio, the Jensen's Alpha, the Omega ratio and the Calmar ratio. Other CAPM measures such as the Treynor ratios have not been applied, and VaR or Expected Shortfall is also omitted. Although these measures would provide additional insight, they are excluded due to the scale and scope of the paper.

The analysis and subsequent results are not adjusted to different EV/EBIT values across different sectors. As the theory of EV/EBIT highlights, there are four drivers of this multiple, and arguments can be made to adjust for these to make the companies in the sample comparable.[43] However, this has not been conducted for several reasons. Firstly, the uncertainty associated with estimating the drivers is significant. Secondly, the aim of this thesis is to analyze a *screening tool*, and therefore the above is considered irrelevant as differences in sectors should be taken into account. Furthermore, a correction would decrease the over/underexposure to different sectors. It is believed that the insight of this exposure is valuable information in the analysis as it is considered interesting to see if sectors are overexposed or underexposed in particular portfolios. Therefore, it has been decided to divide the returns of the decentiles into stock and sector contribution instead.

[42] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 373-374
[43] See section 3.2 "Analysis of EV/EBIT"

The analysis does not take transaction costs and taxes into account when rebalancing. These are relevant for investors as they should increase with the frequency of rebalancing however, it has been found to be outside the scope and scale of this paper to include these.

1.6 Critique of Sources

The two primary sources of data are Bloomberg and Compustat. The constituents of the S&P 500 index from Compustat are assumed to be reliable as Compustat is part of the same company as the Standard & Poors indices. However, there might be some issues with certain areas of the data retrieved from Bloomberg, and especially with the return on invested capital values. Accordingly, Bloomberg calculates the return on invested capital as:

$$\frac{\text{Trailing 12 Month Operating Income}}{(\text{Total Invested Capital beginning balance} + \text{Total Invested Capital ending balance}) * 0.5} * 100$$

The return on invested capital is notoriously difficult to measure, and different investors assessing the same company can reach vastly different results depending on their classification of different accounting items. An example of this is cash. Some professionals will say that cash should be included in the invested capital as companies need to maintain some liquidity in order to operate. Others will argue that large cash positions have nothing to do with the day-to-day operations of a business and should therefore be excluded. As a result, RoIC is a very subjective measure, and as such, the quality could potentially vary as the data is retrieved from Bloomberg. These pitfalls are discussed in much greater depth in the section on return on invested capital.[44]

There are periods from which it has not been possible to retrieve data from all of the S&P 500 listed companies. As a result, these firms have been excluded which could potentially distort the results. This is especially the case for the early 1990s. However, it has been possible to retrieve data from the vast majority of companies, and in the final year, 2012, it was possible to gain information from every single company. Furthermore the analysis is subject to a survivorship bias. To elaborate returns are calculated on a yearly basis based on the primo constituents of the S&P 500 index. The index only include companies with large market capitalizations which conversely means that companies that have performed subpar will be excluded from the index. This typically means that companies from the S&P 500 index will very rarely go bankrupt as they will be excluded from the index before such extreme events incur.

Some of the authors of the books referred to in this thesis are biased. For instance, it is considered unlikely that Greenblatt would be critical of the ”Magic Formula” considering he created the formula. .

[44] 2.23 Accounting Issues related to Invested Capital

In regards to the calculations of beta, it is important to realize that a change in beta may reflect a change in the underlying risk of the company, or it may reflect measurement problems. The interval between each observation has proven to affect the beta estimate as beta calculated on daily observations and monthly observations do not yield the same results.[45]

In the analysis, different statistical measures have been applied, among these, the standard deviation. When conducting these tests, the sample size is of great importance, as a sample size that is too small can distort results. Historically, the mean return of the S&P 500 has been 12.26%.[46] With a desired margin of error of 1% (= m), the required sample size for a 95% confidence interval is 1,534.

1.7 The Magic Formula

The strategy of investing in stocks with high returns on invested capital and low EV/EBIT values was originally developed by Joel Greenblatt.[47] Greenblatt is an American investor that runs the hedge fund Gotham Asset Management and teaches an investing course at Columbia Business School.[48] He presented the strategy in his book, "The Little Book That Still Beats the Market", and terms it the "Magic Formula". According to Greenblatt, the strategy is based upon the investment philosophy of two of the greatest investors of all time, namely Warren Buffett and Benjamin Graham.[49] Entire books could be written (and have been) on the strategies of the two, and thus it is considered beyond the scope of this thesis to provide an in-depth analysis of their strategies. Instead, it has been decided to summarize the investment philosophies of the two, which can be found in Secondary Exhibits "1. Introduction".

Greenblatts approach uses EV/EBIT to measure how "cheap" a company is. The reason he does not use Graham's "net-net" method is that according to himself, it is very tough (if even possible) to find companies that are trading at less than their net working capital.[50] As a result, he uses Graham's other method of determining whether a company is undervalued, which is to value the company from their earnings.[51] Greenblatt posits that the earnings yield is the best measure for the price of stocks.[52] He argues that the earnings yield is a way to observe the rate of return a particular investment provides. The higher return, the better the bargain - ceteris paribus. In the model, he uses historical earnings to calculate the earnings yield. Greenblatt does admit that historical

[45] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 253
[46] Ravi Shukla, Risk of Investing in the S&P 500 Index, p. 1
[47] Joel Greenblatt, The Little Book That Still Beats the Market, p. 1
[48] http://www.valuewalk.com/joel-greenblatt-resource-page-bio-books-quotes-interviews-videos/
[49] http://www.forbes.com/2010/04/16/formula-s-&-p-500-intelligent-investing-greenblatt.html
[50] Joel Greenblatt, The Little Book That Still Beats the Market, p. 52
[51] Benjamin Graham, The Intelligent Investor, p. 166
[52] Joel Greenblatt, The Little Book That Still Beats the Market, p. 44

earnings might not be a good indicator for future earnings as they could be extraordinarily high or low.[53] However, he is of the opinion that consensus earnings are even worse as the reason a stock could be undervalued is that the market consensus underestimates the company's earnings potential.[54] This is completely in line with Graham's thinking as he believed investors should invest in companies where earnings are temporarily depressed.[55] Greenblatt believes the ideal measure would be normalized earnings. However, this is a difficult figure to calculate, especially for the average investor, and is extremely time consuming to do for more than 500 stocks a year. Therefore, Greenblatt states that this approach is suitable for professional investors only.

As a measure for the quality of a company, Greenblatt prefers to use return on invested capital, but due to accounting issues, he applies return on capital instead which he calculates as: $\frac{EBIT}{Tangible\ capital}$.[56] His main concerns are the classification of accounting items when calculating invested capital.[57] There are several other reasons for Greenblatts choices. Firstly, he does not want to use net income as it includes all sorts of items that have nothing to do with the operating business.[58] Instead, Greenblatt considers EBIT to be a better measure because he believes this measure is focused is on the profitability from operations as it relates to the costs of the assets used to produce the profits.[59] The reason for using tangible capital, as opposed to the usual operating capital or equity, is that debt and tax levels vary across different companies, which can cause distortions in earnings.[60] As a result, Greenblatt is of the opinion that tangible capital better captures actual operating capital used. Equity value typically used to return on equity (RoE) ignores assets financed via debt, and the total assets value used in return on assets (RoA) includes intangible assets that may not be tied to the firm's primary operation.[61]

2 Theoretical Framework

2.1 Price Measures

There are numerous ways to determine the value of a company, and academics and practitioners alike are in continuous discussions as to which is best. The most commonly used methods are the discounted cash flow

[53] Joel Greenblatt, The Little Book That Still Beats the Market, p. 152
[54] Joel Greenblatt, The Little Book That Still Beats the Market, p. 37
[55] Benjamin Graham, The Intelligent Investor, p. 166
[56] Joel Greenblatt, The Little Book That Still Beats the Market, p. 44
[57] Joel Greenblatt, The Little Book That Still Beats the Market, p. 167
[58] Joel Greenblatt, The Little Book That Still Beats the Market, p. xx
[59] http://www.aaii.com/computerizedinvesting/article/3-using-the-magic-formulafor-investing
[60] http://www.aaii.com/computerizedinvesting/article/3-using-the-magic-formulafor-investing
[61] More on different return measures on, in 2.1 Price Measures

models (DCF) and relative valuations.[62] As stated in the demarcation, the focus will be on relative valuations as the purpose of this thesis is to examine the strategy of Greenblatt.

In general, there are two types of multiples: Equity measures and firm measures.[63] As indicated by their names, equity measures are concerned with the equity of the business, whereas firm measures take both equity and debt into account.[64] Examples of equity multiples are: Price to Earnings, Prices to Sales, and Price to Book. Examples of firm multiples are: Enterprise Value to EBIT and Enterprise Value to EBITDA.

Over the course of this thesis, it has been decided to examine one equity measure (Price to Earnings) and one firm measures (Enterprise value to EBIT). EV/EBIT has been selected as the preferred measure because of its considerable advantages when comparing different companies from numerous sectors due to the fact that it eliminates the effect of leverage.[65] Furthermore, it is the measure used by Greenblatt. The reasoning for analyzing the equity measure Price to Earnings (P/E) is that it is the most widely used measure among professional investors.[66] As a result, it is deemed relevant to analyze the advantages/disadvantages of using it compared to the EV/EBIT. Moreover, much of the research conducted on multiples is focused solely on the Price to Earnings ratio as it is the most widely used measure. Accordingly, this will analyze the Price to Earnings ratio, and subsequently relate this to the findings using firm measures.

Another aspect that deserves attention is behavioral finance, which has been a subject of great debate among scholars. Behavioral finance is a field that studies the human nature when making financial decisions. In this regard, it is particularly interesting to analyze whether investors tend to become overly optimistic or pessimistic as Greenblatt and Graham suggest they do. Academic research finds that this is in fact often the case as investors have a tendency to become overly optimistic about growth stocks.[67] Investors will argue there are no limitations to the growth rates the sector/company can experience. An example of this could perhaps be the Internet bubble. Research has shown that investors are usually overly optimistic because of anchoring, selection bias, linear thinking etc.[68] This is very interesting, but due to the scope of this paper this will not be analyzed further. Research has further shown that the reasons investors become overly pessimistic are often similar and based on the assumption that there is no way the business can turn as it is a declining industry/stock.

[62] Aswath Damodaran, Investment Valuation, p. 456
[63] Aswath Damodaran, Investment Valuation, p. 456
[64] Aswath Damodaran, Investment Valuation, p. 454
[65] Part 2.12 Advantages of EV/EBIT
[66] Aswath Damodaran, Investment Valuation, p. 19
[67] Charles MacKay, Extraordinary Popular Delusions and The Madness of Crowds, p. 160
[68] Charles MacKay, Extraordinary Popular Delusions and The Madness of Crowds, p. 184

2.2 Price Earnings as a Measure

Price earnings consist of two variables – namely, the price per share or market value of the company (the price) and the earnings per share or total company earnings.[69] The price earnings ratio can be calculated by dividing the price with company earnings:[70]

$$\frac{P}{E} = \frac{Price\ per\ share}{Earnings\ per\ share}$$

In other words, the price earnings ratio measures how much an investor is willing to pay (price) for the earnings of a given company. For instance, if a company has a P/E ratio of 10, this implies that the investor would be willing to pay $10 today for $1 of earnings.

The measure is used as a method to determine whether a stock is undervalued. The general idea is that the higher the P/E multiple, the more expensive the company is, ceteris paribus. The reason is that there are only two ways the price earnings ratio can increase; if the price increases or the earnings decrease. If the price of a stock growths proportionally more than the earnings, investors will have to pay more for earnings than before, and thus the earnings would not be as "cheap" as before. If earnings decrease proportionally more than the price of the company, investors will receive less current earnings for their investment. In other words, ceteris paribus, the lower the price earnings ratio, the cheaper the stock. This way of analyzing P/E ratios however is too simplistic as the differences in P/E ratios can also be a result of different growth possibilities, risk, etc. As an example, if a company is growing at 20% p.a., it should have a higher P/E ratio than a company that is not growing at all. This is the case because the value of a stock is the present value of all future cash flows, and investors will thus be willing to pay a higher price now for increasing earnings in the future.[71] To gain a deeper understanding of this, a further analysis of what the drivers of the P/E ratio is conducted below.

2.3 Drivers of the Price to Earnings Ratio

Although there are numerous discussions regarding whether fundamental valuations, such as the discounted cash flow model or relative valuations models such as the price to earnings ratio, are the best models to determine the price of assets, it is important to keep in mind that these models are theoretically equivalent.[72] However, even though the two models should theoretically yield the same result, this is very rarely the case for two reasons.[73] Firstly, many professionals in the investment industry, such as analysts, use shortcuts to calculate the price earn-

[69] http://lexicon.ft.com/Term?term=price/earnings-ratio
[70] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 18
[71] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p.34
[72] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 226
[73] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 116

ings multiple, which cause the values to differ. Secondly, in order for the two to yield the same, the forecasts must be identical. As this is very rarely the case, the two will usually not yield the same value. The value of the P/E ratio can be derived from the present value formula through the following equation:[74]

$$\frac{P}{E} = \frac{P_o}{EPS_0} = \frac{Payout\ ratio * (1 + g_n)}{k_e - g_n}$$

- Where:
  - P_o = Price at time zero
  - EPS_0 = Earnings per share at time zero
  - $Payout\ ratio$ = The proportion of net income used for share buybacks or dividends
  - g_n = Expected stable growth rate
  - k_e = Cost of equity

Determined in this manner, it becomes apparent that the price to earnings ratio is dependent on three factors: the ability to generate cash flows, expected growth, and uncertainty associated with cash flows (risk).[75] The ability to generate cash flows is expressed in the equation as the payout ratio and the growth rate. The growth rate is determined by the expected stable growth rate in the steady state. Any uncertainty associated with cash flows or risk is included in the cost of equity. The effects of the factors on the P/E ratio are bipartite. The ability to create cash flows and growth will cause the P/E ratio to increase (ceteris paribus) as investors are willing to pay a higher price if the company is able to generate an increased amount of cash that can be distributed to shareholders in the future. On the other hand, the P/E ratio will decrease as risk increases because investors need to be compensated to take on more risk, which occurs in the form of a decrease in the price.[76] A further analysis of the drivers will be conducted in greater detail below.

2.4 Ability to Create Cash Flows

The ability to generate cash flows can be measured in a number of ways. In the equation mentioned above, it is measured as the payout ratio and the growth rate. In other words, everything else being equal, a higher payout ratio will result in a higher P/E ratio. The reason is that in general, the more cash a company can pay out to shareholders, the greater their ability to generate cash. An alternative way of looking at it is that if a company has a low payout ratio in the steady state, it would imply a need to reinvest a lot of capital in their operating business in order to maintain it, which would decrease the future cash flows available to investors.

[74] Aswath Damodaran, Investment Valuation, p. 471
[75] Aswath Damodaran, Investment Valuation, p. 460
[76] Aswath Damodaran, Investment Valuation, p. 472

The notion that a higher payout ratio equals a higher P/E ratio is essentially the same as saying that the P/E ratio increases as return on equity increases, ceteris paribus.[77] This is the case because the payout ratio can be derived by the following equation:[78]

$$Payout\ ratio = 1 - \frac{g_n}{Return\ on\ equity}$$

Thus, the price earnings ratio is partly driven by return on equity. Therefore, it is relevant to examine what in turn drives the return on equity. To observe what the drivers for RoE are, it can be decomposed as:[79]

$$Return\ on\ equity = RoIC + (RoIC - NBC) * \frac{NIBD}{BVE}$$

- Where:
  - RoIC = Return on invested capital
  - BVE = Book value of equity
  - NIBD = (Book value of) net interest-bearing debt
  - NBC = Net borrowing cost after tax in percent
    - NBC is calculated as: $NBC = \frac{Net\ financial\ expenses\ after\ tax}{Net\ interest-bearing\ debt}$

In other words, the return on equity is a function of the return on invested capital, the net borrowing costs, and the leverage of the company. With this in mind, an increase in return on invested capital should increase the P/E ratio. Increased leverage should, ceteris paribus, increase the P/E ratio as long as the return on invested capital is higher than net borrowing costs. However, this might not always be the case as increased leverage could very well increase the cost of equity.[80] Therefore, it cannot be determined whether leverage increases or decreases the P/E ratios. It does however have a large impact, and this is among other things the basis for the decision not to use the P/E ratio as the price measures.

2.5 Growth Rate

As derived earlier, the P/E ratio is an increasing function of the expected growth rate (as long as return on equity is higher than cost of equity).[81] The rationale behind this is that an investor is often willing to pay more for a

[77] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/invfables/peratio.htm
[78] http://people.stern.nyu.edu/adamodar/pdfiles/pbv.pdf
[79] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 117
[80] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 441-442
[81] Aswath Damodaran, Investment Valuation, p. 472

dollar of earnings today if e.g. the earnings are expected to increase by 10% p.a. than if earnings are expected to grow by 5% p.a. It is however important to assess how the growth is measured. In the case of the P/E ratio, the growth is focused on net income. Net income can primarily be increased in three ways:[82]

- Increasing revenues
- Decreasing costs
- Acquisitions

Accordingly, these are the three factors that should determine whether a company grows its net earnings or not. However, it should be noted that although acquisitions most likely will increase earnings in order to determine if economic value is generated, the price must be taken into consideration. It should be noted that if high growth is expected small deviations in the actual growth rate can cause significant changes in multiples (due to price changes). The reason being that the expected growth rate is priced into the stock price and if this growth rate is no longer sustainable that will affect companies trading at high multiples considerably more.[83]

2.6 Uncertainty of Future Cash Flows (Risk)

The final component affecting the P/E ratio is risk. All other things equal higher risk will decrease the P/E ratio.[84] In other words, the P/E ratio should be higher for a company that can grow predictably and stably compared to an otherwise similar firm with unstable growth. The reason is that investors require a premium to invest in something that is riskier.[85] This premium comes in the form of a lower price. There are numerous ways of measuring risks in securities, and this subject will be analyzed in greater detail in the section on risk measures.[86] The most common measurement for risk, however, is the cost of equity, which relies on beta. The cost of equity is usually calculated by the capital asset pricing model: [87]

$$E(R_i) = r_f + \beta_i\left[E(R_m) - r_f\right]$$

- $E(R_i)$ = Expected return of security i
- r_f = Risk-free rate
- β_i = Stock's sensitivity to the market
- $E(R_m)$ = Expected return of the market

[82] Kenneth A. Merchant & Wim A. Van der Stede, Management Control Systems, p.447-450
[83] Aswath Damodaran, Investment Valuation, p. 472
[84] Aswath Damodaran, Investment Valuation, p. 472
[85] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 18
[86] 2.4 Risk
[87] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 235

Accordingly, the risk is dependent on the risk-free rate, the beta of the stock, and the expected return of the market. Of these factors, the expected return of the market and the risk-free rate are factors that cannot be influenced by the company. The company cannot directly affect its beta either, however, the beta will be a result of the inherent risk in the business.[88]

2.7 What Earnings to Use?

Whereas the price component of the P/E ratio is fairly uncontroversial, there is a lot of disagreement on whether to use historical earnings, forward earnings, normalized earnings, or a completely different measure for the earnings component.[89] In addition, it is debatable whether one should use primary shares outstanding or if it should be calculated using fully diluted shares. The figure below illustrates that it makes a big difference whether one uses the trailing, current or forward price earnings ratio. Historically, this has been exploited by analysts as it can help make their case.[90] For example, if an analyst is very bullish on a stock, he will most likely use the forward multiples as these make the stock seem cheaper.

There are advantages and disadvantages with each of the different methods. The main advantage of using trailing earnings is that the earnings are known. Thus, there is no bias as to what earnings are estimated to be in the future.[91] This is particularly beneficial for companies that the market has a strong opinion of. For instance, if overall skepticism about a company is present, market participants will most likely be pessimistic about future earnings which will make the P/E ratio seem higher as estimated earnings decrease. This will not be the case for the trailing P/E ratio which merely consists of actual earnings. The disadvantage of using trailing P/E ratios is that earnings can be affected by one-off events that have no implications for future earnings.[92] For example, one year accounting gains, e.g. the sale of non-core assets, might not be very telling about future earnings. The alternative to trailing earnings is to use the current earnings or to use the forward earnings. The advantages of these are evidently the opposite of using trailing earn-

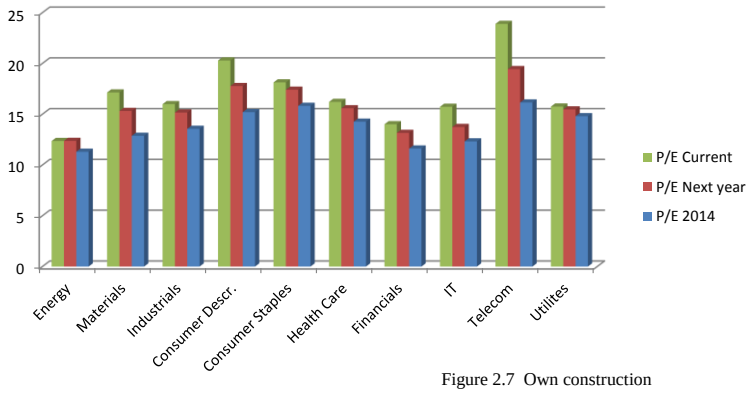


Figure 2.7 Own construction

[88] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 341-354
[89] Aswath Damodaran, Investment Valuation, p. 456
[90] Aswath Damodaran, Investment Valuation, p. 456
[91] Aswath Damodaran, Investment Valuation, p. 456
[92] http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/earnmult.pdf

ings. As such, forward earnings will in most cases be a lot more informative in terms of the future earnings power of the company as earnings will more likely be "normalized".[93] Therefore, one-off events will not have as large of an effect. This theory has been proven by academic research conducted on the subject, as forward price earnings ratio has shown to be a better indicator for future performance of the company.[94] The disadvantage of using the forward multiple is that it is dependent on estimates on future earnings which are usually too optimistic[95] even though research shows that on average, they have beaten the market.[96] This can be a major disadvantage as future earnings estimates will most likely be highly affected by the market sentiment towards the stock. Therefore, a stock considered to be an underperformer by the market might have lower expected earnings, which will result in a higher forward price earnings multiple even though this might not be justified.

2.8 P/E Across Different Sectors

Generally, P/E ratios should vary across different sectors. As mentioned above, the reason being that a P/E ratio is determined by the ability to generate cash, expected stable growth in earnings, and risks.[97] Since these three factors vary across different sectors, different sectors are expected to have different P/E ratios on average. For example, a fast growing IT company should have a higher P/E ratio than a consumer staples company with negative growth, ceteris paribus. This also seems to be the case which can been seen in Primary Exhibits "2.8 P/E across different sectors" 1 and 2.

2.9 Is Price to Earnings A Valid Measure?

A vast amount of theoretical evidence supports the posit of the P/E ratio as a valid technique to value companies if used the right way. However, this is not very useful if it cannot be empirically proved that it is an effective measure to indicate whether a company is "cheap" or not. The idea behind P/E is that the ratio describes whether a company is cheap by measuring earnings to the price you pay for the company. If a company is significantly undervalued as a result of the market being overly pessimistic, a lower P/E should occur as a result. Investing in companies with lower P/E values should in turn lead to better returns. Academic research seems to support this.[98] It has been shown that investing in companies with low P/E multiples has created significant alpha.[99] Nevertheless, there is a need to investigate whether this strategy is riskier than others. Academic research suggests that the

[93] Aswath Damodaran, Investment Valuation, p. 456
[94] Jing Liu, Doron Nissim & Jacob B. Thomas, Equity Valuations Using Multiples, p. 29
[95] http://www.mckinsey.com/insights/corporate_finance/equity_analysts_still_too_bullish
[96] Jean-Sébastien Michel & J. Ari Pandes, Are Analysts Really To Optimistic?, p. 30
[97] See part 2.3 Drivers of the price earnings ratio
[98] S. Basu, Journal of Finance Vol. 32, p. 680
[99] S. Basu, Journal of Finance Vol. 32, p. 680

P/E ratio does to some degree take into account the risks of the stock in the form of beta and standard deviation. Yet it remains an open question whether these are appropriate risk measures. Therefore, this will be further discussed in the section on risk measures. In addition, academics argue that P/E can be viewed as a measure to determine whether markets are overvalued, and moreover, that they can stay overvalued for longer periods of time.[100] Empirical results have found this to be the case, which can be seen in Primary Exhibit "Is price to earnings a valid measure?" 1 and 2 that illustrate the P/E from 1992-2012 and from 1880-2012.

2.10 EV/EBIT as a Measure

Although not as common as the P/E ratio or the EV/EBITDA multiple,[101] the EV/EBIT multiple is another common relative valuation tool that investment professionals use. Like the P/E ratio, the EV/EBIT attempts to determine how "cheap" a stock is. The multiple is calculated as follows: [102]

$$\frac{EV}{EBIT} = \frac{Enterprise\ value}{EBIT}$$

- Where:
  - EBIT is defined as earnings before interest and taxes[103]
  - Enterprise value is the value of the company's debt and the market value of their equity[104]

Thus, there are some major differences between the EV/EBIT multiple and the P/E ratio. This is evident as the EV/EBIT multiple is based on enterprise value, not the market value of the equity. Whereas market value is simply the number of outstanding shares times the price of the shares, the enterprise value is generally defined as the market value of the equity plus adjusted net debt.[105] There are, however, different definitions of enterprise value. The most common definitions being:[106]

- Total enterprise value consists of all the activities of the business including non-core assets and the value of investments
- Operating enterprise value is the total enterprise value less non-operating assets at market value
- Core enterprise value is the operating enterprise value less non-core assets at market value

[100] Robert J. Shiller, Irrational Exuberance, p. 186
[101] Aswath Damodaran, Investment Valuation, p. 452
[102] Aswath Damodaran, Investment Valuation, p. 452
[103] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 148
[104] Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 134
[105] Peter Suozzo, Stephen Cooper, Gillian Sutherl& & Zhen Deng, UBS Warburg – Valuation Multiples, p. 24
[106] Peter Suozzo, Stephen Cooper, Gillian Sutherl& & Zhen Deng, UBS Warburg – Valuation Multiples, p. 24

Multiples based on enterprise value are thus firm value measures because they include debt.[107] Some investors consider firm values superior because it is the cost of buying the right to core cash flows for the entire enterprises.[108] Furthermore, it is equal to the estimated value of the operations of an enterprise as represented by the value of the various claims on cash flows and profits. The idea behind EV/EBIT is thus to determine how cheap the stock is by looking at what price investors would have to pay (market value of equity and debt) to buy the rights to all of the operating earnings (EBIT). EBIT is used as operating earnings due to the fact that interest is not subtracted as interest is considered a payment to the company's financial investors and not an operating expense. By classifying interest as a financial item, EBIT and Net Operating Profit after Tax (NOPAT) are independent of the company's capital structure.[109]

As with the P/E ratio, there are only two factors that can cause the EV/EBIT ratio increase or decrease. The first relates to whether the enterprise value increases/decreases, which would result in a higher/lower EV/EBIT. Thus, ceteris paribus, if the market value of the equity or the net debt increases, the EV/EBIT will increase, and the company will become pricier as investors must pay more for the operating earnings of the business (however, if net debt increases, the market value of the equity will often fall due to increased risk).[110] The other scenario is that EBIT increases which, ceteris paribus, will make the EV/EBIT decrease making the stock "cheaper" because investors are paying less for the operating earnings of the company.

2.11 Fundamental Drivers of EV/EBIT

There are several discussions whether EV/EBIT is valid approach to value a company when compared to e.g. the discounted cash flows model. Many even consider relative multiples inferior as they are too simplistic. However, just as with the price earnings ratio, the EV/EBIT measure should yield the same value as cash flow models.[111] This can be derived from the following formula:[112]

$$\frac{EV}{EBIT} = \frac{RoIC-g}{WACC-g} * \frac{1}{RoIC} * (1-t)$$

- Where:
  - RoIC = Return on invested capital
  - WACC = Weighted Average Cost of Capital

[107] Aswath Damodaran, Investment Valuation, p. 500
[108] Peter Suozzo, Stephen Cooper, Gillian Sutherl& & Zhen Deng, UBS Warburg – Valuation Multiples, p. 24
[109] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 134
[110] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 258
[111] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 226
[112] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 228

- g = Growth rate
- t = Tax rate

Even though the EV/EBIT multiple theoretically equals the value one would get using the discounted cash flow model, this is rarely the case as with P/E. The reason is that usually a lot of short cuts are used when multiples are applied. Furthermore, the analysts forecast may deviate from the general market expectations which will cause a different value.[113] However, from the decomposed EV/EBIT, the factors that influence EV/EBIT are:[114]

- Return on Invested Capital
- Weighted Average Cost of Capital
- The growth rate
- The tax rate

Accordingly, the same factors that are important to the P/E ratio are important to the EV/EBIT multiple as well. It is still the ability to create cash flows (RoIC), the growth rate (g) and risk (WACC) that determine how "expensive" a stock should be. The growth rate is thus the same as analyzed in regards to P/E, and the only differences are that tax is included and that RoIC and WACC are used instead of RoE and cost of capital. This is the case as the EV/EBIT multiple includes debt and is thus a firm value.[115] As earlier described, RoE is a function of RoIC, and thus, these two measures should be correlated. Return on invested capital will be further decomposed in much greater detail in section 2.24 The Decomposition of RoIC.

The primary difference between WACC and cost of capital is that WACC includes debt. WACC can be derived using the following equation:[116]

$$WACC = \frac{Debt}{Debt + Equity} * Cost\ of\ debt * (1 - Tax\ rate) + \frac{Equity}{Equity + Debt} * Cost\ of\ equity$$

- Where:
  - Debt = Market value of the total debt
  - Equity = The market value of the equity

Consequently, weighted average cost of capital (WACC) is just an alternative way of determining the cost of capital. When the using WACC, the risk is determined by four factors; cost of equity, cost of debt, leverage, and

[113] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 226
[114] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 230
[115] Aswath Damodaran, Investment Valuation, p. 500
[116] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 231

tax rate. It is only considered the weighted average cost because it includes the cost of capital that occurs when including debt. This is also the reason that WACC is used in the EV/EBIT multiple; the EV/EBIT multiple is a firm measure. Furthermore, the tax rate affects the EV/EBIT multiple due to the fact that interest is tax deductible.[117]

2.12 Advantages of EV/EBIT

One of the main arguments for the use of EV/EBIT is that it is a much better measure when comparing different companies across different sectors with differentiating levels of debt.[118] There are several reasons for this. Firstly, companies across different sectors usually have very different debt levels[119] which Primary Exhibits "2.12 Advantages of EV/EBIT" 1 and 2 illustrates. These significant differences in the levels of debt and cash positions across different sectors can distort the price to earnings ratio severely as market value is affected by debt because the value of equity is defined as liabilities subtracted from assets, [120] and as a result, when the debt increases, the value of equity should decrease. Increased levels of debt also have a significant impact on net earnings as costs related to interest will increase, and thereby net earnings will fall. As a result, the P/E ratio is affected because both the market value of equity is affected as is the earnings. In stark contrast to this, the EV/EBIT multiple is not affected. The reason is that the enterprise value already takes levels of debt into account, and thus different levels of debt do not influence the valuation. Furthermore, the earnings measure used in the EV/EBIT multiple is EBIT. EBIT is per definition measured before interest and taxes, and therefore it is not affected by differentiating levels of debt. As a result, the EV/EBIT multiple is often considered superior to the P/E multiple when comparing companies with different levels of debt.[121] This is illustrated by the example in figure 2.12. If investors analyze the companies above solely on the basis of P/E, the companies would be expected to be fairly similar since their price earnings ratios are equivalent. In other words, companies should have the same tradeoffs in terms of growth prospects, ability to create cash flows, and risk. However, this is not the case, especially in regard to risk. In the example below, growth has not been taken into account, yet it is obvious that the risk for the various companies is significantly different due to their varying levels of debt. These different levels of debt are accounted for in the EV/EBIT ratio as the ratio increases as debt increases.

[117] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 231
[118] Aswath Damodaran, Investment Valuation, p. 500
[119] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 247-258
[120] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 115
[121] Peter Suozzo, Stephen Cooper, Gillian Sutherl& & Zhen Deng, UBS Warburg – Valuation Multiples, p. 25

	Company A	Company B	Company C
	No leverage	Moderate leverage	High leverage
Debt (market value)	200	150	50
Enterprise Value	0	50	150
	200	200	200
Interest costs	10%	10%	10%
Taxation	25%	25%	25%
EBIT	20	20	20
Interets	0	-5	-15
Profit before tax	20	15	5
Tax	-5	-3.75	-1.25
Net Income	15	11.25	3.75
P/E Ratio	13.33	13.33	13.33
EV/EBIT multiple	13.33	17.78	53.33

Figure 2.12 Own construction

Therefore, it is often argued that the price earnings ratio is not an optimal measure to compare companies with different capital structures, and as such, the EV/EBIT multiple should be used when valuing companies across sectors.[122] The way in which the EV/EBIT is determined can obviously have a major impact on the results. In this thesis, Bloomberg's definition has been applied:

$$\frac{Current\ Enterprise\ Value}{Trailing\ 12\ months\ EBIT}$$

More specifically, Bloomberg adds that the trailing 12-month operating income (EBIT) is calculated by adding operating income for the most recent four quarters, and that Current Enterprise Value = Market Capitalization + Preferred Equity + Minority Interest + Short-Term and Long-Term Debt - Cash and Equivalents - Nominal Amount of Debt Included in Price.[123] Thus, trailing earnings have been used. The advantages and disadvantages of different earnings stated earlier in this section are considered valid here as well.

There are a number of accounting issues related to the use of EV/EBIT as a measure, and these are examined in greater details in 2.31 Accounting Issues Related to EBIT and 2.33 Accounting Issues Related to Enterprise Value.

[122] Glenn E. Atkins, Capital Structures, P/E Ratios & Cash Flow, p. 1
[123] Secondary Exhibits "1.6 Critique of Sources" 1

2.2 Return on Invested Capital

Return on invested capital is a financial measure that is calculated by dividing the net operating profit after tax by invested capital:[124]

$$RoIC = \frac{NOPAT}{Invested\ Capital}$$

Thus, as the name indicates, the measure shows the profitability of invested capital. RoIC centers around operating earnings that are generated by the net operating assets, which are the basis for the creation of these earnings. Return on invested capital focuses on the entire company as the net operating assets are financed by both shareholder equity as well as interest-bearing debt.[125] Accordingly, (NOPAT), represents the total after-tax operating income generated by the company's invested capital available to all financial investors. The invested capital is the investor capital needed to fund the operations without distinguishing between the funding methods.[126]

As mentioned earlier in the section, data from Bloomberg has been used in the analysis. Bloomberg calculate RoIC as:

$$\frac{\text{Trailing 12 Month Operating Income}}{(\text{Total Invested Capital beginning balance} + \text{Total Invested Capital ending balance}) * 0.5} * 100$$

Based on the above, RoIC will be described in greater detail as well as the underlying drivers hereof and how these differ from industry to industry. Moreover, a further attempt to describe the link between RoIC and Economic Value Added and how the value of the firm can be calculated based on this will be presented.

2.21 NOPAT

NOPAT is derived from the analytical income statement, and measures the operating earnings on a post-tax basis. The operating earnings are a key performance measure that illustrates a firm's profit from its core operations. Generally, operating earnings can be measured on both a pre- and post-tax basis. Operating earnings before tax is generally equivalent to the accounting entry EBIT, and net operating profit after tax is equal to EBIT * (1-Tax rate).[127] The analyzed data is based on Bloomberg's definition that uses the trailing 12-month operating income. Bloomberg define the trailing 12-month operating income as *"Trailing 12-month operating income (EBIT), calculated by adding operating income for the most recent four quarters. Operating income is after amortization of goodwill."*

[124] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 94
[125] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 73
[126] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 106
[127] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 73

Tax on the operating earnings is an expense that is related to the core operations, and income tax expenses relate to both operating and financing items. As net financial expenses are tax deductible, the income tax expense should be divided into tax on operations and tax on financing.[128] It is important to be aware of the fact that the reported tax is positively affected by net financial expenses as these are tax deductible, and therefore it is necessary to add back the tax advantage that the net financial expenses offer.[129] Academia suggests that the effective tax rate is used by the analyst, which is a result of the lack of information about the different local tax rates in the respective countries that the company operates. A reasonable approach would be to assume that the operating income as well as the financial income is taxed by the same rate.[130]

2.22 Invested Capital

Invested capital represents the amount a firm has invested in its operating activities that requires a return.[131] The total investments in a company's operating activities is denoted as invested capital or net operating assets and equals the sum of operating assets minus operating liabilities. Operating liabilities are excluded because they reduce the need for interest bearing debt. As an example, accounts payable could be viewed as an interest free loan.[132]

There are two sources used to finance the invested capital; shareholders equity and interest-bearing debt. As a result, invested capital can be regarded as net operating assets or the sum of equity and net interest-bearing debt. As such, invested capital is the sum of operating working capital (current operating assets minus current operating liabilities), fixed assets, intangible assets, and other net long-term assets.[133] Viewed from a liabilities perspective, it is the funds that are used to finance the operations.[134]

It is critical to define invested capital consistently with the definition of EBIT, and include only the capital that has generated the given profits.[135] By doing so, consistency between the numerator and the denominator in the calculation of RoIC can be ensured.[136]

As mentioned in the demarcation, Bloomberg is used to extract data for, among other things, invested capital. Bloomberg's definition of invested capital is as follows: *[137]*

[128] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 76
[129] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 73
[130] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 76
[131] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 74
[132] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 74-75
[133] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 137
[134] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75
[135] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 134
[136] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 134

"Total invested capital is a measure of economic capital from shareholders, lenders, and other financing resources that is tied up in the business for the purpose of funding the company operations. It is derived by deducting non-financing accounts such as account payables and accrued expenses, capitalizing several types of expenses, and adding off-balance sheet items to total liabilities and equity."

2.23 The Decomposition of RoIC

As stated earlier, return on invested capital is the overall profitability measure for operations. The ratio expresses the return on capital invested in a firm's net operating assets as a percentage. The ratio is important in a valuation context since it is a significant factor in determining the value. Hence, a higher rate of return will lead to a higher estimated value, ceteris paribus.[138]

RoIC is not able to explain whether profitability is driven by a better revenue and expense relation or an improved capital utilization. A way to determine this is the Du Pont pyramid illustrated in Primary Exhibits "2.24 The Decomposition of RoIC" 1 to decompose the return on invested capital. As stated in the Du Pont model[139]:

RoIC = Profit Margin * Turnover rate of invested capital.

- The profit margin after tax[140] = $\frac{Net\ operating\ profit\ after\ tax\ (NOPAT\ or\ NOPLAT)}{Net\ revenues}$
- The profit margin before tax[141] = $\frac{Earnings\ before\ interest\ and\ tax\ (EBIT)}{Net\ revenues}$
- The turnover rate of invested capital is calculated as[142] = $\frac{Net\ revenue}{Invested\ capital}$

The profit margin describes the relation between revenue and expenses, and it is considered optimal to have a high profit margin, ceteris paribus.[143] The turnover rate expresses a firm's ability to utilize the invested capital as it expresses the amount of time the firm has tied up its invested capital. Alternatively, it expresses that for each dollar the firm has invested in operation (net operating assets), a sale of $\frac{Net\ revenue}{Invested\ capital}$ is generated. Ceteris paribus, it is attractive to have a high turnover rate of invested capital.[144]

---

[137] Description of Invested Capital, Bloomberg excel add in
[138] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 94
[139] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 107
[140] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 107
[141] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 107
[142] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 108
[143] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 107
[144] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 108

Based on the profit margin and the turnover rate of invested capital, it is possible to describe rather well what type of business is being analyzed. Grocery stores in general have a high turnover rate because their goods are perishable and usually sold quickly after they arrive. On the other hand, the price is typically a major competitive parameter, and thus the profit margins are rather low. On the contrary, pharmaceutical companies are investing heavily, and in general have a low turnover rate of the invested capital. However, because the price is not an important competitive parameter to the same degree (especially if they have patens), pharmaceutical companies are able to keep higher profit margins.[145] Thus, different sectors should not only have different returns on invested capital, they should also reach their return on invested capital in various ways. There are likely to be competitive and technological constraints on both variables, and firms in general should chose the mix of both that maximizes RoIC.[146] This will be described in greater detail in the following section about the different industries.

As the Du Pont model indicates, the firm's competitive edge is of enormous importance when decomposing the return on invested capital. If a company has a competitive advantage, it earns a higher RoIC because it either charges a price premium or produces its products more effectively (at lower cost or lower capital per unit), or both.[147] Both suggest that the company must have some kind of competitive advantage. Higher profit margins imply that the company has a competitive advantage as they earn abnormal profits relating to the earlier example, which could be a result of patents or superior products. Higher turnover rates suggest superior cost structure or better inventory management. An example of this could be Wal-Mart that utilize their economies of scale to increase turnover rate. In particular, McKinsey points out that the underlying strategy model on the drivers of competitive advantage and RoIC is in line with Michael Porter's theory about competitive strategy as well as the resource-based approach.[148]

[145] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 108
[146] Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset, p. 46
[147] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 58
[148] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 58-62

With this in mind, it is relevant to describe the return on invested capital for each industry. In the article, "The Five Competitive Forces That Shape Strategy", Michael Porter describes the differences in RoIC between different industries in the US, which figure 2.23 illustrates. Porter's results are similar to those of McKinsey which are displayed in Primary Exhibits "2.24 The decomposition of RoIC" 2.

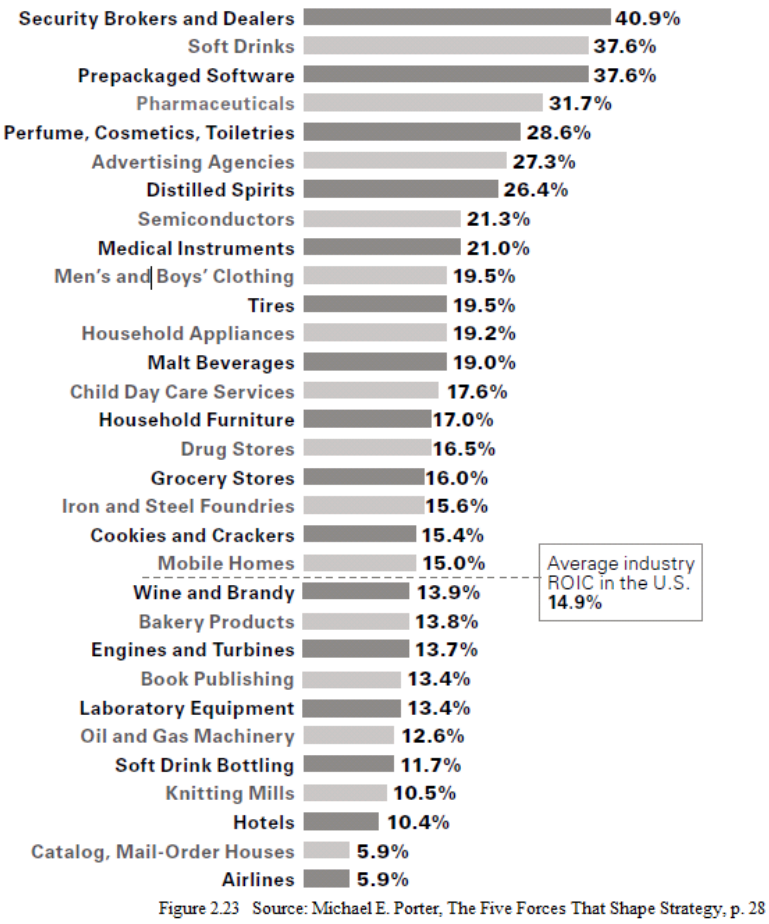


Figure 2.23 Source: Michael E. Porter, The Five Forces That Shape Strategy, p. 28

With these findings in mind, it is interesting to focus on the persistency in RoIC. McKinsey concludes that RoIC is especially persistently high for the industries: household and personal products, beverages, pharmaceuticals and software, which Primary Exhibits "2.24 The decomposition of RoIC" 3 describes in greater detail. Inasmuch, the sustainability of the return on invested capital is dependent on:[149]

- Length of product life cycle
- Persistence of competitive advantage
- Potential product renewal

Accordingly, there seems to be evidence that especially pharmaceutical firms have historically had very high RoIC. However, this could be due to the accounting treatment of R&D expenses, which will be elaborated in 2.32 Accounting Issues Related to Invested Capital.

Nonetheless, if a company has a high return on invested capital, it does not necessarily mean that they are creating value for shareholders. RoIC only creates value in the instance that: [150]

"Value creation is only obtained if accounting returns (ROIC) exceeds the required rate of return (WACC) or alternatively if return on equity (ROE) exceeds investors required rate of return (r_e)"

[149] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 66-67
[150] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 132

Another way to express this mathematically is: [151]

Value added (EVA) = (ROIC – WACC) * Invested capital

Primary Exhibits ”2.25 The Decomposition of RoIC” 4 illustrates the relation between EVA and RoIC by using the DuPont pyramid.

Just as the valuations of the relative models are theoretically identical to the discounted cash flow model, so is the economic profit or EVA.[152] Economic profit, or EVA, should thus be a good measure for creating economic value. On the basis of EVA, the value of a company can be determined by the initial invested capital plus the present value of all future EVAs, which the following equation shows: [153]

$$Enterprise\ value_0 = Invested\ capital_0 + \sum_{t=1}^{\infty} \frac{EVA_t}{(1+WACC)^t}$$

Where $EVA_t = Economic\ Value\ Added\ (NOPAT_t - WACC * invested\ capital_{t-1})$

As stated in the equation, the EVA model uses the invested capital from the last fiscal year as a starting point for the valuation. The present value of all future EVAs is then added to the invested capital from the last year. This equals the enterprise value of the company.[154] In regards to the above section regarding RoIC, this is considered consistent as RoIC focuses on the entire company because the net operating assets are financed by both share-holder equity as well as interest-bearing debt.

It is important to note that only excess returns are relevant. For instance, when RoIC=WACC, the excess returns are 0 which causes the terminal value to be 0% of the enterprise value. In other words, the book value of equity = the market value of the equity *if* the return on invested capital equals the weighted average cost of capital. Based on this, when a company trades below or above the book value of invested capital the present value of expected EVAs is positive and below when the present value of expected EVA’s is negative. Only in the scenario where return on invested capital equals the cost of capital is the market value equal to the book value of invested capi-tal.[155] As a result, if a company’s value of operations exceeds its invested capital, one should be sure to identify the sources of competitive advantage that allow the company to maintain superior financial performance.[156] An

[151] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 132
[152] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 115
[153] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 220
[154] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 220
[155] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 220
[156] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 117

example of an industry that has continuously performed subpar returns on invested capital is the Airline industry.[157] It's estimated that the Airline industry has destroyed economic value of about 20 billion USD a year from the period 2007-2009. Even in the best year in terms of RoIC in 2007 the industry destroyed more than 9 billion UDS of economic value.[158]

2.3 Accounting Issues

2.31 Accounting Issues Related to EBIT

When comparing financial statements, it is important to take different accounting policies into consideration. In this regard, Plenborg & Petersen's remarks about a number of issues that may cause noise in accounting numbers are relevant. These are: [159]

- Application of accounting policies
- Accounting estimates
- Classification of accounting items
- Accounting items or events which are regarded as permanent versus transitory

In regards to the operating earnings, there are a number of accounting issues investors should be aware of. EBIT, the accounting entry applied in this analysis, is derived from the revenue and contains a number of subjective estimates that can cause the reported financial data to vary greatly depending on the person preparing the financial statements.[160] The US GAAP definition of revenue recognition is a great example hereof: [161]

> *"An entity's revenue-earning activities involve delivering or producing goods, rendering services, or other activities that constitute its ongoing major or central operations and revenues are considered to have been earned when the entity has substantially accomplished what it must do to be entitled to the benefits represented by the revenues."*

In other words, in order to be recognized, revenue must be realized or realizable and it must have been earned.[162] However, this definition leaves a lot of room for subjective recognition in terms of the timing of revenues. An

[157] http://www.ft.com/intl/cms/s/0/5410a554-8bd7-11e2-b001-00144feabdc0.html?siteedition=intl
[158] http://www.ft.com/intl/cms/s/0/2e7f76aa-e361-11e0-8f47-00144feabdc0.html#axzz2f5Ng5nCd
[159] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 333
[160] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 373
[161] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 355
[162] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 355

example could be that a firm that sells computer equipment with two years of "free" support and software updates. Accordingly, it is debatable how much should be recognized as revenue each year.[163] Although these subjective estimates of revenues could lead to differences in the reported revenues of two identical firms, this is deemed a general concern caused by accounting policies.

It is highly relevant to focus on the notes of the financial statement to access to which extent the accounting entry complies with the given classification or not. However, as mentioned in the demarcation, it is outside the scope and focus of this paper to discuss whether revenue is estimated correctly as well as the extent to which the accounting entry complies with the notes. As financial statements are audited by an independent auditor, this concern is limited in this context. Furthermore, the aim of the thesis is to assess the use of the strategy as a screening tool to select stocks, and therefore accounting items should be assessed afterwards.

According to US GAAP, the cost of goods sold is the cost of the inventory items sold during the period.[164] These costs can be estimated fairly easily but there are several issues to be aware of. For instance, how the company accounts for its inventory can make a significant difference. The company can use three different methods; FIFO, LIFO or the weighted-average method,[165] and if the firm keeps inventory stock, these methods provide different costs of goods sold. Moreover, it is important to keep in mind that the choice of accounting method for inventory may have direct economic consequences due to the fact that taxable income in the US is based on accounting numbers. Therefore, if a firm uses LIFO and prices are rising, gross profit and hence earnings and taxable income would be lower than if the FIFO was used.[166] However, the accounting practice for the firms causes differences in the cost of goods sold in each year but these differences even out over time. Furthermore, the choice of accounting method results in either a fair value of the inventory but not a great indicator of the cost of goods sold or vice versa.[167] As a result, the methods to measure cost of goods sold have an ambiguous effect on RoIC and EV/EBIT as an increase in costs of goods sold would decrease EBIT and thus decrease the return on invested capital and increase EV/EBIT. However, it would also decrease inventory which would in turn decrease invested capital and thus increase RoIC and decrease EV/EBIT, ceteris paribus.

[163] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 374
[164] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 80
[165] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 315-316
[166] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 413
[167] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 413

The recognition of cost of goods sold can also have a significant impact on the stated EBIT in other ways. For instance, it is important to assess whether development cost are assets or expenses. When making this analysis, one should keep the definition of assets in mind: [168]

> *"Probable future economic benefits obtained or controlled by a particular enterprise as a result of past transaction or events (CON6).*
>
> *The following three characteristics must be present for an item to qualify as an asset:*
>
> 1. *The asset must provide probable future economic benefit that enables it to provide future net cash inflows.*
> 2. *The enterprise must be able to receive the benefit and restrict others' access to it.*
> 3. *The event that provides the enterprise with the right to receive the benefit has occurred.*

All three characteristics must be present for an item to meet the definition of an asset. Assets may have other characteristics, but those characteristics are not essential to the definition."

Based on the above, some academics argue that development costs such as R&D expenses should be capitalized as many argue they comply with three requirements above.[169] The US GAAP states that research and development costs are defined as: [170]

1. *Research is the planned search or critical investigation aimed at the discovery of new knowledge with the hope that such knowledge will be useful in developing a new product or service or a new process or technique or in bringing about a significant improvement to an existing product or process.*
2. *Development is the translation of research findings or other knowledge into a plan or design for a new product or process or for a significant improvement to an existing product or process whether intended for sale or use.*

Furthermore, the US GAAP states that the accounting treatment of R&D depends upon the nature of the cost. If the R&D costs are incurred in the ordinary course of operations and thereby consist of materials, equipment, facilities, personnel, and indirect costs that can be attributed to research and development costs, these are ex-

[168] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 44
[169] Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications, p. 19
[170] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 503

pensed in the period in which they are incurred unless they have alternative future uses.[171] Since these costs are expensed in the period they occur, an argument could be made that the operating earnings are understated. As a result of the methods to capitalize or expense R&D costs, these have an ambiguous effect on RoIC and EV/EBIT as the expense of R&D would decrease EBIT, and thus decrease the return on invested capital and increase EV/EBIT. However, it would also decrease assets which in turn would decrease invested capital, and thereby increase RoIC and decrease EV/EBIT, ceteris paribus.

When calculating Earnings Before Interest Taxes Depreciation and Amortization (EBITDA), operating expenses are subtracted from the gross margin. The operating expenses are primary recurring costs associated with central operations besides the cost of goods sold that are incurred in order to generate sales. Normally, operating expenses are reported in the following two categories:[172]

- Selling expenses
- General and administrative expenses

Selling expenses are those expenses directly related to the company's effort to generate sales, such as sales salaries, commissions, and advertising and delivery expenses. General and administrative expenses are expenses related to the general administration of the company's operations, e.g. management and office salaries, office supplies, telephone, postage, accounting and legal services. In regard to these expenses, it could be argued that if the expenses are related to a marketing campaign launched by a firm, these should be capitalized if the campaign is likely to increase future sales. However, in accordance with the above definition of assets, these expenses cannot be capitalized due to the uncertainty associated with the future economic benefits. At least to some extent the same argument can be made for human capital.[173] Furthermore, investors also must be aware of the effects of leases, and it is important to distinguish between operating and capital leases. This issue is described in greater depth in the section 2.32 Accounting Issues Related to Invested Capital.

When calculating EBIT, depreciation and amortization are subtracted from EBITDA. The US GAAP defines amortization as: [174]

"Amortization. The periodic charge to income that results from a systematic and rational allocation of cost over the life of an intangible asset. Analogous to depreciation of tangible assets"

[171] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 503
[172] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 68-72
[173] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 378
[174] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 434

In other words, amortization is the resource usage of intangible assets. These intangible assets include goodwill, patents, copyright, etc.[175] Goodwill is the excess of the cost of the acquired interest in an investee over the sum of the amounts assigned to the investee's identifiable net assets.[176] As such, there is a clear difference between companies that grow organically and companies that grow through mergers and acquisitions.[177] Under the US GAAP, companies must write-off goodwill only when it is impaired according to business valuations produced by independent auditors.[178] In regard to the operating earnings, the amortization should respond to the actual resource usage of the intangible assets. The extent to which this actually is the case is quite difficult to estimate. In section 2.32 Accounting Issues Related to Invested Capital, a further review of the aspect of goodwill will be presented.

Like amortization, depreciation is also subtracted to get to EBIT, and can thus have an important impact on RoIC and EV/EBIT. According to the US GAAP, depreciation is defined as: [179]

"Depreciation. The periodic charge to income that results from a systematic and rational allocation of cost over the life of a tangible asset. Analogous to amortization of intangible assets. Depreciation is only a method of cost allocation, not a means of determining or presenting current valuation of assets. "

It is relevant to focus on the fact that the depreciation depends on estimates made by management of the future resource usage of the fixed assets. Thus, it is not entirely certain that the depreciation in a given year corresponds exactly to the actual usage of these assets during the given year as management has an incentive to depreciate assets as fast as possible due to tax effects and the time value of money.

There are several accounting items that must be analyzed when calculating the operating earnings. These are the following in particular:[180]

- Special items (other income or expenses)
- Related income and expenses from associates
- Exchange rate differences

[175] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 435
[176] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 511
[177] Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications, p. 40-45
[178] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 355
[179] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 435
[180] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75

The special items accounting entry, which also includes other income and expenses, includes activities that are indirectly part of a firm's core business. Plenborg & Petersen state that the special items typically contain a number of different sources of income and expenses, such as gain and losses from sales of non-current assets, royalty/license income, restructuring costs, and rent income and expenses from property (lease income and expenses).[181] As a result, investors must be aware that these sources of income and expenses can be part of the operating activities. From an analytical point of view, special items raise two fundamental issues. First, it must be decided whether an item should be categorized as part of operations or finance. In most cases, it is considered appropriate to categorize special items under operations. Secondly, the analyst must decide whether the accounting item is unusual or if it is part of the firm's normal operations.[182] This task can be rather challenging. For instance, in many cases, it could be argued that disposal of assets is part of the normal business of the company. However, one could also make the argument that it is a truly unusual event.[183] Accordingly, there is a great deal of subjectivity related to the classification of the special items as whether it is an operating activity or not. Although this is the case, this thesis concurs with Plenborg & Petersen's statement that it is hard to imagine that a firm would not have to adjust its organization to changing market conditions, which explains why restructuring costs must be expected to recur rather frequently.[184]

It is essential to estimate whether income and expenses from associates are regarded as part of the firm's core business.[185] (See 2.32 Accounting Issues Related to Invested Capital for further elaboration). In general, the distinction lies in the extent to which the income and investments are part of the firm's core business or not.

Another grey area that could potentially make a difference in earnings is changes in currency. In general, exchange differences are considered to be a part of the financial income and expenses. Petersen & Plenborg argue that one could separate these into an operating and a financial component, respectively.[186] However, it is difficult to make this distinction. Furthermore, whether a firm hedges its currency risk to a large degree depends upon its financial policies, and therefore Plenborg &Petersen believe that it is fair to classify these as financial items which are not included in EBIT, and would thus have an effect on both RoIC and the EV/EBIT multiple.[187]

[181] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75
[182] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75-76
[183] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 76
[184] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 76
[185] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 76
[186] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 77-78
[187] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 77-78

2.32 Accounting Issues Related to Invested Capital

Accounting classifications can have a major impact on the invested capital. For instance, the extent to which R&D expenses are capitalized significantly affects EBIT and invested capital. The effect of capitalized R&D expenses on RoIC can be summarized as follows: [188]

$$If\ \frac{EBIT(1-t)_{Pre\ R\&D\ adj}}{Invested\ capital_{Pre\ R\&D\ adj}} > \frac{R\&D_{current} - R\&D\ amortization}{Value\ of\ Research\ Asset} : RoIC\ will\ decrease$$

$$If\ \frac{EBIT(1-t)_{Pre\ R\&D\ adj}}{Invested\ capital_{Pre\ R\&D\ adj}} < \frac{R\&D_{current} - R\&D\ amortization}{Value\ of\ Research\ Asset} : RoIC\ will\ increase$$

As the invested capital relies on accounting numbers, there are several accounting issues investors must carefully analyze when determining the invested capital. Deferred tax liability is an accounting issue that can affect the stated invested capital. Deferred tax liabilities arise due to differences between tax according to accounting statements and actual tax paid.[189] Plenborg &Petersen argue that as deferred taxes are paid at a future date, in the event that a firm makes new investments, it would be obvious to discount them at present value.[190] Deferred taxes can be viewed as equity equivalents as they arise due to non-cash adjustments to retained earnings as well as the fact that equity equivalents are similar to debt equivalents.[191] As a result, it is generally accepted to include deferred tax liabilities and accrued income tax in invested capital.

Besides the pitfalls discussed above, it is important to investigate additional accounting items in greater detail. In regard to the operating working capital, this equals operating current assets minus operating current liabilities. When determining the operating current assets, any amount of cash that is greater than the operating needs of the business should be excluded.[192] Just as in the case with NOPAT, it is important to include current assets and liabilities that are part of the operations. In the case of operating working capital, these include accounts payable, accrued salaries, deferred revenue, and income taxes payable.[193] However, the extent to which accounting items should be included or excluded in invested capital varies from company to company.

[188] Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications, p. 22
[189] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 431
[190] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75
[191] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 146
[192] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 137
[193] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 137-140

Moreover, it is considered vital to observe the choice of accounting practices in regard to inventory. As mentioned earlier, the US GAAP allows companies to use FIFO, LIFO, or weighted-average.[194] Furthermore, the US GAAP require inventory to be written down to net realizable value.[195] However, this will not be taken into account in the analysis. The selection of accounting practices will be elaborated in section 2.33 Accounting Issues Related to Enterprise Value.

As mentioned above, it is important to keep in mind that the depreciation of tangible and intangible assets is based on subjective estimates. Firms may use the straight-line method, the diminishing balanced method, the units of production method, or similar methods that most accurately reflect the expected pattern of consumption of the future economic benefits embodied in the asset.[196] This causes differences to occur when determining the invested capital for various businesses due to different subjective estimates made by the respective management.

With the above-mentioned problems in mind, Damodaran's statement below sums up the problem of depreciations and book values in general: [197]

"The book value of capital might not be a good measure of the capital invested in existing investments, since it reflects the historical cost of these assets and accounting decisions on depreciation. When the book value understates the capital invested, the return on capital will be overstated; then book value overstates the capital invested, the return on capital will be understated. This problem is exacerbated if the book value of capital is not adjusted to reflect the value of the research asset."

Accordingly, investors must continuously consider the "old plant trap". Firms with old plants, property, and equipment that have been almost entirely depreciated will have low carrying values and relatively high rates of RoIC. When these assets are replaced by new ones, the book values are increased substantially which causes the rates of return to decrease.[198]

In regards to goodwill and acquired intangibles, there are arguments for including these in invested capital as well as excluding these accounting items. RoIC with goodwill and acquired intangibles measures a company's ability to create value after paying acquisition premiums, and RoIC without goodwill and acquired intangibles measures the competitiveness of the underlying business.[199] Furthermore, in order to evaluate goodwill and ac-

[194] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 315-316
[195] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 413
[196] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 413-414
[197] Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset, p. 291
[198] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 418-419
[199] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 140

quired intangibles properly, two adjustments must be made because unlike other fixed assets, goodwill and acquired intangibles do not wear out nor are they replaceable. Thus, reported goodwill and acquired intangibles should be adjusted upward to recapture historical amortization and impairment.[200]

The US GAAP changed accounting standards in 2001. The changes resulted in that acquisitions must recorded on the balance sheet using the purchase methodology regardless if they are paid for in cash or in stock. In general, the intangible assets are accounted for by using the cost method/purchase method (intangible assets measured at cost or less any accumulated amortization and any accumulated impairment losses) but the revaluation model is also applicable to intangible assets if their fair value can be determined by reference to an active market.[201] Furthermore, if the book value is lower than the discounted cash flows, no impairment loss is recognized.[202] This is deemed highly relevant to relate to Damodaran's findings of the effect of goodwill on RoIC. Primary Exhibits "2.32 Accounting Issues Related to Invested Capital" 1 illustrates the effect of goodwill on RoIC. The impact is significant, however, since EBIT was used, the impact is not always the same as the exhibit illustrates due to the impact of tax. Moreover, goodwill is not amortized. Instead, the company periodically tests the level of goodwill to determine whether the acquired business has lost value. If this is the case, the goodwill is impaired (written down).[203] In contrast to this procedure, intangible assets, which differ from goodwill in that they are separable and identifiable, are amortized over the perceived life of the asset.[204] Investors should keep this in mind when calculating the NOPAT in order to be consistent. Consequently, McKinsey states that amortization and impairment will not be deducted from revenues to determine NOPAT.[205] In addition, calculation of cumulative amortization and impairment will not always match cumulative amortization reported in the company's financial statements as the reported cumulative amortization does not include impairments.[206] McKinsey states that any unrecorded goodwill due to the old pooling of interest/merger accounting should be added to the recorded goodwill.[207]

In addition to these issues, accounting problems can occur when dealing with leases. There are two vastly distinct methods to determine leases. A lease can be classified as an operating lease, and such lease obligations are

[200] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 140
[201] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 414
[202] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 419
[203] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 665
[204] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 435
[205] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 141
[206] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 141
[207] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 141

not recognized in the balance sheet (nor are lease assets) but the contract is disclosed as a contingent liability. In the case of operating leases, the yearly lease payment is recognized as an expense in measuring EBIT. The alternative to operating leases is a capital lease in which the lease is recognized as a lease asset with an offsetting lease liability.[208] Here, the lease payments are capitalized. According to the US GAAP, the lease assets should be recognized as the present value of the future lease payments set forth in the lease contact. The effect of capital leases on the income is twofold: a decrease in the depreciation expense as well as an increase in financial expense. Although the total effect on earnings before taxes over time of recognizing leases as capital as opposed to operating is 0, the effect on EBITDA, EBIT, net financial expenses, and earnings before taxes within each financial year varies between the two different ways leases can be accounted for, which may influence management to classify the lease as either operating or capital.[209] Ernst & Young adds that according to the US GAAP, if the present value of the minimum lease payment exceeds 90% of the asset's fair value, it is defined as a capital lease.[210] Furthermore, in regard to the treatment of capital leases, it is highly relevant to review Damodaran's findings in Primary Exhibits "2.32 Accounting Issues Related to Invested Capital" 2 which illustrates the effect reclassification of leases has on RoIC. Just as was the case with R&D expenses, the analysis disregards this issue, and investors are therefore encouraged to be aware of this fact in regard to the findings. Although Bloomberg does not adjust for the differences in leases, the implied complications hereof and the above discussions should be kept in mind.

Investors need also be aware of retirement benefits. If a company runs a defined-benefit pension plan for its employees, it must fund the plan each year. The US GAAP states that the company can recognize a portion of the excess assets on the balance sheet.[211] An actuarial calculation is made of the present value of future benefits under such plan. If the actuarial present value is different from fair value of any plan assets it must be recognized on the balance sheet. If the defined benefit plan is underfunded, the underfunded part must be recognized as a liability.[212] Petersen &Plenborg argue that due to the fact that recognized retirement benefits are interest bearing (discounted to present value), it seems reasonable to treat the plan as a financing activity, i.e. as interest-bearing debt.[213] McKinsey agrees and further state that pension assets are considered a non-operating asset, and thereby not part of the invested capital.[214]

[208] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 421
[209] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 421-424
[210] Ernst & Young, US GAAP versus IFRS The Basics, p. 30
[211] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 144
[212] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p.78
[213] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p.78-79
[214] Tim Koller, Marc Goedhart & David Wessels, Valuation Measuring & Managing the Value of Companies, p. 144

Besides the above-mentioned pitfalls, it is important to mention the aspect of liabilities with great uncertainty. Petersen & Plenborg state that there are three separate categories of liabilities: liabilities, provision, and contingent liabilities.[215] A liability is a present obligation of an entity arising from past event, the settlement of which is expected to result in an outflow from the entity of resources embodying economic benefits. Provisions are liabilities of uncertain timing or amount. Contingent liabilities are defined as obligations that arise from past events and whose existence will be confirmed by an occurrence or non-occurrence of one or more future events, not entirely within the control of the entity.[216] As it appears from the above-mentioned definitions, there is a great deal of subjectivity in terms of defining a liability as either a liability, provision, or contingent liability. By extension, it is relevant to focus on liabilities and assets that are kept of balance. A great example of this is Enron. Enron was able to borrow $ 658 million by setting up special-purpose entities, which raised cash by a mixture of debt and equity, and then used these debts to help fund the parent company. None of this debt showed up on Enron's balance sheet.[217]

Due to the mentioned flaws concerning accounting numbers, investors should keep in mind that in order for RoIC to be an unbiased estimate of the underlying performance it should be a fair proxy of the internal rate of return.[218] For mature firms, the relation between RoIC and IRR depends upon the depreciation policy:[219]

- Unbiased depreciation policies: RoIC is a fair proxy for IRR
- Conservative accounting policies: RoIC overstates IRR
- Aggressive accounting policies: RoIC understates IRR

In the analysis, the Trailing 12-month operating income (EBIT) is applied, calculated by adding operating income for the most recent four quarters. The invested capital is calculated as an average of beginning and ending invested capital. As Damodaran mentions, this is advantageous due to the fact that EBIT is the sum of the last 4 quarters. Therefore, it is considered more sensible to follow an average for the invested capital.[220] Although this

[215] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 425
[216] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 435
[217] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 381
[218] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 414
[219] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 418
[220] Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications, p. 7

is true, it is acknowledged that arguments can be made for the use of beginning invested capital and ending year EBIT.[221]

Bloomberg includes Minority Interest in the Total Shareholders' Equity which is in line with general ia.[222] Furthermore, academics agree with Bloomberg in the fact that the total debt should be included in the invested capital as it is a reasonable assumption that the debt is used to fund the operations.[223]

2.33 Accounting Issues Related to Enterprise Value

In regard to the enterprise value, there are, as mentioned earlier, three different ways this can be calculated. Either way, the market value of the assets or the liabilities must be calculated. The US GAAP defines the book value as: *"The cost of a long-lived asset less the related accumulated depreciation or amortization to the date of measurement",*[224] and with this definition of book value in mind, differences between the market value and the book value of assets arises. In addition, it is deemed highly relevant to refer to Ernst & Young's statement that for long-lived assets, revaluation of assets is not permitted under the US GAAP.[225] This is also the case for intangible assets,[226] and additionally, the US GAAP does not allow for reversals of previously recorded impairment tests.[227] This clearly makes it more difficult to estimate the market value of assets, and therefore the focus herein remains on the market value of liabilities. The fair value of liabilities, such as notes and accounts payable, long-term debt, warranties, and claims payable, is estimated by calculating the present value of amounts to be paid determined at appropriate current interest rates.[228] Due to the fact that the maturity of the debt as well as the market rate (interest rate) can be determined, it is fairly easy to calculate the market value of the liabilities.[229] As such, the enterprise value is the sum of the market value of the debt and the equity, and in addition, the market value of the equity can easily be estimated by multiplying the stock price per share with the total number of outstanding shares.[230]

---

[221] Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications, p. 11
[222] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p.78
[223] Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis, p. 75
[224] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 435
[225] Ernst & Young, US GAAP versus IFRS The Basics, p. 15
[226] Ernst & Young, US GAAP versus IFRS The Basics, p. 17
[227] Peter Harris & Liz Washington Arnold, US GAAP Conversion To IFRS: A Case Study Of The Balance Sheet , p. 136
[228] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 647
[229] Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles, p. 735
[230] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 525

2.4 Risk

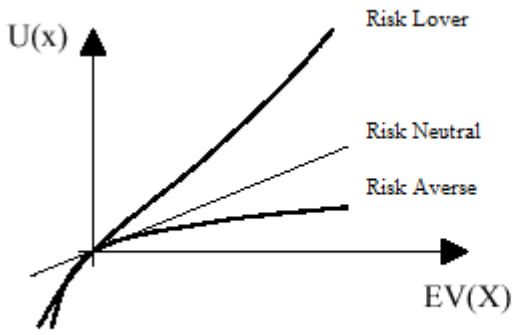
When investing in risky assets investors have to compare the risks of the investment with the potential gains. To access the risk of the investment we describe investor's preferences towards risks. Based on this insight we will review how risk can be measured. This section will furthermore have focus on the downside risk. The emphasis on this measure has especially gained popularity in the aftermath of the financial crisis.[231]

In general, investors can have three different preferences in regards to risk. They can either be:

- Risk averse
- Risk neutral
- Risk lover

To be risk averse means that an investor will likely reject investment portfolios that are fair games or worse, and therefore has a declining utility function.[232] If an investor is risk neutral, he judges risky prospects solely by their expected rates of return.[233] A risk lover is happy to engage in fair games and gambles, and adjusts the expected return upward to take into account the "fun" of confronting the prospect's risk.[234] Daniel Kahneman and Amos Tversky, who devised the prospect theory, have found most investors to be risk averse.[235] Primary Exhibit "2.4 Risk" 1 illustrates the preferences of a risk averse investor.

Casual observation and formal research both suggest that investment risk is as important to investors as expected returns.[236] In this thesis, Frank Knight's definition of risk is applied as something that can be measured by mathematical probabilities, whereas uncertainty is something that cannot be measured because there are no objective standards to express its probability.[237] Although the importance of risk cannot be emphasized enough, academia retains varying opinions in regard to the measurement of this



Graph 2.4 Soruce: http://www.palisade.com/articles/motta_preftheory.asp

[231] Jerry A. Collins, Integrated Tail Risk Hedging: The Last Line of Defense in Investment Risk Management, p. 45
[232] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 162
[233] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 164
[234] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 164
[235] Daniel Kahneman &Amos Tversky, Prospect Theory: An Analysis of Decision under Risk, p. 18
[236] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 117
[237] George A. Akerlof & Robert J. Shiller, Animal Spirits, p. 144

important aspect of investments.

As a result, the analysis of risk will include the traditional mean-variance risk measures as well as the post-modern portfolio theory, which has an extended focus on the downside risk. In the analysis, the portfolios are re-balanced. Here, it is important to remember that portfolio rebalancing is mainly a tool to ensure that an investor's expected returns are maximized and remain positive over time.[238]

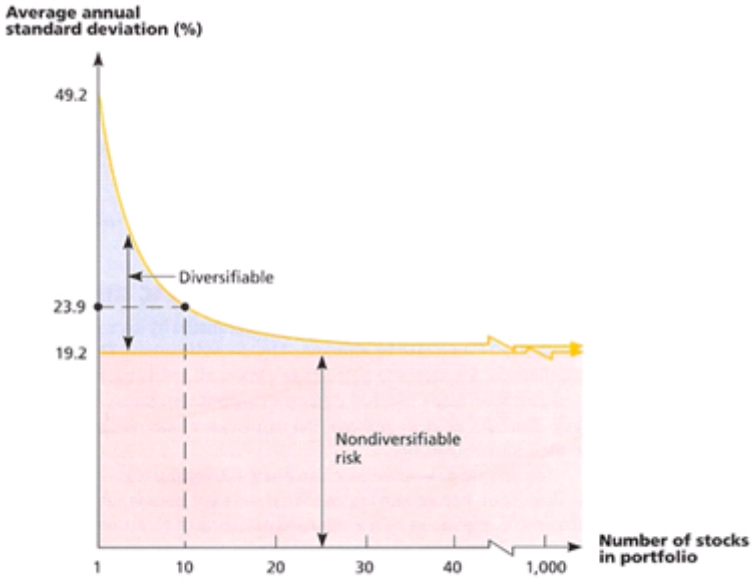


Figure 2.4 Brealey, Meyers & Allen, Principles of Corporate Finance, p. 168

Academic research indicates that when investors think about risk they are interested in the likelihood of deviations from the expected return.[239] As the expectations cannot usually be observed directly, the variance is estimated by averaging squared deviations from the estimate of the expected return (the arithmetic average $\bar{r}$) as this equation illustrates:[240]

$$\sigma^2 = \sum p(s) * [r(s) - E(r)]^2$$

Where:

- p(s) is the probability of s
- r(s) the return of s
- E(r) the expected return

The risk of a stock portfolio depends on the proportions of the individual stocks, their variances, and their covariance. As long as the correlation between the stocks is less than 1 and larger than -1, diversification decreases the volatility of the portfolio.[241]

[238] Marcus Davidsson, Expected Return & Portfolio Rebalancing, p. 17
[239] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 132
[240] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 132
[241] Meir Stratman, How Many Stocks Make a Diversified Portfolio?, p. 362

Figure 2.4 illustrates the standard deviation of a portfolio, is decreased by adding additional securities. As the figure illustrates, the effect quickly decreases, and after 15 securities, the gain in reduced volatility is almost non-existent.

The risk can advantageously be divided into market risk, systematic risk or non-diversifiable risk and unique risk, firm-specific risk, non-systematic risk or diversifiable risk.[242] In regard to the effect of diversification, it is important to realize that this effect is only related to the non-systematic risk, and as figure 2.4 illustrates, the market risk is not affected by the power of diversification. [243]

There are two crucial points regarding security risk and portfolio risk:

- Market risk accounts for most of the risk of a well-diversified portfolio
- The beta of an individual security measures its sensitivity to market movements

If return expectations implicit in asset prices are rational, actual rates realized should be normally distributed around those expectations.[244] This normality of excess returns hugely simplifies portfolio selection due to the fact that the normality assures that standard deviation is a complete measure of risk and thereby the measurement of portfolio performance.

With the thoughts of beta and security market line in mind, the following measures can be used to measure the risk of a portfolio: [245]

- Sharpe measure
- Jensen's measure

The Jensen's Alpha is calculated as ($\propto_p = \bar{r}_p - [\bar{r_f} + \beta_p(\bar{r}_M - \bar{r}_f)]$) and measures the portfolio's alpha value, which constitutes the average return on the portfolio over and above that predicted by the CAPM, given the portfolio's beta and average market risk. The measure has been subject to some criticism. First of all, research shows that low beta stocks provide better returns than they are supposed to according to theory, while high beta stocks perform worse than theory suggests.[246] Therefore, the validity of beta as a risk measure is debatable. Furthermore, the market portfolio is not observable, and as a result, proxies are used, such as the S&P 500 index.[247] This

[242] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 197
[243] Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance, p. 174
[244] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 134
[245] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 134
[246] Michael Finke, Seeking high performance with low risk, p. 43
[247] Véronique Le Sourd, Performance Measurement for Traditional Investment, p. 13

is clearly not the market portfolio as it e.g. contains an overwhelming amount of large cap companies. In addition, it is not possible to account for varying betas, and the model is not applicable for higher movements of returns minus the risk-free rate.[248]

As the CAPM model indicates, investors are presumably interested in the expected excess return they can earn over the risk-free rate. Investors thus price assets so the risk premium is proportionate to the risk of the expected excess return. Hence, it is considered optimal to measure risk by the standard deviation of returns and not realized returns. As a result, the reward-to-volatility measure (Sharpe ratio) is widely used to evaluate the performance of investments. The Sharpe ratio is calculated as follows:[249]

$$\text{Sharpe ratio} = \frac{\text{Risk premium}}{\text{Standard deviation of return}}$$

Based on the Sharpe ratio, it is considered relevant to refer to the capital allocation line (CAL) that starts at the risk-free rate and is a linear curve with standard deviation as the horizontal axis. The Sharpe ratio is the slope of the best possible capital allocation line that constitutes a combination of a risk-free asset and the market portfolio, illustrated in Primary Exhibits ”2.4 Risk” 2.[250] With mean-variance preferences, an investor will want to maximize the Sharpe measure.[251] The Sharpe ratio is an expansion of the Treynor ratio[252] which measures the excess return of systematic risk in units. However, as the analysis does not create portfolios that are fully diversified, it is not deemed appropriate to exclude the specific risk, and therefore the Treynor measure has not been applied to adjust for risk.[253] Scholars generally agree that the Sharpe ratio is an adequate performance measure if the returns of the funds are normally distributed and the investor wishes to place all his risky assets in just one fund.[254] However, the Sharpe ratio has been criticized by several within academia, including William Sharpe himself. Among other arguments, it has been shown that the Sharpe ratio is valid in a static setting but not to the same extent in multi-period settings. This is based on research which has provided evidence suggesting that trading strategies that lead to the most desirable portfolio for each quarter and for four consecutive quarters are not the same as the strategies that offer the highest Sharpe ratio for a year.[255] In addition, the Sharpe ratio is criti-

[248] Roy D. Henriksson & Robert C. Merton, On Market Timing & Investment Performance. II. Statistical Procedures for Evaluating Forecasting Skills*, p.514-517
[249] http://www.stanford.edu/~wfsharpe/art/sr/sr.htm
[250] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 206
[251] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 824
[252] William Sharpe, Mutual Fund Performance, p. 119
[253] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 4
[254] Martin Eling & Frank Schumacher, Does the choice of performance measure influence the evaluation of hedge funds?, p. 2633
[255] Jaksa Cvitanic, Ali Lazrak & Tan Wang, Implications of the Sharpe Ratio as a Performance Measure in Multi-Period Settings, p. 21

cized for the fact that the measure does not take the estimation risk in regard to the standard deviation into account.[256] Additionally, the Sharpe ratio assumes that the returns are normally distributed.[257] The perception of real life, to follow a Gaussian i.e. normal distribution,[258] is criticized as it perceives black swans as outliers that are extremely unlikely to occur, which reality does not validate the same extent.[259]

Others have criticized the Sharpe ratio as it is not easy to interpret. As a result, the alternative approach by Leah Modigliani and Franco Modigliani M^2 (for Modigliani-squared) has gained popularity. Like the Sharpe ratio, the M^2 measure focuses on total volatility as a measure of risk, but its risk-adjusted measure of performance has the easy interpretation of a differential return, relative to the benchmark index. To compute the $M^{2,}$ the portfolio is adjusted to match the volatility of a market index, such as the S&P 500. For instance, if the portfolio has 1.5 times the standard deviation of the index, the adjusted portfolio would be 2/3 invested in the portfolio and one-third invested in T-bills.[260] Therefore, the Modigliani-squared measure is very useful for comparing portfolios with differentiated levels of risk.[261] The Modigliani-squared measure is calculated as follows: [262]

$$M^2 = r_{p*} - r_M$$

It should be noted that the M^2 for portfolio can be negative for two reasons. One is if the return of the portfolio is lower than that of the market. The other is if the portfolio standard deviation that exceeds the markets or a combination of the two. If this is the case investors are better of investing in the market according to the ratio.

The main critique of the Modigliani-squared ratio primarily refers to the fact that it is based on the same assumptions as the Sharpe ratio, i.e. the returns being normally distributed which has been proved to be an unrealistic assumption as many observers believe that deviations from the normality of assets returns are too significant to ignore.[263] With this in mind, it is considered relevant to expand the risk measures beyond the above-mentioned. In this respect, Balzer states: [264]

"It is clear that investors are primarily concerned with downside risk relative to one or more proxies for their liabilities and objectives, i.e. relative to their personally relevant risk benchmarks. Hence we should concentrate

[256] Véronique Le Sourd, Performance Measurement for Traditional Investment, p. 27
[257] Véronique Le Sourd, Performance Measurement for Traditional Investment, p. 27
[258] Nassim Nicholas Taleb, The Black Swan, p. 251
[259] Nassim Nicholas Taleb, The Black Swan, p. 372
[260] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 823
[261] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 3
[262] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 823
[263] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 134
[264] Frank Sortino & Stephen Satchell, Managing Downside Risk in Financial Markets, p. 129

on moments related to the downside tails of the return distributions relative to potentially random, rather than simply static, benchmarks."

The use of standard deviation as a measure of risk when the return distribution is abnormal presents three general problems: [265]

- The asymmetry of the distribution suggests a separate examination of negative outcomes
- Because the alternative to a risky portfolio is a risk-free investment vehicle, deviations of returns should be assessed from the risk-free rate rather than from the sample average
- Fat tails should be accounted for

A measure that takes the two first issues into account is the lower partial standard deviation (LPSD). Lower partial standard deviation is computed by the same technique as the usual standard deviation but only uses "bad" returns; that is, returns that are lower than the acceptable level of return. It uses only negative deviations from the risk-free rate (rather than negative deviations from the sample average), squares those deviations to obtain an analog to variance, and subsequently includes the square root to obtain a "left-tail standard deviation". The LPSD is the square root of the average squared deviation, subject to a negative excess return[266] or underperformance below a minimum target rate.[267] This is also known as semi-variance[268] and is a cornerstone of Post-modern Portfolio Theory which recognizes that investors prefer upside risk rather than downside risk and utilize semi-standard deviation (the square root of semi-variance).[269] Additionally, the perception of risk to be measured by volatility relative to returns is criticized by practitioners as it does not focus solely on the risk of permanent capital losses.[270]

To assess the asymmetry, the measure skew uses the ratio of the average cubed deviations from the average (called the third moment) to the cubed standard deviation to measure any asymmetry or "skewness" of a distribution. When the distribution is positively skewed, the standard deviation overstates risk due to extreme positive deviations from expectations, yet increases the estimate of volatility, and vice versa if the distribution is negatively skewed as the figure illustrates.[271]

[265] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 139
[266] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 139
[267] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 6
[268] W. V. Harlow, Asset Allocation in a Downside-Risk Framework, p. 29
[269] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 6
[270] Howard Marks, The Most Important Thing, p. 47
[271] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 137

Another measure of great importance when analyzing risk is kurtosis. Kurtosis is a measure of the degree of fat tails which are probability distributions that figure 2.41 illustrate large skewness. The deviations from the average raised to the fourth power are used and standardized by dividing by the fourth power of the standard deviation. The kurtosis of a normal distribution is three, and if the kurtosis is greater than three, this indicates a peaked distribution with fat tails. A kurtosis less than three indicates a less peaked distribution with thin tails, illustrated in figure 2.41.[272]

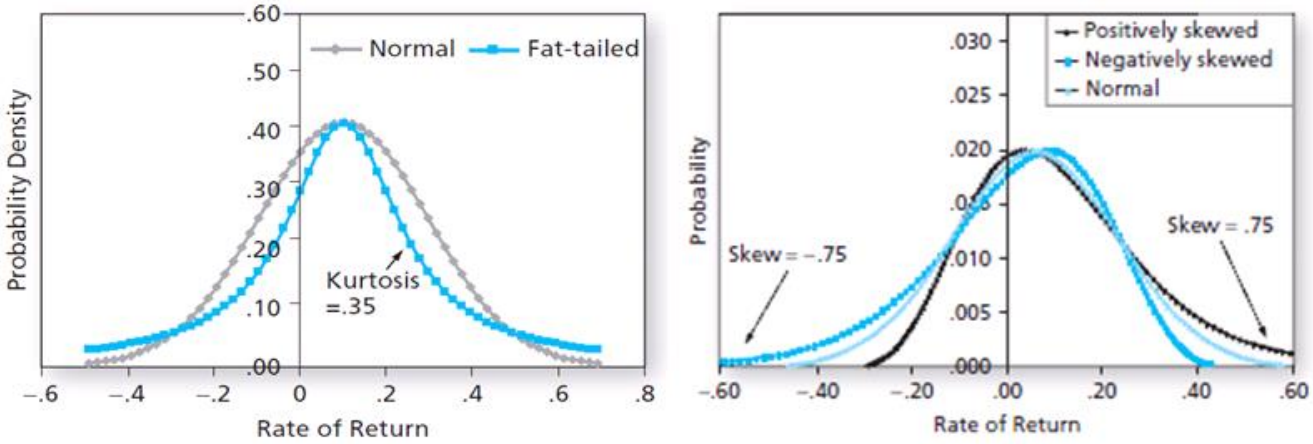


Figure 2.41 Source: Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 137

Because kurtosis and skewness are important to downside risk, the Adjusted Sharpe Ratio can be used. The Adjusted Sharpe Ratio explicitly adjusts for skewness and kurtosis by incorporating a penalty factor for negative skewness and excess kurtosis.[273] It can be calculated as follows: [274]

$$\text{Adjusted Sharpe Ratio} = \text{Sharpe Ratio} * \left[1 + \frac{\text{Skewness}}{6} * \text{Sharpe Ratio} - \left(\frac{\text{Kurtosis}-3}{24}\right) * \text{Sharpe Ratio}^2\right]$$

Considering this, the Omega function can be used as a natural performance measure. The Omega function captures all of the higher moment information in the returns distribution, and also incorporates sensitivity to return levels.[275] The Omega ratio implicitly adjusts for both skewness and kurtosis in the return distribution, and it can

[272] Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management, p. 137
[273] Jacques Pézier & Anthony White, The Relative Merits of Investable Hedge Fund Indices & of Funds of Hedge Funds in Optimal Passive Portfolios, p. 15
[274] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 6
[275] Con Keating & William F. Shadwick, A Universal Performance Measure, p. 1

be used as a ranking statistic, the higher the better.[276] Furthermore, the fact that the ratio takes the upside and downside potential into account is of great importance to investors. [277]

$$\text{Omega Ratio } \Omega = \frac{\frac{1}{n} * \sum_{i=1}^{i=n} \max(r_i - r_T, 0)}{\frac{1}{n} * \sum \min(r_i - r_T, 0)} = \frac{\text{Upside Potential}}{\text{Downside Potential}}$$

However, the Omega ratio has also been the subject of some criticism as the ratio can drive portfolios towards investments with more highly leveraged capital structures even when those choices involve significant downsides.[278] This is not the case in this thesis as leverage is not applied as an investment tool. However, the criticism of downside risk is explained in greater detail in the subsequent section.

In the wake of the financial crisis, there has been a lot of attention on what the maximum amount of money investors can lose on their investment. Therefore, the maximum draw-down (MDD) has gained popularity. [279] The maximum draw-down is defined as the maximum sustained percentage decline which has occurred in the stock within a period. One performance measure that uses the MDD is the Calmar ratio. The Calmar ratio is a Sharpe type measure that uses maximum drawdown rather than standard deviation to reflect the investor's risk.[280] Primary Exhibits "2.4 Risk" 4 illustrates the maximum drawdown, and the Calmar ratio is calculated as follows: [281]

$$\text{Calmar ratio} = \frac{r_p - r_f}{\text{MDD}}$$

The technique behind the Calmar ratio is similar to the Sharpe ratio, the primary difference being that the Calmar ratio uses maximum drawdown as a measure of risk instead of the standard deviation. The emphasis on draw-down is in line with the prospect theory mentioned earlier as investors are more affected by losses than they are of gains. However, due to the focus on downside risk, the measure regards rapid increasing stocks as risk-free despite the fact that the increase might cause a subsequent decline. This has been criticized as it e.g. Internet stocks would appear to have almost no risk during the late 1990's due to their stellar performance.

In the analysis of the performance of the decentiles during different periods of time, the VIX index is used to measure the volatility of the US stock market.[282] The VIX index is illustrated in Primary Exhibits "2.4 Risk" 4.

[276] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 7
[277] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 7
[278] Robert J. Frey, On the Ω-Ratio, p. 17
[279] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 11
[280] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 11
[281] Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures, p. 11
[282] CBOE, The CBOE VOLATILITY INDEX – VIX, p. 1

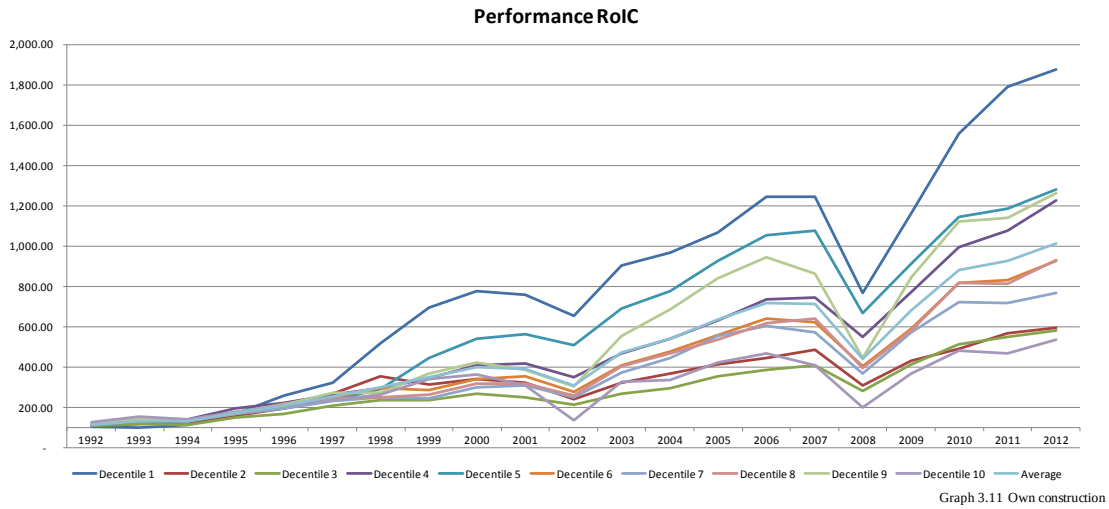
3. Analysis

3.1 Analysis of Return on Invested Capital

Based on our theoretical discussion, RoIC is deemed most effective and relevant to apply as the preferred return measure as it is considered the best indicator of true return of investments, and thereby the best proxy for competitive advantages and the quality of a company. These benefits are believed to outweigh the accounting issues related to the use of RoIC. All companies in the S&P 500 index have been ranked according to trailing operating return on invested capital, and with the theory of RoIC in mind, the larger the value the better. However, as mentioned in the demarcation, the financial and utility sectors have been excluded. The companies with the 10% largest RoIC values are included in decentile 1, the companies with RoIC values in the interval between top 10% and top 20% are in decentile 2 etc. The ranking is made ultimo January, and each portfolio is held for one year and subsequently rebalanced.

3.11 Returns

Throughout the research process, an examination of how companies with higher returns on invested capital perform compared to companies with lower returns on invested capital has been conducted. As described in the theory above,[283] the idea is that companies with higher returns on their invested capital must have some sort of competitive advantage in order to reach superior returns. Furthermore, companies with higher RoIC values should, ceteris paribus, tend to perform better as they are assumed to create economic value. For the same reasons, the lowest decentiles should underperform as their returns on invested capital most likely will not surpass their cost of capital. Hence, the companies are in effect destroying economic value.



Graph 3.11 Own construction

[283] 2.2 Return on Invested Capital

The results of the research process have indicated that this does to some extent seem to be the case. If an investor would have invested in the companies with the ten percent highest RoIC values and rebalanced every year, the investor would have received an annualized return of 15.8% in the period 1992-2012. This is the highest return of the ten constructed portfolios, and can be compared to an average of 12.3%. The companies with the ten percent lowest returns on invested capital had the lowest rate of return of all the constructed portfolios with an annualized return of 8.8% per year. This is 3.5 percentage points lower than the average annualized return. The difference between investing in the companies with the highest and lowest RoIC is thus colossal. If an investor had invested $ 100 in decentile 1, he would have ended up with $ 1,875.14. Had the same investor invested $ 100 in decentile 10, he would have a meager $ 535.41 in 2012, and had he invested in the market portfolio, he would have ended up with $ 1,012.65.

	Annualized Return	Rank
Decentile 1	15.8%	1
Decentile 2	9.3%	8
Decentile 3	9.2%	9
Decentile 4	13.3%	4
Decentile 5	13.6%	2
Decentile 6	11.8%	6
Decentile 7	10.7%	7
Decentile 8	11.8%	5
Decentile 9	13.5%	3
Decentile 10	8.8%	10
Average	12.3%	

Figure 3.11 Own construction

What is particularly interesting is that decentile 1 outperforms all other decentiles by a margin, and the results indicate that RoIC can be a measure of the quality of companies and the creation of economic value. However, this result only seems to be applicable for the ten percent best and worst, respectively, as the results are mixed for the portfolios in between. For example, decentiles 2 and 3 would have been the third and second worst portfolios to invest in, while decentile 9 would have been the third best. There could be many explanatory factors behind the result, one being that even though RoIC is an indicator of the quality of the company, the price could still be unfavorable. Therefore, it is deemed relevant to further investigate this in the analysis pertaining to the combined ranking of EV/EBIT and RoIC.

Considering the differences in return, it is interesting to observe over what periods the different decentiles outperform. As the results were, at best, mixed for decentiles 2-9, it is most interesting to observe how decentile 1 and 10 performed in different times. Figure 3.111 illustrates the outperformance of decentiles 1 and 10. In particular, decentile 1 outperformed the market in the period 1994-1999 with an annualized return of 34.3% compared to the market average of 17.4%. In the same period, decentile 10 underperformed with an annualized return of 13.22%. There could be several reasons for this; the most obvious being the booming Internet stocks. This, however, ended in the early 2000s, and thus it is interesting to see how that affected the two portfolios. Decentile 1 had an annualized increase of 1.78% between 2000 and 2002, while decentile 10 performed poorly with an annualized decrease of 2.13% compared to the market increase of 2.43%. While decentile 10 underperformed the average market, it is worth noticing that it massively outperformed in 2003 and 2009, indicating that companies with low RoIC values had performed so poorly the years before that a correction was in order. In

particular, the performance in 2003 was extraordinary with a return of 137.8% compared with the market return of 53.5%. However, the portfolio performed poorly in the three years leading up to 2003. Therefore, although the fund significantly outperformed in 2003, the performance over a four-year period, including the 137.8% increase in 2003, is still negative. During the financial crisis, decentile 1 performed alike its peers, while decentile 10 vastly underperformed in the period 2006-2008. However, in 2009, the portfolio significantly outperformed the market. Primary Exhibit "3.11 Returns" 1 illustrate the returns for the 20-year period.

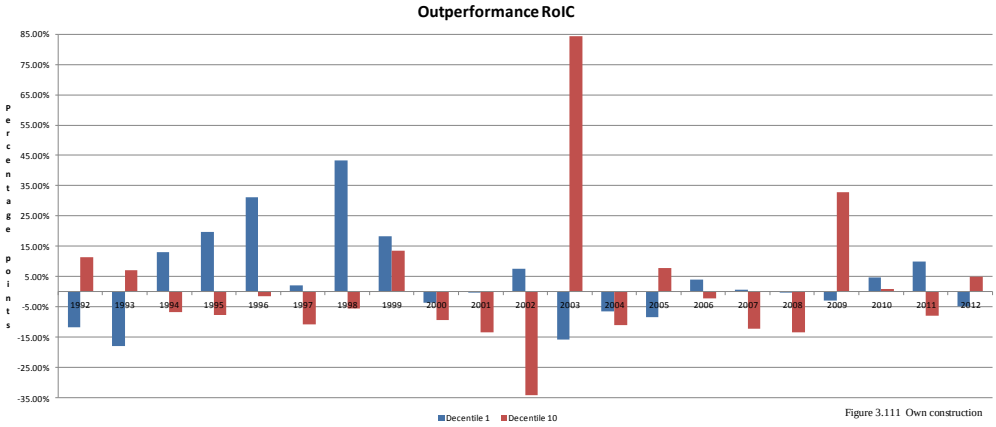


Figure 3.111 Own construction

From the findings it seems like the positive and negative outperformance of decentile 1 and 10 occurred at different periods of time. This is in fact the case, and the outperformance of decentile 1 is negatively correlated with the outperformance of decentiles 6, 7, 8, 9, and 10. In addition, the outperformance of all decentiles, with the exception of decentile 9, is negatively correlated with the outperformance of decentile 10, which Primary Exhibits "3.11 Returns" 2 summarizes.

3.12 Risk Measures

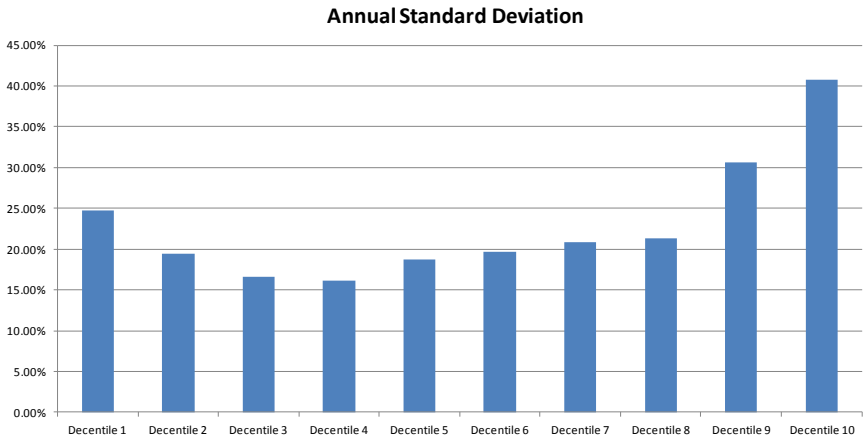
3.13 Risk

Although there seems to be a pattern between the 10% highest and lowest RoIC values and the following return, this could be a result of excess risk. As described earlier, investors tend to be risk averse, which could partly explain the abnormal returns.

As discussed earlier in the theory,[284] there are several ways to measure the risk of a given portfolio. However, the most common is the standard deviation of the return of a portfolio. According to the findings during the research process, a portfolio consisting of the companies with the 10% highest returns on invested capital would have had the third highest standard deviation of all the constructed portfolios with an annual standard deviation of 24.7% compared to an average of 20.8%. In 6 out of 20 years, decentile 1 has among the three highest standard deviations. However, in 5 out of the 20 years, it is among the two lowest standard deviations. The standard deviation is especially high between 1994 and 1999. These finding are presented in Primary Exhibits "3.13 Risk" 1. Accordingly, it seems that risk could be a partial explanation for the excess return. It is also worth noting that decentile 10 has the highest standard deviation of the returns at 40.8%. This is by far the highest standard deviation of the constructed portfolios as it is 10.2 percentage points above the portfolio with the second highest standard deviation. Based on the testing, it thus appears that not only will the companies with the 10% lowest returns on invested capital provide the worst returns, they will also be by far the most risky in terms of the standard deviation. What is further interesting to note is that decentile 10 has one of the highest standard deviations in almost every year. In the period 1992-2012, it is only the case on three separate occasions that decentile 10 has a standard deviation that is among the lowest five. In 7 out of the 20 years, the decentile has the highest standard deviation, and in 18 of the 20 years it has among the highest three standard deviations. Additionally, it is considered highly interesting that the standard deviation is particularly high from 2001-2004, where the decentiles are vastly overexposed to the IT sector. This was also the case in the late 90's however the standard deviation was significantly less due to the great performance of the sector. It's is interesting to note that the bottom five decentiles with the exception of decentile 1 seem to be the riskiest according to the

	Annual STD	Rank
Decentile 1	24.7%	8
Decentile 2	19.4%	4
Decentile 3	16.6%	2
Decentile 4	16.1%	1
Decentile 5	18.7%	3
Decentile 6	19.7%	5
Decentile 7	20.9%	6
Decentile 8	21.3%	7
Decentile 9	30.6%	9
Decentile 10	40.8%	10
Average	20.8%	

Figure 3.13 Own construction



Graph 3.13 Own construction

[284] 2.4 Risk

standard deviation.

Another measure for risk is beta. As outlined in our theoretical findings beta measures the correlation between a given stock or portfolio and the market. The beta of the portfolios supports the findings using standard deviation namely that the bottom 5 decentiles in fact are the riskiest. Furthermore the risk of decentile 1 is less when using beta as a measure indicating that although the decentile does have some variation to its returns the returns correlate relatively less with the market. Additionally this implies that correlation between decentile 1 and the market positively affects the decentile as it has the 5th lowest beta and the 8th lowest standard deviation.[285] The beta confirms that decentile 10 is by far the riskiest portfolio which further validates the findings from the standard deviation. It further shows that the bottom decentiles are still the riskiest when beta is used which is summarized in figure 3.131.

3.14 Risk-Adjusted Returns

As earlier mentioned in the theory of risk,[286] the most commonly used measure for risk-adjusted returns – especially in regards to standard deviation – is the Sharpe ratio. The findings indicate that based on the Sharpe ratio, decentile 10 is the worst performer. This is no surprise considering that decentile 10 had not only the lowest returns but also the highest standard deviation. Decentile 1 would have been the third best investment according to the Sharpe ratio. The reason being that even though decentile 1 did have the highest return, the portfolio had one of the worst risk profiles with a high standard deviation which impacts the Sharpe ratio negatively. A pattern is evident in that the median decentiles have the best risk-adjusted return, namely decentiles 4, 5 & 6, respectively ranks 2, 1 & 4 in regards to the Sharpe ratio. Other than that, the Sharpe ratio does not provide a clear image of how to invest based on RoIC as e.g. decentiles 2 and 3 ranks as number 9 & 6.

	Avg. Beta	Rank
Decentile 1	0.93	5
Decentile 2	0.93	4
Decentile 3	0.89	2
Decentile 4	0.89	3
Decentile 5	0.87	1
Decentile 6	1.00	7
Decentile 7	1.02	8
Decentile 8	0.99	6
Decentile 9	1.12	9
Decentile 10	1.40	10

Figure 3.131 Own construction

[285] The beta of the decentile''s over the period from 1992-2012 is presented in Primary Exhibit "3.13 Risk" 2
[286] 2.4 Risk

	Annualized Sharpe Ratio	Rank	Annualized Jensen's Alpha	Rank	Annualized M^2	Rank	Avg. Adjusted Sharpe Ratio	Rank	Avg. Calmar Ratio	Rank	Avg. Omega Ratio	Rank
Decentile 1	0.51	3	5.1%	1	-0.4%	3	0.45	4	3.10	1	5.42	1
Decentile 2	0.32	9	-1.1%	7	-2.5%	7	0.39	7	3.03	2	1.72	6
Decentile 3	0.37	6	-3.0%	9	-2.5%	8	0.34	10	2.09	7	1.39	9
Decentile 4	0.64	1	1.2%	3	0.4%	2	0.53	2	2.96	3	2.10	4
Decentile 5	0.56	2	1.9%	2	1.5%	1	0.55	1	2.63	5	1.43	8
Decentile 6	0.44	4	-1.1%	6	-0.7%	4	0.47	3	2.87	4	1.48	7
Decentile 7	0.36	7	-2.6%	8	-2.8%	9	0.35	8	2.41	6	1.36	10
Decentile 8	0.41	5	-1.0%	5	-1.7%	6	0.43	6	1.92	8	1.77	5
Decentile 9	0.34	8	0.1%	4	-1.5%	5	0.45	5	1.61	10	3.38	2
Decentile 10	0.14	10	-4.0%	10	-3.2%	10	0.35	9	1.77	9	2.32	3

Figure 3.14 Own construction

The results when analyzing risk-adjusted return from the Modigliani-squared and the Adjusted Sharpe ratio are similar to the findings in the Sharpe ratio as was expected. Once again, decentile 10 has the poorest risk-adjusted return by a margin, except for the average Adjusted Sharpe ratio where it is the second worst. Decentile 1, however, ranks as the fourth best when the skewness and kurtosis is taken into account in the Adjusted Sharpe ratio, and is third according to the Modigliani-squared. Other than that, the pattern is still quite mixed although the median decentiles once again fare relatively well. Unlike the Sharpe ratio, the Modigliani-squared has the advantage of allowing comparisons between returns among different portfolios. When doing so, it is apparent that decentile 1 is two percentage points worse off than the best decentile, and in addition, the annualized M^2 is negative for decentile 1. The portfolio with the lowest RoIC is by far the worst performer with a negative return of 3.2%. This implies that investors are better of investing in the market portfolio rather than in all the decentiles except decentile 4 and 5. It can therefore be implied that all the decentile either contain more risk than the market, have a lower return than the market or both.

The Calmar ratio provides slightly different results as here, decentile 1 is the best, decentile 2 the second best, and decentiles 8, 9, and 10 are the worst, albeit in a non-descending order. This implies that these portfolios have a larger maximum drawdown and/or lower excess return, which is in line with the previously described risk measures. This is also the case for dencetile 1 but as the return is higher the Calmar ratio is significantly better. When analyzing risk-adjusted returns based on Jensen's Alpha, decentile 1 is by far the best investment, while decentile 10 is once again the worst investment even after being adjusted for risk. The reason decentile 1 fares so much better based on Jensen's Alpha is that Jensen's Alpha is based on beta. The beta of decentiles 6-10 is larger than the betas for the remaining decentiles, and this combined with the high rate of return for decentile 1 explains the performance as mentioned earlier.

The Omega ratio clearly indicates that although the overall performance of decentile 10 is inferior compared to all the other decentiles, the portfolio contains stocks with upside potential. This is the case as the Omega ratio is dependent on upside and downside potential of the portfolios. It is therefore not surprising that decentile 1 has a

higher Omega ratio considering the superior performance. Furthermore, the ratio indicates that the median portfolios that otherwise perform rather well do not to the same extent appear to be attractive investments when measured by the Omega ratio. This is most likely due to the smaller standard deviation found earlier as this would imply less upside and downside potential. With these descriptions in mind, it is considered advantageous to review the best and worst performing stocks within each decentile in greater depth.

3.15 Top & Bottom Performers

An alternative way of identifying risk is to analyze the best and worst performers of a given portfolio. This is particularly interesting for this thesis as the objective is to investigate the model as a screening tool. Accordingly, the return of the 15 best and worst performing stocks from each portfolio every year has been analyzed as follows.

The findings illustrate that the top 15 performing stocks in decentile 1 has the highest annualized return of all the portfolios. However, decentile 10 and 9 also perform very well, and it is worth noticing that the top 15 performing stocks in decentiles 8, 9, and 10 overall are the second, third and fourth best performing of all the decentiles,

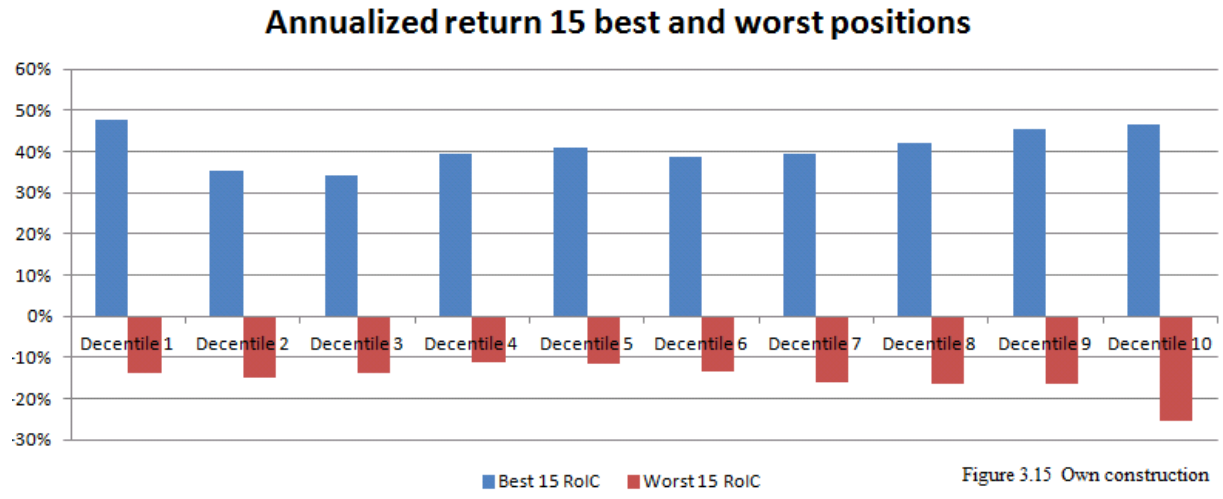


Figure 3.15 Own construction

respectively. However, decentile 2 only ranks ninth out of all the portfolios. As such, it seems that despite decentile 10's overall poor performance, the portfolio does indeed include some stocks that perform very well.

When analyzing the 15 worst performing stocks from each decentile, it is apparent that the bottom four also has the four lowest returns, and this consequently cancels out the great performance of the best stocks in the decentile. Particularly decentile 10 contains poor performers as the annualized return of the 15 worst performing stocks is an abysmal negative return of 25.45%, which is 9.14 percentage points less than the second worst per-

forming portfolio. In terms of the worst performers, the better decentiles are the median portfolios 4, 5, and 6 which could also explicate these portfolios had the lowest standard deviations and beta which is summarized in Primary Exhibits "3.15 Top and bottom performs". It is worth noticing that the high standard deviation for decentile 10 can probably be explained by the major difference in the return for the best performing stocks and the worst performing stocks.

3.16 Decomposition of Portfolios

The analysis on portfolios ranked according to returns on invested capital supports the theory that different industries have different RoIC.[287] As figure 3.16 illustrates, decentile 1 and 10 have significantly different exposures towards the GIC sectors.

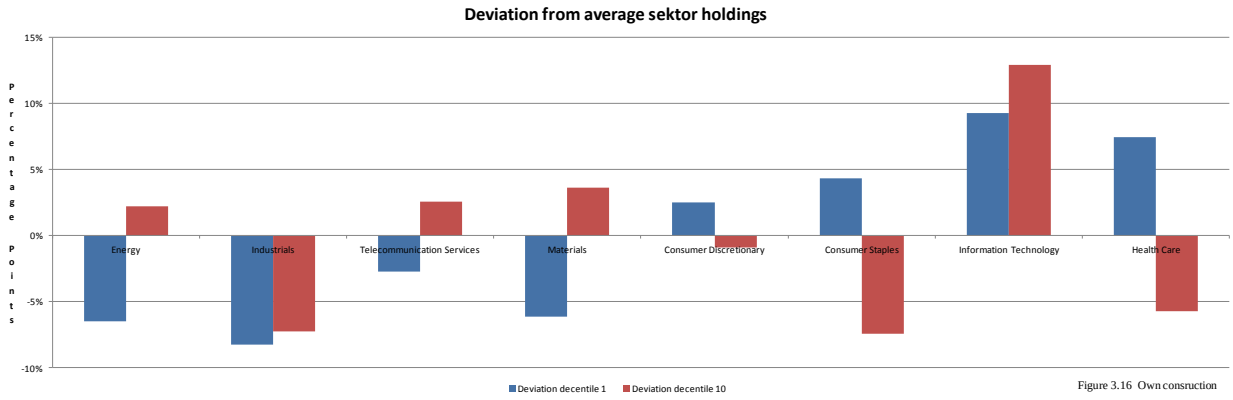


Figure 3.16 Own consruction

As it appears, and as mentioned earlier in section "3.13 Risk", decentile 1 and 10 have a few sector exposures in common, and differ entirely in others. There is a clear tendency for companies in the energy sector to have lower returns on invested capital. One of the reasons for this could be that the energy sector tends to be very capital heavy, thus requiring a lot of reinvestments in order to maintain operations. Consequently, this lowers the returns on invested capital as the invested capital is higher. Both the materials and telecommunications sector appear to have lower return on invested capital. While there may be several reasons for this, the same argument could apply as a lot of investments in infrastructure are needed in order to compete, at least for the telecommunication sector. It is interesting that both decentile 1 and 10 are heavily underexposed to the industrial sector. Accordingly, this indicates that it is primarily the median decentiles that are overexposed to this sector. Moreover, it also indicates that the industrial sector includes some companies with very high returns on invested capital as well as some companies with very low returns on invested capital. This could potentially be due to the fact that the industrial sector is very broad and contains a vast variety of companies. For instance, the industrial sector includes

[287] 2.24 Decomposition of RoIC

anything from shipping companies such as C.H. Robinson to airplane manufactures such as Boeing.[288] Another sector with a similar exposure within the two portfolios is the information technology sector. Both decentile 1 and 10 have a major overrepresentation here, which indicates that the sector is characterized by some very strong performers as well as some companies that really struggle, similar to the industrial sector. However, it would seem that the basis for the differentiation is divergent as the information technology sector is not as broad as the other sectors. Another possible explanation could be that some companies invest in long term growth, and thereby hinder their returns in the short-term while some companies experience massive growth, and thus experience very high returns on the invested capital. Take for instance Amazon, which had a RoIC of only 2% due to its heavy investment in future growth.[289] Apple, on the other, hand has a return on invested capital of 39.41%[290] as they are already an established company that has the potential to earn very high returns. Both the consumer sectors and health care sector show a tendency to contain stocks that generally have good returns on invested capital which is in line with our theoretical analysis of RoIC.

To further examine the relationship between return on invested capital and the performance of stocks a regression analysis has been conducted. The explanatory power of the ranking of RoIC of the returns, both on individual stock level as well as a portfolio level has been analyzed, and the main findings indicate that the R^2 for the regression between rank and return varies quite a lot from year to year with a maximum explanatory power of 17.62% in 2003 and 0% in 2006, which is evident in Primary Exhibits ”3.16 Decomposition of portfolios” 2. Furthermore, R^2 for the regression for the total ranking of the stocks and the returns over the 20-year period is 0.012% indicating that the relationship is not valid when measured for individual stocks. A similar analysis has been performed in regard to the ranking of the decentiles and the return of these. Overall, the ranking of the various decentiles to a larger extent explains the returns compared to the individual stocks. However, the R^2 varies a lot as it explains 84.77% of the returns in 2011, yet only 0.24% in 2006 which Primary Exhibits ”3.16 Decomposition of Portfolios” 3 summarizes.

Moreover, an analysis of the causal relations between rank and return for the period 1992-2012 has been conducted, however, the findings are not statistically significant. The R^2 for individual stocks is 0.12%, and the p-value is 0.336, which thereby renders it insignificant as Primary Exhibits ”3.16 Decomposition of Portfolios” 4 illustrates. The same can be said for the relation between the rank of decentile and return where the p-value is 0.77 as illustrated in Primary Exhibits ”3.16 Decomposition of Portfolios” 5. These statistical analyses confirm the overall picture that screening stocks based on RoIC alone is not a recommendable strategy.

[288] Operating RoIC
[289] Amazon: Q2 2013 Amazon.com, Inc. Earnings Conference Call Slides, p. 5
[290] Bloomberg profitability measure of Apple 2012

To gain further insight as to why the portfolios perform as they do the outperformance has been divided into sector contribution and stock contribution. Sector contribution describes to what extent the different sectors explain the return of the portfolio; e.g., if an investment portfolio was overweight in information technology stocks and the sector performed above the market in general, this would signify a positive sector contribution. On the other hand, had the IT sector underperformed the market in the specific period, it would have been a negative sector contribution. Stock contribution is alpha to the provision of that specific portfolio. For instance, if a portfolio achieves a return of 10% in their information technology stocks and the market return for information technology stocks is only 5%, the portfolio will have achieved a positive stock contribution. By applying this manner of categorizing the return, it is the ambition to be able to determine whether the higher/lower returns are a result of superior stock selection, better sector allocations, or a combination of the two. Although the results are mixed, it is clear that decentile 1's sector exposure is high as it generates 2.2% annualized outperformance. This is in line with theory as some sectors tend to have higher returns on invested capital which should in turn lead to economic value added. The portfolio with the second highest return caused by the sector exposure is decentile 10 with 0.8%. This is contrary to theoretical findings as some sectors e.g. the airline industry tends to have consistently low returns on invested capital which hence destroys economic value. Primary Exhibits "3.16 Decomposition of Portfolios" 10, 11, and 12 illustrate the contribution of the top three decentiles, the four median decentiles as well as the bottom three decentiles. The exhibits show that the outperformance of the top three decentiles and the bottom three decentiles are causally related, i.e. when the top three decentiles outperform, the bottom three underperform and vice versa. Furthermore, the decomposition illustrates that this is the case for the sector contribution as well as the stock pick. Moreover, the outperformance of the top decentiles is to a greater extent caused by sector contribution rather than stock contribution, and for the bottom three, the outperformance is caused by both stock pick and sector contribution.

Annual	Annualized Sector Pick	Annualized Stock Pick
Decentile 1	2.2%	1.2%
Decentile 2	-1.6%	-1.9%
Decentile 3	-1.3%	-2.7%
Decentile 4	-1.0%	1.0%
Decentile 5	0.6%	-0.1%
Decentile 6	0.4%	-1.3%
Decentile 7	0.2%	-1.9%
Decentile 8	-0.7%	0.1%
Decentile 9	-0.3%	3.1%
Decentile 10	0.6%	-0.6%
Average	0.0%	0.0%

Figure 3.161 Own construction

As a better way to analyze how the different portfolios perform during different times we have categorized the sector and stock contribution into the top 3 decentiles, the median 4 decentiles and bottom 3 decentiles. The reason is that we have seen similarities between the returns and risks of these groups and our results indicate that the top decentiles outperform the market while the bottom decentiles underperform. Figure 3.162 illustrates the decomposition of the returns.

Contribution - Top 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-4.0%	-4.3%	3.3%	2.0%	0.8%	2.4%	8.9%	-0.2%	0.2%	-3.0%	2.0%	-7.2%	-0.8%	-2.0%	-1.0%	2.0%	-0.3%	0.0%	-2.0%	1.1%	0.6%
Stock Pick	-3.4%	-7.4%	3.8%	2.9%	6.6%	4.7%	8.0%	-8.0%	-4.3%	0.3%	1.6%	-13.7%	-2.7%	-2.3%	-0.5%	3.7%	2.7%	-7.6%	-3.3%	6.5%	-4.7%
Outperformance	-7.4%	-11.7%	7.1%	4.8%	7.4%	7.1%	17.0%	-8.1%	-4.1%	-2.6%	3.6%	-20.9%	-3.5%	-4.2%	-1.4%	5.8%	2.4%	-7.7%	-5.3%	7.6%	-4.1%

Contribution - Median 4 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	0.6%	0.7%	-0.3%	0.1%	-2.5%	0.9%	-0.7%	-2.2%	-0.5%	1.3%	2.1%	-0.9%	0.5%	1.2%	0.0%	0.7%	0.3%	-0.9%	-1.0%	0.2%	-0.3%
Stock Pick	1.8%	0.9%	-1.1%	1.0%	-2.2%	-3.6%	-2.2%	7.8%	4.1%	3.1%	2.3%	-9.5%	1.2%	0.2%	0.4%	-0.5%	3.1%	-6.4%	-1.2%	-0.9%	0.4%
Outperformance	2.4%	1.5%	-1.4%	1.1%	-4.8%	-2.7%	-2.9%	5.7%	3.6%	4.4%	4.4%	-10.3%	1.6%	1.4%	0.4%	0.2%	3.4%	-7.2%	-2.1%	-0.8%	0.1%

Contribution - Bottom 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	2.7%	2.3%	-2.6%	-1.7%	2.1%	-3.8%	-8.1%	6.3%	-0.5%	-0.3%	-5.6%	9.4%	-0.9%	1.0%	0.3%	-2.9%	-1.0%	2.1%	2.8%	-1.4%	-0.3%
Stock Pick	2.7%	6.1%	-3.3%	-2.4%	-1.5%	-0.7%	-5.2%	1.1%	-1.4%	-5.2%	-4.9%	29.2%	1.0%	1.8%	0.0%	-2.4%	-7.1%	18.3%	2.4%	-4.0%	3.8%
Outperformance	5.4%	8.4%	-5.9%	-4.0%	0.6%	-4.6%	-13.2%	7.4%	-1.9%	-5.6%	-10.4%	38.6%	0.2%	2.8%	0.3%	-5.3%	-8.1%	20.4%	5.3%	-5.4%	3.5%

Figure 3.162 Own construction

When analyzing the returns two periods are of specific interest in terms of sector and stock contribution. First the period surrounding the dot-com bubble from 1997-2001 and the time around the financial crisis from 2007-2010. During the dot-com or internet bubble in the late 90's it is interesting to note that the sector contribution for the top decentiles varies but overall was positive. However the returns were especially caused by stock picks which over the 4 year period resulted in a negative outperformance.

During the dot com bubble the bottom three decentiles overall had a negative outperformance which was caused by both a negative sector contribution as well as poor stock picks. The median portfolios fare well as they outperform the market by superior stock selections.

During the financial crises the picture was once again mixed. The top decentiles had a positive outperformance in both 2007 & 2008 which was caused mainly by stock contribution. However the outperformance was negative in both 2009 & 2010 which was a result of a poor sector allocation and underperforming stocks. The negative return was mainly driven by a negative stock contribution though.

The bottom three decentiles had an outperformance completely opposite of the top decentiles underperforming in 2007 and 2008 and outperforming significantly in 2009 and 2010. The outperformance was in both periods driven by stock contribution although the sector contribution was negative in 2007 & 2008 and positive in both 2009 & 2010.

The median decentiles had a positive outperformance in 2007 & 2008 while underperforming in both 2009 & 2010. The performance was a result of stock contribution, however the outperformance was much less in all of the four years.

3.17 Summary of Analysis of Return on Invested Capital

By using RoIC as a screening tool, it was possible to identify the best and the worst portfolio. The analysis of risk-adjusted returns for decentile 1 clarifies that the superior return is achieved with higher than average stand-

ard deviation as well as the fact that the return of decentile 1 to some extent is caused by the performance of a few stocks. Decentile 10 has by far the worst performance based on the Sharpe ratio, the Modigliani-squared ratio, and the Jensen's Alpha, and the second worst performance based on the Adjusted Sharpe ratio and the Calmar ratio. However, the performance of the portfolio is not considered quite as bad based on the Omega ratio. Although the portfolio performs poorly, relative to its peers there is some upside potential within the portfolio which is supported by the performance of the top and bottom 15 stocks within the portfolio. However, while this may be the case, it still implies increased risk.

Furthermore, decentile 1 and 10 have significantly different exposures to sectors, and their outperformance is negative correlated. For the other decentiles, the results are mixed and no clear picture emerges which also denotes that the relationship between rank (both for individual stocks and decentiles) and returns are statistically insignificant.

3.2 Analysis of EV/EBIT

3.21 Analysis of Pricing Measures

Based on the theoretical discussion EV/EBIT has been selected as the preferred pricing measure for this thesis. The reason being that according to research, companies trading a low P/E and EV/EBIT[291] multiples should be underpriced and thus selecting stocks with low multiples should provide better returns. Nonetheless, EV/EBIT has been preferred to P/E as a price measure as it is considered beneficial to use when comparing companies with different capital structures. Furthermore it includes the capital charges for the fixed assets. All companies in the S&P 500 index (excluding the financial and the utility sectors) have been ranked according to trailing EV/EBIT and with the theory in mind the lower the value the better.

3.22 Returns

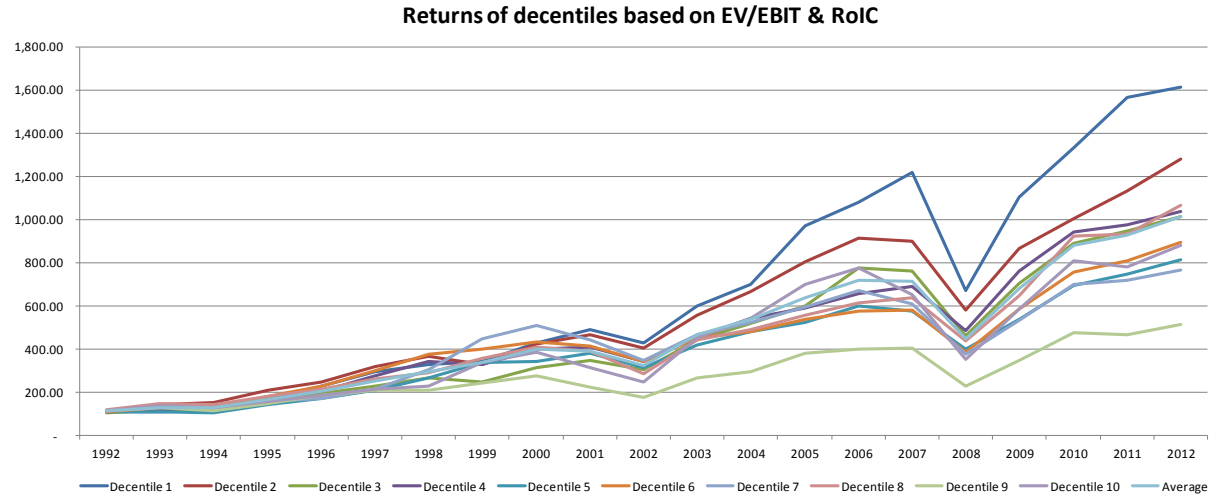
In the research of the S&P 500 index (not including utility or financial companies,) it has been examined how companies with low EV/EBIT multiples fare compared to companies with high EV/EBIT multiples. The general idea behind EV/EBIT is to buy companies cheap as investors can buy earnings cheaper by investing in companies with lower EV/EBIT multiples.

[291] 2.1 Price measures

Hence companies trading at lower EV/EBIT multiples should ceteris paribus outperform stocks trading at high EV/EBIT multiples as earnings are more "expensive". The results indicate that this in fact the case as the highest ranked companies have the lowest EV/EBIT multiples. Moreover, the results show that companies with lower EV/EBIT multiples tend to outperform stocks with higher relative valuations. Based on these results, it can be deduced that if investors rebalance their portfolio every year and only invested in companies with the 10% lowest EV/EBIT multiples, that specific portfolio would provide an annual return of 16.9% between January 1992 and January 2012. This is compared to the companies with the highest multiples that only achieve an annual return of 9.42%. Consequently, the difference would have been immense. If a person were to have invested $ 100 in 1992, and had applied the strategy of only selecting companies with low EV/EBIT values, a portfolio as such would have been worth $ 2,288.39 in 2012. This is significantly higher than the result investors would have achieved by investing in the companies with the highest return on invested capital. If that investor had picked the decentile 10, the portfolio would only have been $ 604.88, and had the investor invested equally in all stocks in the index, the portfolio would have been worth $ 997.03. In other words if investors had invested in decentile 1 instead of the market their return would have been more than double that of the market. According to these findings, it seems that EV/EBIT can indeed be used as a measure of how "cheap" a stock is, and that "cheap" stocks tend to outperform more "expensive" stocks. However, this is

Decentile	Annualized return	Rank
Decentile 1	16.9%	1
Decentile 2	14.4%	2
Decentile 3	10.1%	9
Decentile 4	12.8%	3
Decentile 5	10.2%	8
Decentile 6	10.4%	7
Decentile 7	10.9%	6
Decentile 8	11.2%	4
Decentile 9	11.2%	5
Decentile 10	9.4%	10
Average	12.2%	

Figure 3.22 Own construction

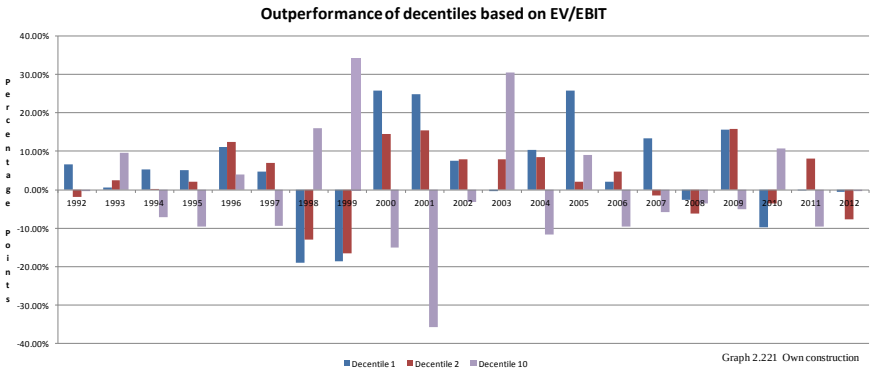


Grpah 3.31 Own construction

mainly the case for companies with the very lowest EV/EBIT scores and the ones with the very highest EV/EBIT scores. Particularly decentile 1 and 2 provide superior returns. Otherwise, there does not seem to be a clear pattern as to which decentiles perform the best. Decentile 4 ranks as the third best portfolio to invest in over the time period, however, decentile 3 is also considered the second worst to invest in and it is thus a blurry picture.

When looking at the underlying basis as to why decentile 1 and 2 perform so much better than decentile 10, one interesting aspect is the actual time period in which the decentiles perform the best. The returns of the different portfolios vary significantly, especially in the time around the Internet bubble and the financial crisis. The tests found that while companies with high EV/EBIT values performed very well in 1998 and 1999, companies with low EV/EBIT values performed poorly, falling more than 10% in both years. However, after the bubble busted in 2000, high EV/EBIT stocks performed terribly, falling more than 10% in 2000 and more than 30% in 2001, while companies with low EV/EBIT values provided positive results in both periods. This is clearly due to the overexposure of the bottom decentiles to the IT sector. This is as expected from theory as growth industries such as the IT sectors tend to trade at high EV/EBIT multiples.

On the contrary, the results during the financial crisis were mixed. Prior to the crisis, decentile 1 outperformed the market in both 2006 and 2007 while decentile 2 outperformed in 2006 and underperformed in 2007. Decentile 10 underperformed during both years. The three portfolios all underperformed the market in 2008, while decentile 1 and 2 beat the market by more than 15 percentage points in 2009. Decentile 10 had an underperformance of roughly 5 percentage points in this year. Primary Exhibit "3.22 Returns" 1 illustrate the returns over the period.



Graph 2.221 Own construction

As such, it seems that the companies with very high EV/EBIT multiples and very low EV/EBIT multiples fare differently especially in times with very high uncertainty and volatility. The studies for this thesis find this to be a general trend as there is actually a negative correlation between the outperformance of decentile 1 and decentile 10. In other words, generally when decentile 1 performs well, decentile 10 performs poorly, and vice versa. Yet this is not solely the case for the best and worst portfolios, but rather a general tendency in that the top decentiles correlate well with decentiles near them, and that bottom decentiles correlate with the bottom decentiles

just as in RoIC. Accordingly, stocks with similar EV/EBIT multiples tend to respond similarly to news and events. This is summarized in Primary Exhibit "3.32 Returns in Different Times" 1.

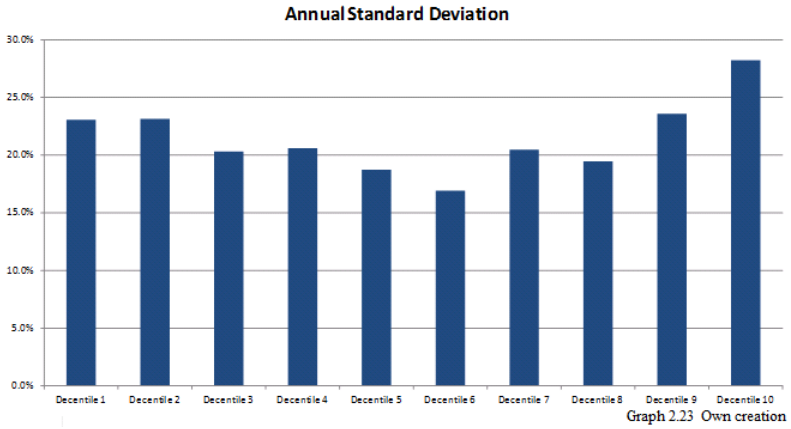
3.23 Risk

Although companies with lower EV/EBIT multiples perform superiorly, this could be a result of increased risk, and thus the returns would not be abnormal according to theories such as the efficient market hypothesis.[292] As earlier described, investors tend to be risk averse, and thus in order to provide superior returns for investors, the returns need to be adjusted for risk.

Decentile	Annual STD	Rank
Decentile 1	23.0%	7
Decentile 2	23.1%	8
Decentile 3	20.3%	4
Decentile 4	20.6%	6
Decentile 5	18.7%	2
Decentile 6	16.9%	1
Decentile 7	20.4%	5
Decentile 8	19.4%	3
Decentile 9	23.6%	9
Decentile 10	28.2%	10
Average	19.3%	

Figure 3.23 Own construction

As discussed in the theory section,[293] there are numerous ways to measure risk. However, the most common way is to measure the standard deviation of returns. The findings related to this show that the standard deviations of returns are highest for companies with very high EV/EBIT multiples implying they are riskier. This is as expected as companies with high EV/EBIT multiples usually have a tendency to have an overrepresentation of technology and growth companies which usually fluctuate more.[294] However, according to theory,[295] this should also lead to higher returns, which is not the case according to this thesis's findings. As illustrated by graph 2.23 it is evident that the bottom two decentiles has the highest standard deviation of the returns of all the decentiles. Thus the bottom decentiles not only provide the worst returns they also contain the most risks. It is clear that companies with low EV/EBIT multiples have also experienced fairly high standard deviations in their returns. This is not surprising as these companies will typically be in very tough business situations, and as a result, negative or positive news will tend to move prices significantly.[296]



Graph 2.23 Own creation

[292] See 2.4 Risk
[293] See 2.4 Risk
[294] 2.11 Fundamental drivers of EV/EBIT
[295] 2.4 Risk
[296] 2.11 Fundamental drivers of EV/EBIT

Furthermore, the findings seem to indicate that companies with average EV/EBIT multiples have the lowest volatility on their returns. Thus, the superior returns that were found when investing in companies with low EV/EBIT multiples could be a result of increased risk. In order to determine which portfolios performed the best, the risk-adjusted returns must be analyzed.

As earlier mentioned another commonly used risk measure is beta. When using beta as a risk measure the findings using the standard deviation are verified. The bottom 2 decentiles once again turn out to be the riskiest. Furthermore the relative risk of decentile 1 is higher when using beta as a measure than the standard deviation and the risk of decentile 8 is increased as well. Additionally it is worth noticing that the pattern from earlier that the median decentiles contain less risk is further enhanced as they perform better than when measuring their risk by the standard deviation.

Decentile	Avg. Beta	Rank
Decentile 1	1.02	8
Decentile 2	0.95	6
Decentile 3	0.90	5
Decentile 4	0.88	2
Decentile 5	0.83	1
Decentile 6	0.88	3
Decentile 7	0.89	4
Decentile 8	0.95	7
Decentile 9	1.04	9
Decentile 10	1.28	10

Figure 3.231 Own construction

3.24 Risk-Adjusted Returns

As mentioned above, the most commonly used measure for risk-adjusted returns – especially in regard to standard deviation - is the Sharpe ratio. When analyzing the different portfolios based on their Sharpe ratio, a clear pattern emerges. Firstly, it is worth noting that the top two decentiles achieve the highest risk-adjusted return based on the Sharpe ratio in that order. This suggests that the decentiles return more than satisfies the risk incurred. On the contrary decentile 10 has the lowest annual Sharpe ratio, and decentile 9 has the third lowest Sharpe ratio. This is considered interesting as the lowest ranked portfolios not only experience the worst returns, they also experience the highest risk if measured by standard deviation, which figure 3.23 summarizes. Thus the findings from earlier that decentile 1 and 2 do well and the bottom portfolios perform worse is validated. The performance of the remaining decentiles is still unclear.

Decentile	Annual Sharpe ratio	Rank	Avg. Adjusted Sharpe Ratio	Rank	Annualized return M^2	Rank
Decentile 1	0.60	1	0.58	1	0.57%	1
Decentile 2	0.49	2	0.47	2	-0.67%	4
Decentile 3	0.34	9	0.45	3	-1.83%	8
Decentile 4	0.47	3	0.44	5	-1.36%	5
Decentile 5	0.38	7	0.34	10	-2.41%	9
Decentile 6	0.43	4	0.43	6	-1.73%	7
Decentile 7	0.38	6	0.42	7	-0.63%	3
Decentile 8	0.42	5	0.44	4	-0.53%	2
Decentile 9	0.34	8	0.36	9	-1.44%	6
Decentile 10	0.23	10	0.38	8	-2.41%	10

Figure 3.24 Own construction

Not surprisingly, the results of the M^2 are similar to the results of the Sharpe ratio, although decentile 9 performs better relatively, and decentile 2 performs slightly worse. One of the advantages of the M^2 is that the differences

in return can be interpreted. These show that the risk-adjusted returns an investor would have achieved from investing in decentile 1would have provided positive results of 0.57% p.a., and are therefore far superior to the remaining decentiles' as their risk-adjusted returns are negative. As earlier mentioned the only reason that decentiles can provide a negative return according to the Modigliani-squared is that they either underperform the market or have a higher standard deviation than the market or both. This is interesting as nine out of ten decentiles have a negative return which implies that almost all of the portfolios either underperform or have an outperformance partially explained by higher risk. Thus the measure indicates that investors are better of investing in the market portfolio. The results for the Adjusted Sharpe ratio confirm the pattern as the top three decentiles provide the best scores, whereas the two lowest decentiles provide two of the worst scores. This implies that kurtosis and skewness do not affect the results of the Sharpe ratio significantly.

When analyzing beta measures such as Jensen's Alpha, the same pattern occurs for the top two decentiles and the bottom decentiles in the sense that they deliver the best and worst risk-adjusted returns, respectively. However, when considering market based risk-adjusted returns, the lower decentiles perform better that the upper median decentiles. This is due to the fact that the median decentiles have relatively low standard deviations, however, their betas are relatively high, and thus their risk-adjusted return compared to the market are not as commendable. Additionally although decentile 1 has relatively high beta (the 7^{th} lowest) the return compensates for the increased risks. This is not the case for decentile 10 as it has the highest beta and the lowest Jensen's Alpha which indicates that investors are not compensated for the excessive risk.

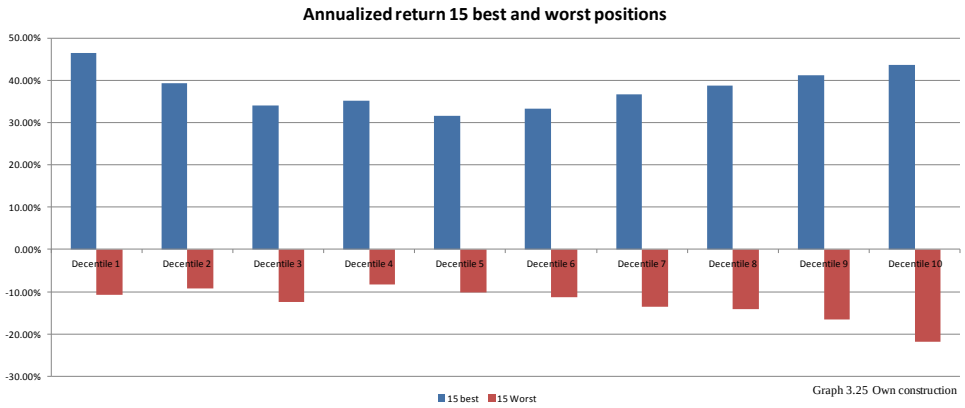
The Calmar ratio provides different results. According the Calmar ratio decentile 1 is the third worst portfolio to be invested in which compares to the Sharpe ratio where it was the best. The reason being that although the portfolio provides a great relative return the portfolio contains a lot of drawdown risk which affect the Calmar ratio negatively. The same applies for decentile 2 that drops for the second best portfolio to be invested in to becoming the fourth best portfolio. However, this is also the case for the lower decentiles as their drawdown risk should be significant while the returns are inferior. Therefore it is not surprising that the bottom two decentiles would have been the worst investments according to the Calmar ratio. Furthermore a picture emerges in which the stocks in the median portfolios appear less risky. However the findings seem unsystematic.

The Omega ratio supports these findings as the median portfolios fare worse than the top and bottom decentiles. This implies that these portfolios do not to the same extent include a favorable upside potential relative to downside potential. However according to the Omega ratio the very top and bottom decentiles appear to be the best investments implying a lot of upside potential. This is explained in greater detail in the following section.

3.25 Top & Bottom Performers

Another way to perceive risk is to analyze the best and worst performers from a portfolio or index. This is particularly interesting in this case as the intent is to analyze to what extent it can function as a screening tool. Therefore, the return of the 15 best and worst performing stocks, respectively, from every portfolio has been analyzed, which is illustrated in graph 3.25.

Based on this research, it is apparent that portfolios containing companies with both the highest and lowest EV/EBIT multiples achieve the highest returns and the median companies achieve the lowest returns from the best performing stocks. While the returns for the best performing stocks are extraordinary for decentile 10, as graph 3.25 points out, the return of the worst performing stocks is also much worse. In fact, the returns are more than 5 percentage points lower than the second worst portfolio which could be the cause for the low returns. Decentile 1, on the other hand, experiences the highest returns for the best performing stocks and only ranks fourth in terms of the worst performing stocks. This could explain why this particular decentile outperforms, and also seems to suggest that the two lowest decentiles have significantly more downside risks, especially if one were to pick stocks individually and not invest in the entire portfolio. This further confirms the findings of the Calmar ratio and the Omega ratio.



Graph 3.25 Own construction

3.26 Decomposition of Portfolios

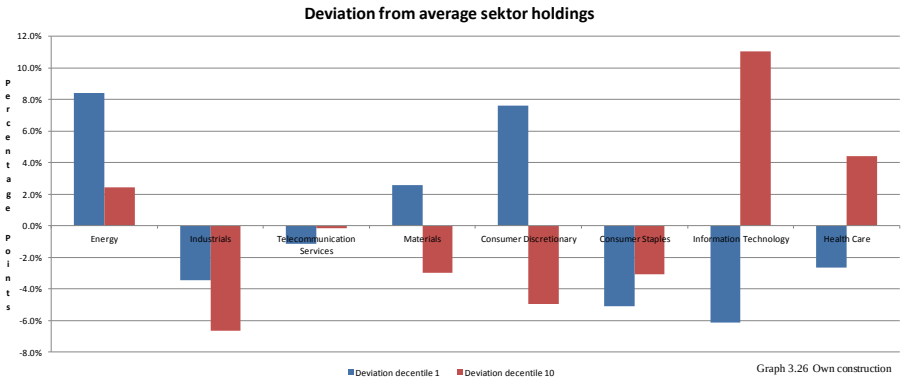
In line with the theory of EV/EBIT and other price measures, the EV/EBIT multiple should deviate for different companies as a result of different growth possibilities, risk and the ability to create cash flows. It is therefore considered relevant to analyze whether certain industries are over/under represented in the different portfolios and to what extent this could explicate the differences in performances. Accordingly, the exposure of the decentiles in regards to GIC sectors has been analyzed as graph 3.26 illustrates.

The information technology sector is overrepresented in the decentiles with high EV/EBIT multiples. This is according to theory as there should be a lot of growth companies in this sector. The high levels of volatility, in particular during the Internet bubble, could also represent an explanatory factor in terms of decentile 10's high

standard deviation and poor returns. Similarly, it is not surprising that this sector is underrepresented in decentile 1. The same effect is seen in the health care sector. The findings also indicate that decentile 1 is overexposed to the consumer discretionary sector, while decentile 10 is underexposed.

While the over/underrepresented sectors are typically opposite in the two portfolios as the graph indicates, it is interesting to note that both decentiles are overrepresented in the energy sector. Initially, this is surprising given that energy companies usually trade at low multiples due to the massive reinvestment needs and uncertain energy prices.[297] However, the energy sector is a broad industry, and some sub-groups exist, some of which experience high growth. For instance, the shale-gas companies in the US that are currently trading at high multiples due to superior growth outlooks.[298]

Considering the fact that the two highest and lowest ranked decentiles had the most significant results, it is particularly interesting to observe how their return occurred. In terms of decentile 1's returns, it is apparent that the contribution from stock pick was the biggest basis for the portfolio's outperformance, representing 3.7% of the annualized stock pick. Sector contribution was 1.1% as Primary Exhibits "3.26 Decomposition of Portfolios" 1 illustrates. The results for decentile 2 are similar, where the sector contribution is actually negative, and the stock contribution thus explains the entire positive outperformance. Interestingly, the opposite is the case for decentile 10. In this portfolio, the sector contribution is actually positive while the stock contribution is negative, and thus causes much of the underperformance. This is interesting considering the theory on EV/EBIT on sectors which suggest that decentile 1 and 10 should be exposed to different sectors. Therefore it is surprising that both decentiles experience positive sector contribution. The proportions of the outperformance of the annualized stock and sector picks are presented in Primary Exhibits "3.26 Decomposition of Portfolios" 2. EV/EBIT is thus not a good approach for sector allocation as the price appears to incorporate different growth possibilities, abilities to create cash flows and risks on a sector level. On the other hand there does appear to be some mispricing's on the individual stock level.



Graph 3.26 Own construction

[297] 2.11 Fundamental drivers of EV/EBIT
[298] http://www.bloomberg.com/news/2011-02-21/bhp-buys-chesapeake-unit-for-4-75-billion-adding-u-s-shale-gas-assets.html

Considering our findings and the outperformance in different time periods, it is considered relevant to examine the source of this under/outperformance in volatile times. Here, it is particularly interesting to note that decentile 1, 2, and 3 have very negative sector and stock contributions in the late 90s. The sector contribution is indeed the main cause of their underperformance in 1999 and heavily influenced the underperformance in 1998 with an average sector contribution of -6.9% and negative outperformance of -14.9%. This is due to the underexposure towards IT and growth stocks that performed particularly well during this period. In 1999, the sector contribution was -9.9% and the outperformance of the top three decentiles was -20.1%. This is a result of the underweight of the IT sector in the top decentiles. It is also worth noticing that while the sector contribution is significant in the outperformance in the beginning of the 2000s, it is not the primary contributor of the top three decentiles' returns as the stock contribution is significantly more important in 2000 and 2001. However, the sector allocation does represent the main reason for the outperformance in 2002. Unlike the top three decentiles, the outperformance of the bottom three decentiles in the late 1990s was caused by sector contribution. However, the sector contribution also caused the underperformance of the early 2000's as illustrated in Primary Exhibits "3.26 Decomposition of portfolios" 4. This is a result of the bottom decentiles significant exposure towards the IT sector. During the time surrounding the financial crisis, the main factor behind the under/outperformance was the stock contribution for the top three decentiles, and for the bottom three, the impact of the stock of the sector contribution was quite similar.

An alternative way to analyze how the different portfolios performs during different times is to categorize the sector and stock contribution into the top 3 decentiles, median 4 and bottom 3 decentiles similar to the analysis of return on invested capital. This is deemed reasonable as there were a lot of similarities between the returns and risks of these groups and. Furthermore the results indicate that the top decentiles outperform the market while the bottom decentiles underperform. Figure 3.26 illustrates the decomposition of the returns.

Contribution - Top 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	0.1%	0.3%	0.5%	-0.8%	0.4%	2.0%	-6.9%	-9.9%	2.3%	8.0%	3.9%	-2.6%	3.9%	2.1%	1.3%	5.1%	-3.0%	1.4%	-1.4%	1.3%	-0.7%
Stock Pick	1.6%	0.4%	3.2%	3.3%	4.9%	1.2%	-7.9%	-10.3%	9.2%	8.6%	1.2%	1.8%	1.5%	6.6%	3.5%	0.0%	-2.4%	12.0%	-6.4%	4.3%	-1.5%
Outperformance	1.7%	0.8%	3.7%	2.5%	5.3%	3.2%	-14.9%	-20.1%	11.6%	16.6%	5.1%	-0.8%	5.4%	8.7%	4.8%	5.1%	-5.4%	13.3%	-7.7%	5.6%	-2.3%

Contribution - Median 4 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-0.3%	-1.3%	0.6%	0.4%	-1.6%	1.1%	0.2%	-5.7%	1.0%	1.6%	0.7%	-3.0%	-0.6%	-2.1%	1.4%	-0.4%	0.7%	0.0%	-1.0%	0.2%	0.6%
Stock Pick	1.2%	1.1%	-0.2%	2.3%	-1.6%	-0.3%	1.8%	5.9%	-4.9%	1.7%	-0.9%	-2.0%	-1.4%	-3.6%	-0.5%	-1.1%	1.0%	-2.0%	-1.8%	0.0%	-0.5%
Outperformance	0.9%	-0.2%	0.4%	2.6%	-3.3%	0.7%	2.0%	0.2%	-3.9%	3.2%	-0.2%	-4.9%	-2.0%	-5.8%	0.9%	-1.6%	1.7%	-2.0%	-2.8%	0.2%	0.1%

Contribution - Bottom 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	0.0%	1.6%	-2.1%	0.2%	2.4%	-3.0%	7.0%	19.8%	-3.8%	-12.2%	-4.9%	7.5%	-2.8%	1.6%	-3.2%	-3.4%	1.8%	-1.5%	2.4%	-1.5%	-0.4%
Stock Pick	-3.3%	-2.7%	-2.6%	-5.4%	-3.1%	-1.7%	4.2%	3.9%	-0.3%	-9.4%	0.2%	5.7%	-0.8%	-0.3%	-4.8%	2.3%	-0.2%	-6.6%	10.1%	-4.6%	0.6%
Outperformance	-3.3%	-1.1%	-4.7%	-5.2%	-0.7%	-4.7%	11.1%	23.7%	-4.1%	-21.5%	-4.7%	13.3%	-3.6%	1.3%	-7.9%	-1.2%	1.6%	-8.0%	12.6%	-6.0%	0.2%

Figure 3.26 Own construction

During the Internet bubble in the late 90's it is interesting to note that the outperformance of the top and bottom decentiles is negatively correlated as the top decentiles vastly underperformed whereas the bottom decentiles outperformed. Furthermore for the outperformance of the top decentiles is especially caused stock pick. Howev-

er this isn't the case for the bottom decentiles as sector contribution has a larger impact for the outperformance of these decentiles than the stock pick. This suggest the bottom decentiles were overweighed in growth stocks and especially IT stocks which is most likely a result of their high EV/EBIT multiples. Whereas the bottom decentiles performed very well in the late 90's they had a horrible performance in 2000, 2001 and 2002, which was mainly caused by sector contribution. On the other hand the top decentiles performed very well in the same years however this was driven by both sector and stock pick.

During the financial crisis the picture isn't as clear as during the dot-com, but it is interesting that the two have a negative correlation from 2007-2012. When the top decentiles outperform positively the bottom decentiles underperform and the other way around. It is also interesting that the outperformances are mainly driven by stock contributions for both the bottom and top decentiles. The bottom decentiles have negative outperform during the crisis which especially is caused by the stock pick. However in 2010 the bottom 3 decentiles vastly outperforms the market which especially is caused by the stock pick. The reason for the difference in the financial crisis could be that the crises was not contained within a few sectors but caused entire markets to fall significantly.

To gain additional insight into the explanatory power of the ranking of EV/EBIT and the returns, both on individual stock level as well as decentiles level, a regression analysis' of the relationship between rank and return has been performed. As is evident in the Primary Exhibits "3.26 Decomposition of Portfolios" 5, the R^2 for the regression between rank and return for individual stocks varies quite significantly from year to year with a maximum explanatory power of 20.31% in 2001 and 0.1% in 1993. In addition, the R^2 for the regression for the total ranking of the stocks and the returns over the 20-year period is 0.018%. Furthermore, a similar analysis has been conducted for the ranking of the decentiles and the return of these. Overall, the rank of the decentiles explains to a larger extent the returns compared to the individual stocks. However, the R^2 varies a lot as it explains 85.7% of the returns in 2011 and 3.17% in 1993, which the Primary Exhibits "3.26 Decomposition of portfolios" 2 summarizes. Furthermore, the p-value of 0.0004 is statistically significant for individual stocks as Primary Exhibits "3.26 Decomposition of portfolios" 3 shows. However, the relationship between the rank of the decentiles and return is not statistically significant as the p-value is 0.3865, illustrated in Primary Exhibits "3.26 Decomposition of portfolios" 4. This indicate that the EV/EBIT multiple is a better screening tool than solely screening stocks based on return on invested capital, ceteris paribus.

3.27 Summary of Analysis of EV/EBIT

As the theory suggested, using EV/EBIT as a screening tool is a technique to detect the best and worst portfolios. By using EV/EBIT as a ranking tool, the two best performing portfolios were identified as the worst performing portfolio. The performance of the top and bottom decentiles are negatively correlated, suggesting that the portfo-

lios genuinely contain different characteristics. Decentile 10 tends to outperform the market in periods with a high degree of volatility, which is the directly contrary to decentile 1 and 2.

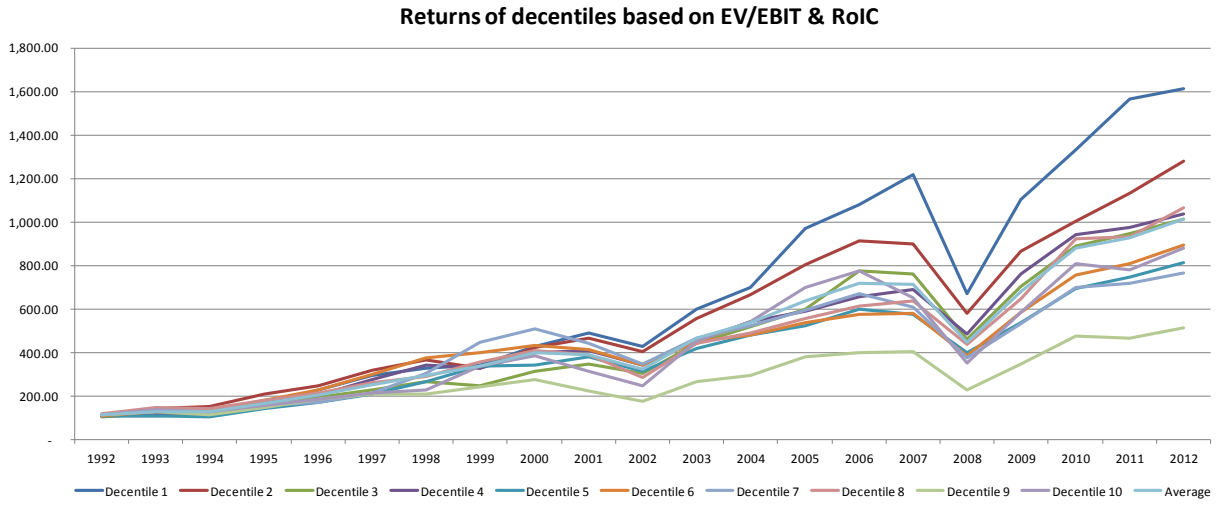
Adjusting the returns for risk provides similar results when applying the Sharpe ratio, the Modigliani-squared ratio, the Adjusted Sharpe ratio and the Jensen's Alpha in the analytical process. However, the ratios with a greater focus on downside risk provides different results as the lowest decentiles fare better. The impact of the performance of few stocks on the return of the portfolio is especially minor for decentile 2. This is however a general tendency as the impact on the performance of few stocks is much smaller than it was for RoIC. As such, it seems that EV/EBIT as a screenings tool identifies portfolios with much less diverging performances. The relationship between rank and return is statistically significant for the individual stocks, albeit not for decentiles. The performance of the best performing decentiles is to a large extent caused by stock picks rather than sector exposure.

3.3 Analysis of EV/EBIT & RoIC

As discussed earlier, January has been selected as the starting point of the studies, and as such, data ranging from 1992-2012 has been analyzed. However, for the combined analysis, the analysis has also been performed with a starting point in every other month to ensure that the findings are not biased by seasonal factors. In the following section, an analysis of the entire collated mass of data will be conducted, however, in order to ease manageability and understanding, the data with monthly starting point has been combined into to one average. All of the findings for the individual months are attached in the Secondary Exhibits "3.3 Analysis of EV/EBIT & RoIC" 1. As stated earlier, the EV/EBIT multiple has been selected as the price measure and RoIC as the return measure, and as such, these will continue to be the preferred measures in the combined analysis.

3.31 Returns

Considering the earlier findings it is interesting to see how the portfolios ranked on the basis of RoIC and EV/EBIT fare compared to the portfolios based solely on RoIC and EV/EBIT, respectively.



Grpah 3.31 Own construction

Based on the returns, it is notable that of the top four decentiles, all of them are among the five best performing portfolios in terms of return except when rebalancing semi-annually as figure 3.311 shows. It is of particular interest to observe that decentile 1 and 2 performs significantly better than the rest (14.9% and 13.6% in return, respectively, where the third best portfolio has a return of 12.6%). Decentile 9 & 10 once again provides subpar returns (8.5 % and 11.5 %). Thus if investors had invested $ 100 in decentile 1 in 1992 they would have ended up with $ 1,610.87 in 2012 compared to the market which would ended up being $ 1,010.92. Had investors invested $ 100 in decentile 9 & 10 in 1992 instead they would have ended up with $513.38 and 878.17 respectively. It is worth noticing that the performance of the best decentiles are lower than both the best returns achieved by rankings based solely on EV/EBIT or RoIC and better than the worst decentiles when ranking based solely on EV/EBIT and RoIC.

It is interesting that the results for decentiles 1-4 seem to explain investments results more effectively than when investing solely on the basis of RoIC and EV/EBIT. In those studies, it was found that investing solely based on RoIC and EV/EBIT resulted in the top decentile would have been the best investment, and that the bottom decentile would have been the worst. However, the remaining returns for the other portfolios were mixed, and it was difficult to distinguish a clear pattern. It is also worth noticing that when investing on the basis of RoIC and EV/EBIT, decentiles 5-10 seem to perform worse, even if their ranking is not in a descending order. Also, it is notable that the bottom half of the decentiles are also in the bottom half based on performance with the exception of decentile 8 which fares relatively well.

Annualized Return	Annualized Return Ranked Semi-Annual	Annualized Return Ranked Annualy Jan.	Annualized Return Ranked Annualy All Months	Annualized Return Ranked 3 years
Decentile 1	1	1	2	3
Decentile 2	6	2	1	2
Decentile 3	2	5	5	1
Decentile 4	4	4	4	4
Decentile 5	3	8	3	6
Decentile 6	10	6	9	8
Decentile 7	7	9	10	10
Decentile 8	8	3	7	5
Decentile 9	9	10	8	9
Decentile 10	5	7	6	7

Figure 3.311 Own constuction

As stated earlier, studies have also been conducted with starting months throughout the year in order to ensure consistency in the findings across all periods. Here, it is striking to observe that alike the January findings, decentile 1 and 2 perform significantly better than the rest of the portfolios. It is also worth noting that the top five decentiles are all among the top five performers in terms of return. Their performance is significantly better than decentiles 6, 7, 8, 9, and decentile10 as the worst performing portfolio. Of the top five decentiles, decentiles 5 has a return of almost 1 percentage point higher than the best performing portfolio in the lower half, illustrated in figure 3.312.

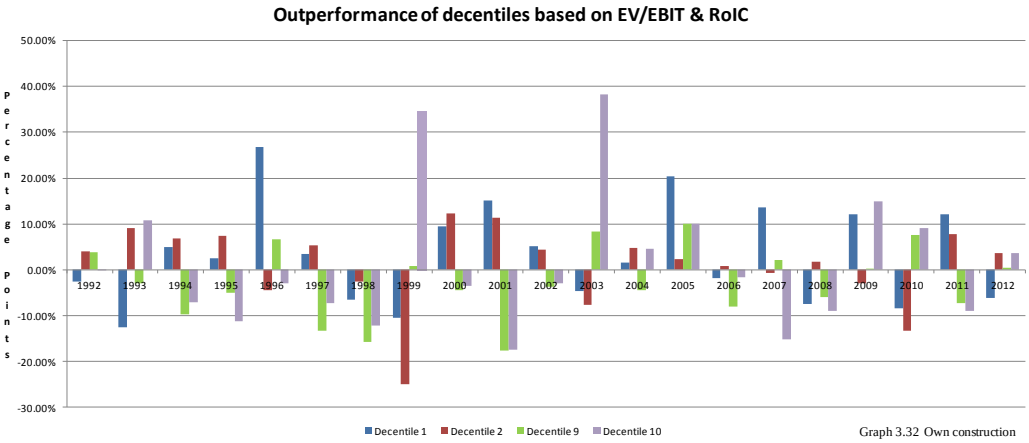
Annualized Return	Annualized Return Semi-Annual	Annualized Return Annualy Jan.	Annualized Return Annualy All Months	Annualized Return 3 years
Decentile 1	16.4%	14.9%	14.3%	12.3%
Decentile 2	12.0%	13.6%	14.5%	13.4%
Decentile 3	13.6%	12.3%	12.7%	13.5%
Decentile 4	12.2%	12.4%	12.7%	11.2%
Decentile 5	12.4%	11.0%	12.8%	9.7%
Decentile 6	9.8%	11.6%	11.0%	9.0%
Decentile 7	11.8%	10.7%	10.9%	7.5%
Decentile 8	11.3%	12.6%	11.7%	10.1%
Decentile 9	10.0%	8.5%	11.4%	8.6%
Decentile 10	12.1%	11.5%	11.8%	9.4%
Average	12.4%	12.3%	12.5%	10.8%

Figure 3.312 Own constuction

It is particularly interesting to note that the top four in January and top five in all months performs significantly better as their performance is better by at least one percentage point per annum than all the remaining portfolios with the rare exception of decentile 8 in January. This pattern is thus much stronger than for the top decentiles than what was found when ranking solely on the basis of EV/EBIT and RoIC. Furthermore the returns of the bottom half is fairly equally distributed which is contrary to previous tests on RoIC and EV/EBIT.

Initially, the focus has been on an annual rebalancing of the portfolio. However, a further analysis was conducted in order to gain insight into the consequences of rebalancing semi-annually and every three years. This allows for the possibility to analyze the strategies' long-term capabilities, and further investigate whether it will be beneficial to rebalance more frequently due to market corrections.

When rebalancing semi-annually, similar returns are evident in terms of how the portfolios perform relative to each other. However decentile 2 performs worse when rebalancing semi-annual as it is only the sixth best investment. It is also worth noting that decentile 6 is the worst portfolio to be invested in while decentile 10 performs mediocre as it is the fifth best investment. The top half once again outperforms the bottom half significantly. However, the absolute return by investing in the top decentiles and rebalancing semi-annually is considerably higher. If investors had invested in the top decentile and rebalanced semi-annually, the investor would have achieved an annual return of 16.4%, a total of 1.9 percentage points more than the outcome of the best possible investment with annual rebalancing. However, when rebalancing semi-annually, the worst performing portfolios performs better than when the holder period is longer. It should be noted that the results do not include transaction costs, which would have increased when rebalancing semi-annually.



Graph 3.32 Own construction

In terms of returns, if investors had invested in the various portfolios and held them for three years at a time, the top four decentiles once again provide the best returns. The top four decentiles are ranked number 4, 2, 3 and 1, respectively, upon annualized returns. The returns of the top four portfolios are significantly better than the bottom decentiles'. However, the bottom two decentiles perform relatively worse when compared to the annual and semi-annual holding period. The bottom decentiles would have yielded a return of only 8.6% and 9.4%, respectively, compared to the market return of 10.8% indicating that the companies are genuinely inferior.

3.32 Returns in Different Times

When analyzing the underlying reasons for the results, it is interesting to observe how the various portfolios outperform as well as underperform over differing time periods. In particular, it is considered highly notable to discern how the portfolios performed during bull markets, such as the late 90s and during crises such as the Internet bubble and the financial crisis.

Here, it must be noted that a difference in performance occurs in the various portfolios over differing time periods. Decentile 1 and 2 performed very similarly in different times, which is also the case for decentile 9 and 10. Furthermore, in the time leading up to the Internet bubble, decentile 1, 2, 9, and 10 all provided disappointing returns, except in 1999 where decentile 10 outperformed the average by more than 30 percentage points. This is in sharp contrast to the findings found in both EV/EBIT. This is surprising considering the negative correlation between top and bottom decentiles that was found in the two previous tests. After the bubble burst the top decentiles outperformed in the years 2001-2003 while the bottom decentiles underperformed the entire period. This is in line with the findings from EV/EBIT and it is interesting because it suggest that the top decentiles were underexposed to the IT sector in the late 1990s and early 2000s.

It is also worth noticing that the correlation of outperformance by decentile 1 and 10 is negative once again. However, the relationship is not as negative as earlier findings suggested based on the EV/EBIT multiple. These findings are summarized Primary Exhibits ”3.32 Returns in Different Times” 2.

The outperformance results are similar for the top and bottom decentiles when the holding period is three years or rebalancing occurs semi-annually. Especially in the time period around the Internet bubble, where the higher decentiles tended to outperform massively after the bubble burst, which Primary Exhibits ”3.32 Returns in Different Times” 3 and 4 illustrates.

3.33 Risk Measures

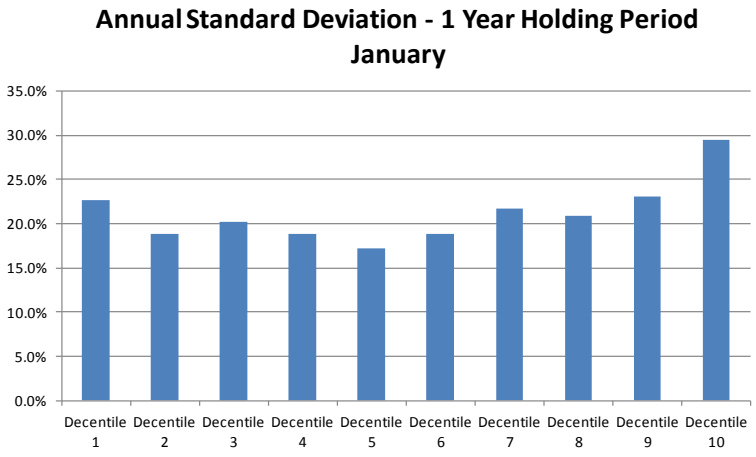
The returns of the different portfolios do not justify superior performance as this could be a result of excessive risk-taking. As conducted in the analysis of EV/EBIT and RoIC, the risk involved with investing in the different portfolios has been studied further.

When analyzing the standard deviation of the returns for the different portfolios, from a theoretical point of view, it should be expected that the top decentiles experienced the highest standard deviation, and the bottom portfolios experienced the lowest standard deviation. This should be the case as higher returns should be accompanied by higher risks. However, according to the analysis, when rebalancing annually, this is not the case. Here, the lowest decentiles actually experience the highest standard deviations, which are evident as decentile 9 and 10

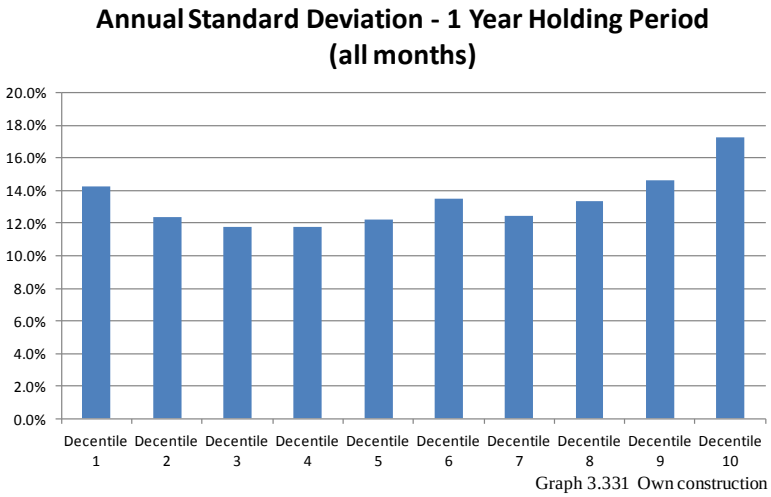
have the highest standard deviation, and the bottom five decentiles contain four of the portfolios with the highest standard deviations in returns. In other words, they not only have the worst returns, they also have the worst standard deviations, which is in line with earlier findings.

On the other hand, the top decentiles indeed have a relative high standard deviations as decentile 1have the eighth lowest standard deviation, respectively, (ranked ultimo January) which the figure 3.33 illustrates.

Just as it was the case with the EV/EBIT measures, and to a lesser extent the RoIC measures, there seems to be a tendency for the median portfolios to experience the lowest standard deviation. This pattern appears to be similar when considering the average results for one-year holding periods as well rebalancing semi-annually and every third year. Those results once again show that the bottom decentiles experience the highest standard deviations as decentile 9 and 10 rank ninth and tenth, respectively, in terms of standard deviation. The top decentile however ranks as 8 out of 10 in terms of standard deviation, and thus appear risky as well. Graph 3.331 illustrates the average standard deviation of the returns of the 10 portfolios with a one-year holding period. When examining the results of the standard deviation of the average returns for all months, the results confirm that there is a tendency for the median portfolios to experience the lowest standard deviations in returns. Thus, they appear to be the least risky portfolios as decentile 4, 5, and 6 have the second, first, and fourth lowest standard deviation of the returns. The relationship does however seem to be skewed slightly to the left. This is also evident from the fact that three of the bottom four portfolios have the fifth, fourth, second and highest standard deviation of



Graph 3.33 Own construction



Graph 3.331 Own construction

the returns.

Standard Deviation	Annual Standard Devation Ranked Semi-Annual	Annual Standard Devation Ranked Annually Jan.	Annual Standard Devation Ranked Annuly All Months	Annual Standard Devation Ranked 3 years
Decentile 1	8	8	8	5
Decentile 2	4	3	4	3
Decentile 3	5	5	1	4
Decentile 4	2	2	2	8
Decentile 5	1	1	3	1
Decentile 6	3	4	7	6
Decentile 7	6	7	5	2
Decentile 8	7	6	6	7
Decentile 9	9	9	9	9
Decentile 10	10	10	10	10

Figure 3.33 Own constuction

As with the research on EV/EBIT and RoIC the risk by using beta as a measure for risk have also been analyzed. Overall a clear picture emerges as decentile 1, 9 and 10 have the highest beta. This is in line with the standard deviation described earlier although the results are a little bit stronger when using beta. Furthermore the upper median portfolios seem to contain less risk by using beta as a risk measure which is in line with the findings on standard deviation.

Beta	Beta Ranked Semi-Annual	Beta Ranked Annually Jan.	Beta Ranked Annuly All Months	Beta Ranked 3 years
Decentile 1	7	8	8	7
Decentile 2	5	2	5	2
Decentile 3	2	3	3	6
Decentile 4	4	4	1	4
Decentile 5	1	1	2	1
Decentile 6	3	5	4	3
Decentile 7	6	6	6	5
Decentile 8	8	7	7	8
Decentile 9	10	9	9	9
Decentile 10	9	10	10	10

Figure 3.331 Own construction

3.34 Risk-Adjusted Returns

As it mentioned above, the correlation between risk and returns is not always crystal clear. Consequently, the risk-adjusted returns have been analyzed in the same manner as the EV/EBIT and RoIC based analysis. The results illustrate the top decentiles' tendency to deliver the highest in regard to Sharpe ratios. It is evident that at least four of the best five portfolios according to the Sharpe ratio are in the top half across all holding periods. When rebalancing semi-annually the top five ranks in Sharpe ratios are all among the top five decentiles, which indicates that this tendency is particularly evident when rebalancing is conducted biannually. However, it is

worth noticing that only when rebalancing semi-annually does the supposed best decentile produce best relative to the Sharpe ratio. In other periods, decentile 1 ranks second, third or fifth.

Annual Sharpe Ratio	Sharpe Ratio Ranked Semi-Annual	Sharpe Ratio Ranked Annualy Jan.	Sharpe Ratio Ranked Annualy All Months	Sharpe Ratio Ranked 3 years
Decentile 1	1	2	5	3
Decentile 2	5	1	1	1
Decentile 3	2	6	3	2
Decentile 4	4	3	2	5
Decentile 5	3	4	4	4
Decentile 6	8	7	8	7
Decentile 7	6	8	7	8
Decentile 8	7	5	6	6
Decentile 9	10	10	9	9
Decentile 10	9	9	10	10

Figure 3.34 Own construction

The reason is that even though the top decentile provided some of the best returns, the portfolio also incurred some of the highest standard deviations, which severely affects the Sharpe ratio. Decentiles 2 through 4 rank among the top five Sharpe ratios in all of the findings. In all of the measured periods except semi-annually, decentile 2 is the best performing portfolio according to the Sharpe ratio. Thus, although decentile 1 produces great returns, a lot of volatility is present which decreases the risk-adjusted returns hence making decentile 2 the best portfolio to be invested in according to the Sharpe ratio.

Decentile 9 and 10 ranks ninth and tenth in terms of Sharpe ratios across all holding periods. Considering the earlier findings of, at best, mediocre relative returns and very high standard deviations, this is as expected and suggests they have not performed well in the selected periods. This is the case for both returns and for the risk contained in the bottom portfolios.

When analyzing Jensen's Alpha, the results show that decentile 1 is either the best or third best portfolio to invest in according to the measure. Decentile 2 performs very well when rebalancing occurs annually and every third year, as it is one of the top three in all holding periods, except semi-annual where it ranks seventh. This relative poor performance is especially caused by a mediocre return which does not compensate for the risk incurred. Decentile 9 and 10 perform poorly which is evident in their low rankings, ninth and tenth, respectively, in all holding periods except in semi-annual where decentile 10 ranks fifth. There does seem to be a general pattern signifying that the top four decentiles perform well when using Jensen's Alpha, whereas decentiles 9 and 10 perform badly. This is interesting with the previously mentioned findings of beta in mind. Overall Jensen's Alpha explains that investors are compensated for the high risk (measured by beta) in decentile 1 which is not the case for decentile 9 and 10.

The research on Modigliani-squared generally shows that the top ranked decentiles performs superiorly. In all of the different holding periods, the top four decentiles contain three of the four best performing portfolios with the exception of semi-annual holdings, which contain the best and second best. Similarly, the performance of decentile 9 and 10 is poor as they are among the bottom four performing portfolios in all of our measured holding periods. However, decentile 10 is the fourth best when rebalancing semi-annually. Furthermore, in all of the measured holding periods, at least two of the top five portfolios are in the top half and vice versa for the bottom half, which once again seems to indicate that the top portfolios fare better. The pattern is especially clear when the results of rebalancing semi-annually is ignored.

M^2	M^2 Ranked Semi-Annual	M^2 Ranked Annualy Jan.	M^2 Ranked Annualy All Months	M^2 Ranked 3 years
Decentile 1	1	1	2	4
Decentile 2	5	2	1	2
Decentile 3	2	7	3	1
Decentile 4	6	4	5	3
Decentile 5	7	5	4	7
Decentile 6	10	3	8	5
Decentile 7	3	9	9	10
Decentile 8	8	6	6	6
Decentile 9	9	10	10	8
Decentile 10	4	8	7	9

Figure 3.342 Own construction

The results from the Omega ratio show that overall decentile 1 and 10 perform rather well, which further indicates that these portfolios contain stocks with significant upside potential. A picture emerges similar to the analysis of RoIC and EV/EBIT in that the median decentiles are more risky which is most likely because the performance of these portfolios is not to the same extent caused by a few stocks which decrease the upside and downside risk. It is quite insightful to discover that the median portfolios generally perform badly across different holding periods as top and bottom decentiles generally perform fairly well. This indicates that the upside potential is large compared to the downside potential of the different portfolios. One of the reasons the top and bottom portfolios fare so well could thus be that they include some stocks that considerably outperform the market which as it was the case in the findings on RoIC and EV/EBIT. This will be further investigated when analyzing the top and bottom stocks in section 3.35 Top & Bottom Performers.

Omega Ratio	Omega Ratio Ranked Semi-Annual	Omega Ratio Ranked Annually Jan.	Omega Ratio Ranked Annuly All Months	Omega Ratio Ranked 3 years
Decentile 1	1	6	3	2
Decentile 2	4	1	1	4
Decentile 3	7	8	4	6
Decentile 4	8	5	7	8
Decentile 5	9	4	6	1
Decentile 6	10	7	9	3
Decentile 7	6	10	10	7
Decentile 8	2	3	8	9
Decentile 9	3	9	5	10
Decentile 10	5	2	2	5

Figure 3.343 Own construction

The results from the Calmar ratio are quite vague, and there seems to be no discernible pattern when considering different holding periods. The results for the top and bottom performers vary a great deal and the top and bottom portfolio rank anywhere from fourth to tenth. The reason for this could be a result of the maximum drawdown. If the maximum drawdown is too large, this could have a major negative effect on the Calmar ratio. This will be determined in the following section.

Calmar Ratio	Calmar Ratio Ranked Semi-Annual	Calmar Ratio Ranked Annualy Jan.	Calmar Ratio Ranked Annualy All Months	Calmar Ratio Ranked 3 years
Decentile 1	5	5	7	3
Decentile 2	9	8	2	8
Decentile 3	6	3	1	5
Decentile 4	2	7	8	2
Decentile 5	1	10	5	6
Decentile 6	7	6	9	9
Decentile 7	8	1	6	10
Decentile 8	3	2	4	1
Decentile 9	4	9	10	4
Decentile 10	10	4	3	7

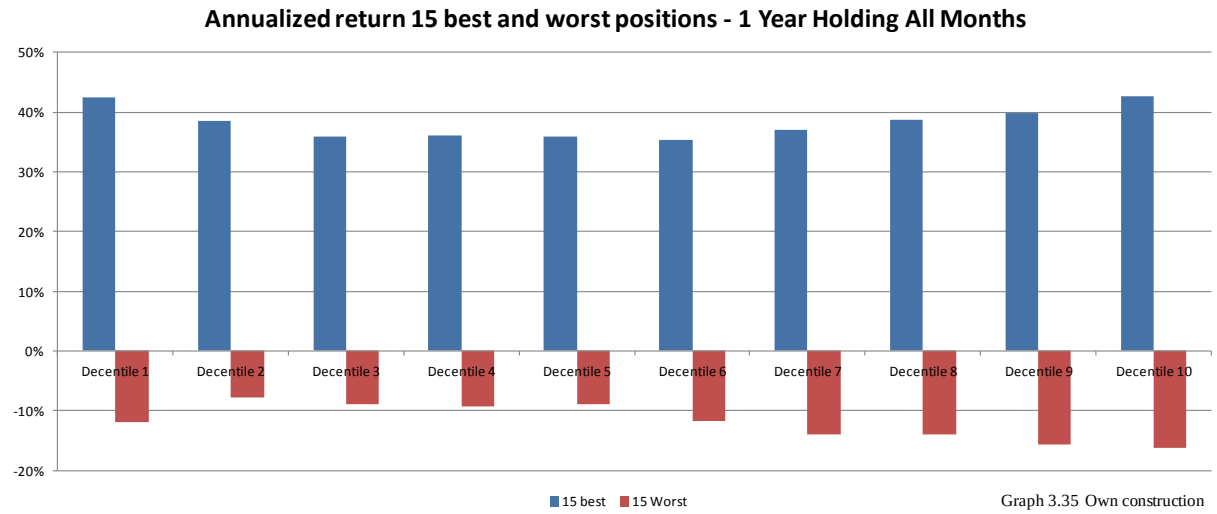
Figure 3.344 Own construction

3.35 Top and bottom performers

Another way to perceive risk – especially when considering the model as a screening tool – is to analyze how the best and worst performing stocks within the portfolios behave.

The findings show that decentile 1 usually contains the 15 best performing stocks as it is either the best or second best across all holding periods. Decentile 2, however, does not perform very well. The return for the 15 best returning stocks within the portfolio is only fifth best when the holding period is one or three years, and the worst when the holding period is six months. It is notable that of the 15 best performing stocks, decentile 10 combined with decentile 1 is clearly superior in terms of return. Decentile 10 ranks as number one and two when the holding period is six or twelve months, however, it ranks second worst if the holding period is three years. There also seems to be a general pattern that the median stocks contain the least amount of stellar performers which is in line with earlier findings although the results are not as clear as in earlier findings.

When looking at the worst performers, it is particularly interesting to note that decentile 9 and 10 have the 15 worst performers in all holding periods, and that decentile 8 has the third or fourth worst in all holding periods other than three years. This is interesting for two reasons; firstly it implies that the performance of the bottom decentiles is a result of the stellar performance of some stocks and subpar returns of others which is supported by the higher standard deviations of the portfolios. Secondly the ranking based on EV/EBIT & RoIC tend to capture the worst performing stocks within the four lowest decentiles which is in accordance to solely ranking on RoIC and EV/EBIT however it is more evenly distributed. It is also remarkable that decentiles 2, 3, 4, and 5 provide the least bad returns regardless of how often the portfolio is rebalanced.



Graph 3.35 Own construction

Thus, there is a clear pattern that the bottom portfolios contain some of the stocks with the worst returns, while the top performers generally contain stocks that do not provide the worst returns, except decentile 1. These findings are in line with the Omega ratio as the upside and downside potential expressed by the 15 best and worst performing stocks within each decentile is much larger for the top and bottom portfolios than for the median portfolios.

3.36 Decomposition of Return

Similar to the analysis of EV/EBIT and RoIC, the returns of the respective rankings have been divided into sector contribution and stock contribution in order to better understand the nature of the returns. As stated earlier, a pattern was evident in terms of the returns that were derived and the rankings of the constructed portfolios based upon the companies' EV/EBIT multiples and RoIC values. Generally, the top portfolios provided better returns (adjusted and unadjusted for risk) while the lower decentiles generally performed poorly, both before and after adjusting for risk although the result wasn't as clear for RoIC.

The results are considered quite interesting as the superior returns of decentile 1 and 2 are due to better stock picks when rebalancing annually. In fact, the sector pick was actually negative for decentile 2, and

Annual	Annualized Sector Pick	Annualized Stock Pick
Decentile 1	0.4%	2.5%
Decentile 2	-0.3%	1.3%
Decentile 3	0.1%	-0.3%
Decentile 4	-0.1%	-0.1%
Decentile 5	0.3%	-2.2%
Decentile 6	0.9%	-1.9%
Decentile 7	-0.7%	-0.9%
Decentile 8	-0.3%	0.7%
Decentile 9	-1.3%	-1.9%
Decentile 10	0.1%	0.5%
Average	0.0%	0.0%

Figure 3.36 Own construction

thus the entire positive outperformance is a result of superior stocks. For decentile 1, stock contribution is 2.5% annually. This tendency is generally the same when rebalancing semi-annually or every third year. In each case, in the top four portfolios, the stock pick is the main factor of outperformance. One noticeable exception, however, is decentile 1 when rebalancing every third year where sector contribution is the main contributor. As such, it seems the outperformance of the top decentiles is due to mainly stocks that create excess return. However, the stock contribution is the biggest factor in the favorable returns.

The outperformance from the lower decentiles shows a tendency to be driven by stock contributions as well. This is the case when rebalancing annually and semi-annually. When rebalancing every third year, however, the lowest decentiles' (9 and 10) performance is almost as much a result of poor sector contribution as poor stock contribution. However, for the median portfolios when rebalancing every three years, the sector contribution revolves around zero while the stock contribution generally remains negative. When rebalancing annually, the median portfolios actually provide a positive sector return but a negative stock contribution ruins the outperformance. Accordingly, it is curious to note that the negative outperformance of the lower decentiles is generally a result of both poor sector allocation as well as poor selection of stocks, where the stocks are the most significant factor. This suggests that the model is mainly advantageous to use for stock selection and not sector allocation.

An alternative method of analyzing how the different portfolios perform during different times, is to categorize the sector and stock contribution into the top three decentiles, median four, decentiles, and bottom three decentiles. This is based on the reasoning that similarities between the returns and risks of these groups have been observed, and the results indicate that the top decentiles outperform the market while the bottom decentiles underperform. Figure 3.361 illustrates the decomposition of the returns when the rebalancing is conducted in January:

Contribution - Top 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	0.8%	-2.1%	2.7%	-0.5%	-1.7%	1.4%	-3.0%	-10.4%	2.8%	5.2%	2.9%	-3.6%	2.1%	3.4%	0.8%	4.6%	-2.5%	1.7%	-2.3%	1.3%	-0.2%
Stock Pick	-2.4%	0.4%	3.0%	6.0%	6.4%	-0.4%	-1.0%	-8.7%	8.2%	7.3%	2.0%	-0.2%	0.8%	3.0%	4.5%	-0.7%	-0.1%	1.5%	-6.0%	5.7%	-1.4%
Outperformance	-1.6%	-1.7%	5.7%	5.5%	4.7%	1.0%	-4.0%	-19.1%	11.0%	12.5%	4.9%	-3.7%	2.9%	6.3%	5.3%	3.9%	-2.6%	3.2%	-8.3%	7.0%	-1.6%

Contribution - Median 4 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-0.5%	-1.2%	0.0%	1.0%	0.0%	1.1%	5.9%	-2.6%	-0.2%	0.3%	0.2%	-1.0%	-0.2%	-3.3%	0.8%	-1.2%	1.3%	-2.1%	-0.8%	0.5%	0.3%
Stock Pick	-1.4%	-2.1%	-0.1%	-1.3%	-3.9%	1.5%	4.5%	9.0%	-3.3%	0.9%	-1.0%	-7.5%	1.0%	-3.3%	-0.3%	-0.3%	2.0%	-3.4%	-0.3%	-1.1%	-1.6%
Outperformance	-1.9%	-3.2%	-0.1%	-0.3%	-3.9%	2.6%	10.3%	6.4%	-3.5%	1.2%	-0.8%	-8.4%	0.8%	-6.5%	0.5%	-1.5%	3.3%	-5.5%	-1.1%	-0.5%	-1.3%

Contribution - Bottom 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-0.3%	2.6%	-3.3%	-2.1%	1.1%	-4.2%	-5.2%	11.6%	-2.0%	-5.2%	-3.4%	6.3%	-1.4%	2.4%	-1.9%	-3.1%	0.6%	-0.8%	2.7%	-1.9%	-0.3%
Stock Pick	4.5%	2.8%	-3.4%	-4.6%	-1.1%	-2.9%	-6.5%	2.4%	-1.2%	-7.5%	-1.8%	12.5%	0.1%	2.4%	-2.3%	0.5%	-3.7%	4.4%	7.3%	-5.0%	3.4%
Outperformance	4.2%	5.4%	-6.7%	-6.7%	0.0%	-7.0%	-11.6%	14.0%	-3.2%	-12.7%	-5.2%	18.8%	-1.3%	4.8%	-4.2%	-2.7%	-3.1%	3.7%	10.0%	-6.9%	3.1%

Figure 3.361 Own construction

During the Internet bubble in the late 90s, the top decentiles had a negative sector contributions and stock contributions in 1998 and 1999. The sector contribution is the largest factor when rebalancing annually with a negative contribution of 3% in 1998 and negative contribution of 10.4% in 1999. Indicating that the IT sector was vastly

underweighted compared to the market which is also the case. The results are similar when the holding period is three years as the sector contribution for the top three decentiles from 1998-2001 was -5.7%, while the stock contribution was actually positive with 0.6%. The sector contribution is similarly negative when rebalancing semi-annually with -1.8% in 1998 and -9% in 1999. However, the stock contribution is slightly more negative for both years. As a result of this, the top three decentiles all underperformed the market in the late 90s regardless of the holding period. After the bubble burst in 2000, the top three decentiles vastly outperformed the market. However, this pertained to all three holding periods mainly due to stock picking, although sector contribution was positive in all of the circumstances which is in line with our findings on EV/EBIT but contrary to the findings in RoIC.

Considering the earlier findings in terms of correlation, the results for the bottom decentiles are, not surprisingly, quite opposite. They outperform the market immensely in 1999 with an outperformance of 14% when rebalancing annually, and an outperformance of 17.5% if rebalanced semi-annually. The largest part of this outperformance is due to sector contribution (11.6% annually and 10.2% semi-annually). Suggesting that the bottom decentiles were heavily overexposed to the IT sector. However, this was not the case had the holding period been three years. The most likely reason being that the holding period is 1998-2001, and considering that stocks with high EV/EBIT multiples fell massively after the bubble burst in 2000,[299] this should have a large impact on the results. Not surprisingly, the bottom decentiles underperformed the return of the market from 2000-2002 by -3.2%, -12.7% and -5.2%, respectively when rebalancing annually, and -3.7%, -14.3% and -2.9% if rebalanced every six months. From 2001-2004, the bottom three decentiles underperformed by 14.5% when rebalanced every three years. For the annual and semi-annual holding period, the stock contribution is the main reason behind this underperformance, although the sector contribution is negative as well. For the three-year holding period, the sector allocation is the biggest source of underperformance. This suggests that if this model is used as a screening tool the stocks available could underperform in long periods of time. However it also seems to be the case that the best decentiles will eventually outperform.

During and after the financial crisis, the top decentiles performed differently. They outperformed in 2007 and 2009, yet underperformed the market in 2008 and 2010 for both a six-month holding period and an annual holding period. The outperformance in 2007 and 2009 was respectively between 3.2% and 4.0%, while the underperformance was negative 0.1% and 1.4% in 2008, and was much larger at negative 8.3% and 8.6% in 2010. The top three portfolios underperformed the market by 1.4% from 2007-2010 due to a negative stock contribution of 2.4%, while the sector allocation contributed with a positive outperformance of 1%. In 2008 and 2009, the bot-

[299]Primary Exhibits "3.26 EV/EBIT Decomposition of return" 1

tom decentiles provided a negative outperformance of -2.7% and -3.1% with an annual holding period and 3.4%, and 4.1% when rebalancing semi-annually. The biggest factor in the poor performance was the sector allocation in 2007, while in 2008, the selected stocks were the issue. In 2009 and 2010, the bottom three decentiles outperformed in both annual and biannual holding periods. For the 12-month holding period, the excess returns were 3.7% in 2009 and 10.0% in 2010, and for the six-month holding period, the excess returns were 4.3% and 11.2%, respectively. These returns were largely driven by stock picking in both periods. If an investor had a three year holding period, the returns in 2007-2010 would have been -2.4% lower than that of the market. The results are thus not as clear as was the case with the Internet bubble. This is most likely a consequence of the type of crises. Whereas the Internet bubble affected certain sectors significantly the financial crises affected entire markets. This is especially the case for this thesis as financials stocks are not included.

Contribution - Top 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-0.9%	-1.1%	1.3%	0.7%	-0.1%	1.1%	-1.8%	-9.0%	0.7%	2.6%	1.9%	-2.6%	2.1%	2.8%	0.1%	2.6%	-2.0%	0.3%	-1.7%	0.7%	0.2%
Stock Pick	1.4%	2.0%	5.7%	5.2%	3.6%	1.4%	-3.0%	-10.5%	11.5%	10.5%	-0.7%	-2.7%	2.3%	4.6%	4.5%	1.3%	0.6%	3.5%	-7.0%	5.7%	-1.6%
Outperformance	0.5%	0.9%	7.0%	5.9%	3.5%	2.4%	-4.8%	-19.6%	12.2%	13.1%	1.2%	-5.3%	4.4%	7.4%	4.6%	4.0%	-1.4%	3.7%	-8.6%	6.4%	-1.4%

Contribution - Median 4 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	-0.8%	-0.8%	-0.1%	0.9%	0.1%	0.7%	2.6%	-1.3%	-0.4%	0.4%	0.1%	-1.4%	-0.3%	-2.0%	1.0%	-0.6%	1.0%	-1.4%	-0.5%	0.8%	0.3%
Stock Pick	0.4%	-2.6%	1.0%	-0.9%	-3.2%	2.7%	3.9%	4.5%	-4.6%	0.8%	0.9%	-4.5%	0.1%	-1.4%	-1.2%	0.9%	2.5%	-3.1%	0.6%	-0.5%	-2.6%
Outperformance	-0.4%	-3.4%	0.9%	0.1%	-3.1%	3.3%	6.5%	3.2%	-5.0%	1.2%	1.0%	-6.0%	-0.2%	-3.3%	-0.2%	0.3%	3.5%	-4.5%	0.1%	0.3%	-2.2%

Contribution - Bottom 3 decentiles	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sector Contribution	2.5%	1.8%	-1.3%	-2.9%	-0.4%	-2.7%	-3.2%	10.2%	-0.1%	-3.1%	-2.5%	4.4%	-1.3%	0.7%	-1.7%	-2.0%	0.3%	0.4%	2.3%	-1.9%	-1.0%
Stock Pick	0.2%	4.2%	-6.0%	-3.3%	1.2%	-5.2%	-3.0%	7.2%	-3.6%	-11.2%	-0.4%	13.3%	-0.5%	0.3%	-1.5%	-1.4%	-4.4%	3.9%	8.9%	-5.9%	3.4%
Outperformance	2.8%	6.0%	-7.2%	-6.2%	0.8%	-7.9%	-6.2%	17.5%	-3.7%	-14.3%	-2.9%	17.7%	-1.8%	1.0%	-3.2%	-3.4%	-4.1%	4.3%	11.2%	-7.8%	2.4%

Rebalancing done semi-annualy

Figure 3.362 Own construction

3.37 Decomposition of Portfolios

When analyzing Greenblatts method for stock picking as a screening tool, it is advantageous to consider what type of companies the various portfolios contain, and whether some sectors are over or underrepresented as this could explain some of the characteristics of the various decentiles. The results suggest that the different decentiles do in fact contain different types of companies. For instance, decentile 1 is overweight in the consumer discretionary sector in all different holding periods with at least 8 percentage points compared to the average. This is in stark contrast to decentile 10, which is underweight in consumer discretionary across all holding periods at between 2-4 percentage points. Another sector where the differences are obvious is the information technology sector. This sector has a relatively large underweight in decentile 1, but is relatively overweighed in decentile 10. This corresponds to the findings in the EV/EBIT studies, and could thus be a result of very high EV/EBIT multiples. It is also somewhat the same result as found in RoIC except that the information technology sector was overrepresented in decentile 1 when ranking on the basis of RoIC. This is something to be aware of if using the model as a screening tool the reason being that the stocks to choose from will mainly be from certain sectors.

It is further interesting to note that the different decentiles have some sectors that are under and overrepresented in common. As an example, both the industrial sector, the consumer staples sector, and the health care sector is relatively underweighted in both decentile 1 and 10, while the energy sector has an overweight. This is in sharp contrast to the findings in RoIC where the health care sector was overrepresented in decentile 1, and underrepresented in decentile 10. This is the same for consumer staples which is underweighted, however, the fact that both decentile 1 and 10 are underweighted is expected based on the RoIC findings.

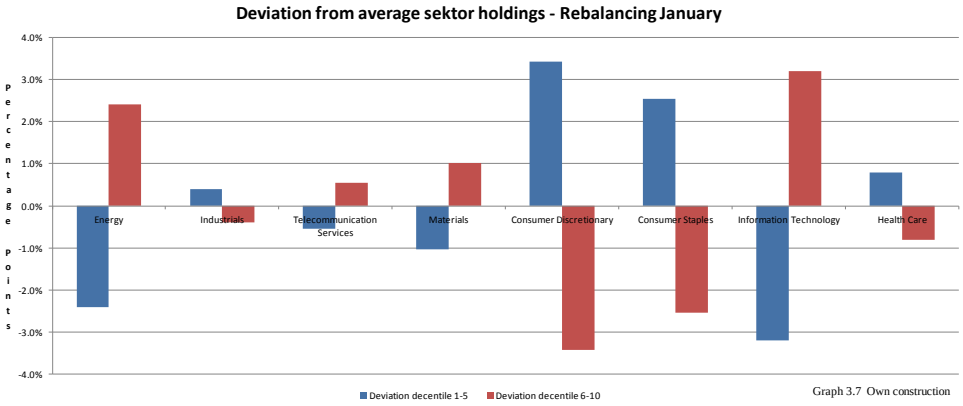
Sector - Decentile 1 (Deviations in percentage Points)	Deviations From Average Semi-Annual	Deviations From Average Annual Jan.	Deviations From Average Annual All Months	Deviations From Average 3 Years
Energy	1.8%	2.3%	0.1%	4.0%
Industrials	-1.0%	-2.1%	-6.0%	-2.7%
Telecommunication Services	-1.4%	-1.6%	-2.1%	-2.4%
Materials	-0.5%	0.4%	-2.4%	-0.8%
Consumer Discretionary	8.8%	8.9%	2.7%	8.0%
Consumer Staples	-2.7%	-2.3%	-5.7%	-2.6%
Information Technology	-2.6%	-2.5%	-6.4%	-1.3%
Health Care	-2.4%	-3.0%	-5.2%	-2.3%

Figure 3.37 Own construction

Sector - Decentile 10 (Deviations in Percentage Points)	Deviations From Average Semi-Annual	Deviations From Average Annual Jan.	Deviations From Average Annual All Months	Deviations From Average 3 Years
Energy	8.8%	8.6%	3.5%	6.1%
Industrials	-6.1%	-5.7%	-8.7%	-1.6%
Telecommunication Services	0.9%	1.3%	-0.4%	-1.2%
Materials	4.6%	4.2%	1.3%	5.4%
Consumer Discretionary	-4.2%	-4.9%	-9.0%	-2.8%
Consumer Staples	-7.4%	-7.4%	-8.0%	-7.5%
Information Technology	6.7%	7.2%	1.5%	4.6%
Health Care	-3.3%	-3.3%	-5.1%	-3.0%

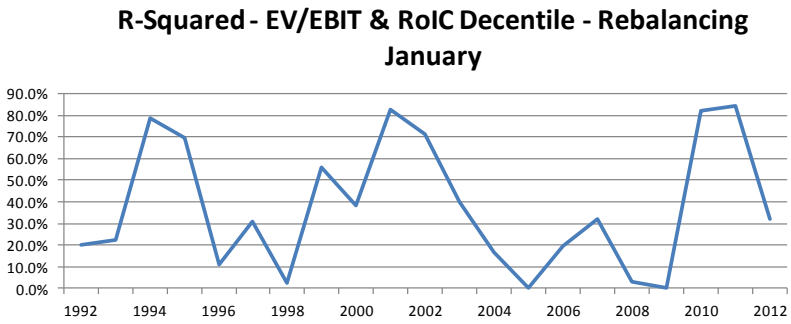
Figure 3.371 Own construction

Another interesting point in the results of different sector allocations within the portfolios is that the same type of sectors are over and underrepresented in the different decentiles regardless of the holding period. There is a remarkably small difference in decentiles' deviations from the average in different holding periods. This is consistent with the findings in the theoretical section, where different sectors were found to tend to have different returns on invested capital and different EV/EBIT multiples. It was also discovered that this lasts over time.

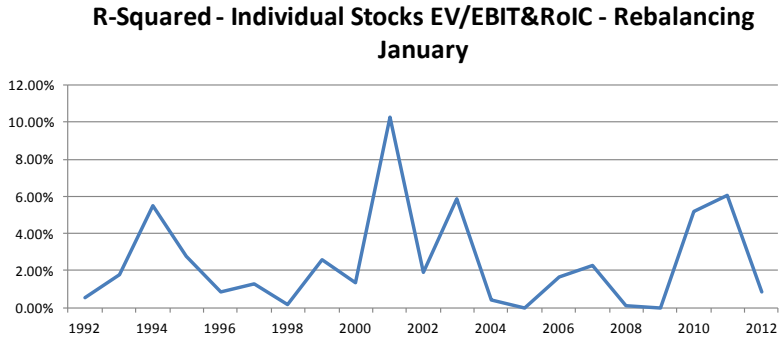


Graph 3.7 Own construction

To gain additional insight into the explanatory power of the ranking of EV/EBIT & RoIC on the returns, both on individual stock level as well as portfolio level, a regression analysis of the relationship between rank and return has been performed. Graph 3.72 illustrates the R^2 for the regression between rank and return, which varies quite significantly from year to year with a maximum explanatory power of 10.37% in 2001 and 0% in 2009. In addition, R^2 of the regression for the total ranking of the stocks and the returns over the 20-year period is 0.087% indicating that the relationship is fairly weak. Furthermore, a similar analysis was conducted for the ranking of the decentiles and the return of these. Overall, the rank of the decentiles largely explains the returns compared to the individual stocks. However, the R^2 varies a lot as it explains 84.4% of the returns in 2011 and 0% in 2009, summarized in graph 3.71. Moreover, the relationship between rank and return is statistically significant for the rankings of the individual stocks from1992-2012 since the p-value is 0.0142.[300]



Graph 3.71 Own construction



Graph 3.72 Own construction

However, the relationship between rank and return of the decentiles is not statistically significant since the p-value is 0.5885.[301] Thus, as were the case for ranking on EV/EBIT but contrary to ranking on RoIC there is a statistical significant relationship between the rank and the return. This confirms the findings namely that the combined ranking to a larger extent is able to segregate the five best performing portfolios and the five worst performing portfolios. This was not to the same extent the case when ranking especially on RoIC but also when ranking solely on EV/EBIT.

[300] Primary Exhibit "3.37 Decomposition of Portfolios" 1
[301] Primary Exhibit "3.37 Decomposition of Portfolios" 2

3.38 Summary of Analysis of EV/EBIT & RoIC

EV/EBIT & RoIC as a screening tool generally concede the identification of the best performing portfolios. In addition, the screening tool is able to detect poor performing portfolios. These results are similar across all of the measured holding periods.

The outperformance of the best decentiles is not as significant for EV/EBIT, and the underperformance of decentile 10 is not as poor as it would be when ranked on RoIC. Adjusting the returns for risk provides similar results as the overall the performance of decentiles 1-5 is better after adjusting for risk than the performance of decentiles 6-10. These risk-adjustments are based on the Sharpe ratio, the Modigliani-squared ratio, the Adjusted Sharpe ratio, and the Jensen's Alpha.

The risk measures with an emphasis on downside risk do not support these findings. The outperformance of decentile 1 and 2 is negatively correlated with the outperformance of decentile 9 and 10 as it was the case for the testing of RoIC and EV/EBIT. The tests further show that generally the returns of the decentiles are caused by stock pick.

The portfolios perform vastly different across different time periods, i.e. during bull markets and crises. For example, from the Internet bubble in the late 90s, there is a general trend that decentiles 1 and 2 underperform in the period leading up to the crises. On the other hand, decentile 9 and 10 outperform during this period. In the aftermath of the burst, however, the roles have changed, and decentile 1 and 2 outperform while decentiles 9 and 10 severely underperform. Interestingly, the findings present this pattern in reverse during the financial crises in 2007, 2008, and 2009.

Furthermore, the relationship between rank and return is statistically significant for individual stocks but not for decentiles per se. These findings are similar to the findings of EV/EBIT but not the findings of RoIC where the relationship was statistically insignificant for both individual stocks and decentiles.

Additionally test performed on other markets provide similar results which is summarized in Secondary Exhibit "3.38 Summary of Analysis of EV/EBIT & RoIC" 1.

3.4 Sectors

The extent to which t the "Magic Formula" can be used as a screenings tool for GIC sector levels has been analyzed. Due to the amount of companies in the various sectors, the companies have been divided into 4 quartiles, where quartile 1 consists of the companies with the 25% best combined scores of EV/EBIT and RoIC within the GIC sector, quartile 2 consists of the top 25%-50%, and so forth. Each portfolio is held for one year and then

subsequently rebalanced ultimo January. Additionally, it is important to consider that the portfolios consist of few stocks, and are therefore is quite concentrated.

3.41 Annualized Return & Standard Deviation of the Returns

It is considered interesting to observe whether the model is a better approach for some sectors than others, and whether this could be a contributing factor as to why some decentiles outperform others. The figures below provide an overview of the annualized return and ranking of the quartiles for the eight GIC sectors, and provide an overview of the ranking of the quartiles. Overall, quartile 1 performs quite well as it has the highest annualized return in five of the eight sectors. For the three remaining sectors, quartile 1 has the second highest annualized return.

Furthermore, quartile 4 performs poorly overall, and has the lowest annualized return in 5 of the 8 sectors. Quartile 2 and 3 perform quite differently among the various sectors. To elaborate, in three of the eight sectors, quartile 2 is among the top two performing quartiles, and in five of the eight sectors, it is among the two worst performing portfolios. Quartile 3 is among the two worst performing portfolios in five of the eight sectors, and in half of the sectors, it is the third best performing quartile.

Annualized Return	Consumer Staples	Consumer Discretionary	Energy	Health Care	Industrials	Information Technology	Materials	Telecommunication Services
Quartile 1	15.8%	10.4%	16.3%	14.0%	13.8%	15.7%	10.8%	15.1%
Quartile 2	12.9%	10.4%	13.5%	16.5%	9.7%	11.7%	9.1%	3.8%
Quartile 3	10.6%	9.6%	13.9%	10.8%	12.3%	16.1%	5.9%	14.0%
Quartile 4	7.3%	9.6%	9.8%	9.4%	12.9%	7.8%	10.6%	9.8%
Average	11.9%	10.3%	13.8%	12.9%	12.3%	13.7%	9.3%	11.6%

Figure 3.41 Own construction

From the sector decomposition of returns, it is apparent that the Energy sector is the best performing sector, slightly ahead of information technology. This is quite interesting as both sectors were some of the largest relative exposures for decentiles 1-5, and was the largest relative exposure for decentiles 6-10. This is also particularly interesting as these were some of the sectors where the exposures were significantly different when ranking on the basis of RoIC and EV/EBIT alone. The energy sector was one of the largest exposures when ranking according to EV/EBIT but was underexposed when ranking on the basis of RoIC. The opposite was the case for the information technology sector. The fact that the IT and energy sector are the best performing sectors suggest that the lower decentiles must have had a positive sector return from these exposures, and thus their subpar performance must be a result of poor stock selections. The research on the sectors support this as the returns across the different quartiles in both the energy and IT sector are vastly different and are in fact some of the sectors where the returns vary the most. Another interesting finding from the different sector returns is that the health care and industrials sectors are the third and fourth best performing sectors. This is as expected as the top decentiles gen-

erally tend to have slightly larger exposures towards these sectors compared to the market, while the lower decentiles are slightly underexposed.

Among the worst performing sectors are the two consumer sectors that rank fifth and seventh. This is of particular interest as the two sectors are some of the largest relative overweight's for the top decentiles, while the sectors had a major underweight in the lower decentiles. Once again, this suggests that the superior returns are a result of better stock picks or market timing in regard to the different sector exposures. However, it is also very interesting that the two consumer sectors are the only sectors where the returns of the quartiles are ranked in the "right" order. Other sectors that performed subpar were telecommunications services, which the sixth best performing sector, and materials, which was the worst performing sector. The top decentiles were slightly underexposed towards those sectors whereas the lower decentiles were overall slightly overexposed indicating that there was some positive sector contribution towards the top decentiles.

Considering that RoIC was found to be a theoretically sound measure to determine whether companies or industries were of high quality, it is also interesting to observe how the sectors with the highest returns on invested capital fared. Of particular note is the fact that the one sector where RoIC was most overexposed was the health care sector, which in fact is one of the best performing sectors. Contrary to this however, one of the sectors that should be most underexposed according to RoIC is the energy sector, which in fact had the best return during the period. The IT sector is also very interesting because it contained companies that both had the highest and the lowest returns on invested capital, thus indicating vastly different types of companies within the sector. The sector did achieve one of the best performances, but the returns were very mixed across the decentiles, and it is thus compelling to further analyze how the different types of companies fared. Other sectors that would have had an overexposure had the investor only invested on the basis of RoIC would have been the two consumer sectors. These sectors had below average returns. This indicates that using RoIC for sector allocations is most likely not a good idea. A major reason for this is that returns on invested capital do not factor in the price of the company, and the high returns could thus be bought at "premium".

As such, it is relevant to refer to the sector exposure for the rankings made on EV/EBIT multiples. According to EV/EBIT, the largest exposure relative to the market should have been the energy, consumer discretionary, and materials sectors. This is significant as the overweight in the energy sector would have been very favorable as the sector had the highest return. Contrary to this, the materials and consumer discretionary sectors were the two worst performing sectors. Another interesting aspect is that one of the major underexposed sectors would have been the IT sector, which has the second best performance of all sectors. This is similar to the results in the health care sector that performed well and would have had a lower weight than the market. It thus seems that

neither EV/EBIT or RoIC, or the combination of the two measures is very good at predicting sector returns. However, it must be taken into account that these are returns over a longer period, and if the sectors were over and underweighted in the sectors at different times (i.e. during the internet bubble), this could change the results significantly.

It is considered interesting to review the standard deviation of the returns of the different quartiles in the eight GIC sectors. The following figure illustrates that although quartile 1 has the highest or second highest annualized return, in four of the eight sectors, the quartile has among the two lowest standard deviations of these returns. Furthermore, the return of quartile 4 has the highest standard deviation in five of the eight sectors, and for the remaining three, it has the second highest standard deviation. Moreover, the return of quartile 2 has among the two lowest standard deviations for seven out of the eight sectors. For quartile 3, the results are mixed due to the fact that the returns of this quartile have among the two lowest standard deviations in five of the eight sectors.

STD	Consumer Staples	Consumer Discretionary	Energy	Health Care	Industrials	Information Technology	Materials	Telecommunication Services
Quartile 1	20.9%	23.0%	26.1%	22.2%	20.4%	32.8%	25.1%	29.1%
Quartile 2	16.1%	26.2%	25.7%	20.6%	21.3%	34.4%	23.2%	25.9%
Quartile 3	15.8%	24.8%	28.5%	16.8%	19.3%	53.6%	20.6%	30.3%
Quartile 4	16.7%	29.3%	31.0%	22.0%	21.0%	38.3%	28.0%	25.0%
Average	15.8%	24.9%	26.1%	18.9%	19.5%	35.3%	22.6%	21.1%

Figure 3.42 Own construction

In regard to the standard deviation, it is notable to observe how it affects the sectors in which the top and bottom decentiles have an over/underexposure towards when based on EV/EBIT, RoIC, and a combination of the two. It is particularly interesting that the IT and energy sector are the two sectors with by far the highest standard deviations during the period. This suggests that the two sectors indeed achieve the highest returns but also incurs the highest standard deviations in their returns. This is not surprising for the IT sector considering the period measured encompasses the Internet bubble and the subsequent burst. It is however also remarkable that the highest quartiles have the lowest standard deviations, and the lowest quartiles incur the highest standard deviations. As a result, in general the risk-adjusted returns are also best for the top portfolios and lowest for the bottom portfolios which can be seen in Secondary Exhibit "3.41 Annualized Return & Standard Deviation of the Returns" 1.

Another aspect worth researching is the periods in which the various sectors outperform the market as this can provide further insight into the results of the portfolios.

The outperformance of quartile 1 within the consumer staples industry is caused by a strong performance during the Internet bubble from 2003 to 2006 and during the financial crisis. On the other hand, the poor performance of quartile 4 is also caused by the circumstances during these periods. In regard to consumer discretionary, quartile 1 does not perform particularly exceptionally, but quartile 4 underperforms during the Internet bubble as well as

during the financial crisis, which is considered the main explanation of the fact that the portfolio is the worst performer. For quartile 1, the outperformance does not to the same extent occur in longer periods. Within the energy sector, quartile 1 is the best performing and quartile 4 is the worst performing. The outperformance of quartile 1 is especially strong in the early 1990s and the early and mid-2000s. On the other hand, the poor performance of quartile 4 is especially inferior to its peers in the period from 1998-2004 as well as during the financial crisis.

Within the health care sector, quartile 1 is the second best performer, and quartile 4 is the worst performer. Quartile 4 underperforms significantly from 1994 to 2001 as well as from 2004 to 2009. For quartile 1, the outperformance cannot to the same extent be explained by the performance during specific periods. Within the industrials sector, quartile 1 is the best performing portfolio, and quartile 4 is the second best. The performance of quartile 1 is especially strong during the late 1990s and mid-2000s, and quartile 4 performs strongly during the Internet bubble.

Within the IT sector, quartile 1 is the second best performer, and quartile 4 is the worst performer. During the Internet bubble, quartile 1 performs relatively well, and from 1998 to 2002, the total decrease of the portfolio is 21%. Quartile 4 performs significantly worse during this period with a total decrease of 40%. However, during the financial crisis, the results are reverse as quartile 4 outperforms the IT market and quartile 1 underperforms.

Within the materials sector, quartile 1 is the best performer and quartile 4 is the second best. Quartile 1 outperforms significantly in the aftermath of the Internet bubble, and strong performance of quartile 2 is especially evident from 2003 to 2005 and 2007 to 2011.

The last GIC sector is the telecommunications services sector, where quartile 1 is the best performer and quartile 2 is the second best. Quartile 1 outperforms from 1997 to 2001 as well as during the financial crisis. The performance of quartile 4 is especially poor in 2002 and 2003.

An analysis was also performed in regard to the extent to which the rank of the stocks explains the return of the stocks as well as the extent to which the rank of the quartile explains the return of the quartile within the eight sectors. Overall, the results are mixed. In general, the rank of the individual stock explains the return of the stock to a lesser extent than the rank of the quartile explains the return of the quartile. This relation is insignificant both for individual stocks and for quartiles.

3.43 Summary of the Analysis of EV/EBIT & RoIC on GIC sectors

By applying EV/EBIT & RoIC as a screening tool within the GIC sectors, it was possible to identify the best performing quartile for five sectors, including consumer staples, energy, industrials, materials, and telecommunications services. Furthermore, the model is able to identify the worst performing quartile for the five sectors which are consumer discretionary, consumer staples, energy, health care, and information technology. Based on the risk-adjustment made on the basis of the Sharpe ratio, quartile 1 has the highest Sharpe ratio for 5 sectors and quartile 4 has the lowest Sharpe ratio for the five sectors as well. The Modigliani-squared measure provides similar results as quartile 4 has the lowest M^2 of the four quartiles, and quartile 1 has the highest M^2 in five sectors. The Adjusted Sharpe ratio provides similar results which also is the case for the Omega ratio. However, the Calmar ratio provide different results.

Furthermore, the descriptive power of rank in regard to return is insignificant in terms of both quartiles and individual stocks. Moreover, it is clear that EV/EBIT & RoIC as a screenings tool do not function optimally within the consumer discretionary sector.

4. Discussion

The analysis was based on RoIC and EV/EBIT, and EV/EBIT was selected as the preferred price measure, despite the fact that the P/E multiple is the most frequently used price measure, as this thesis asserts that it is highly advantageous to use a price measure that is unaffected by the capital structure as well as a measure that focuses on the firm value instead of the equity value. This is mainly due to the fact that EBIT is distributed across the entire enterprise and not solely to the owners of the equity. Additionally, EBIT was used as a proxy for operating earnings created by the core operations, which is in line with the theoretical framework. Although EBITDA is more similar to cash flows, it is deemed sensible to include the resource usage of the long-lived assets as these are part of the reason for the creation of the earnings.

Although Greenblatt suggests the use of return on capital, this thesis has applied return on invested capital. This is primarily due to the link between RoIC and the value of the enterprise, which academia to a large degree supports. The value of the firm is calculated as the present value of the future dividends that are created by the core operations. Therefore, this thesis focuses on the invested capital in the core operations and not the total capital as this includes capital that is not likely to exist in the future. However, it is acknowledged that the total capital is much easier to extract than the invested capital due to the fact that the total capital does not require any subjective classification of accounting items, but rather represents the book value of the enterprise value. Furthermore, there are numerous accounting pitfalls, especially in regards to RoIC that are ignored in the analytical process to a certain extent. The pitfalls presented are considered accurate, but simultaneously, they illustrate the subjectivi-

ty related to calculating the invested capital. For instance, the amount of cash that should be included in operating assets is subjective. Nonetheless, these are the premises when using screening tools, however, it is deemed ill-suited to calculate the invested capital for all firm as this would be excessively time consuming. Instead, the tool should be used to deselect or select certain stocks that can be analyzed in much greater detail, and in this regard, the RoIC could advantageously be calculated by the analyst.

4.1 Return on Invested Capital

As discussed in the theory section, the return on the invested capital captures the profitability of a firm as it solely focuses on the operating earnings by the core operations and the capital invested in these. Furthermore, RoIC is a central element in the valuation of a firm, and therefore it is deemed relevant to the analysis on RoIC as a screening tool.

Greenblatt uses RoIC or ROC as a measure to indicate the quality of a given company. The theoretical findings support this as it was found that companies with higher returns on invested capital tend to have competitive advantages, which in turn is the reason for their superior returns on the capital invested. Considering the theoretical discoveries on return on invested capital and economic value added, it is therefore expected that portfolios containing companies with high returns on invested capital to perform better than companies with lower returns on invested capital, ceteris paribus. Furthermore, it is expected that companies with lower returns on invested capital will perform poorly as they are effectively destroying economic value since their returns will in most cases be lower than their cost of capital as has been the case for the airline industry. This would in effect decrease economic value, and thus the valuation of the company, resulting in poor returns for investors.

The tests supported these theoretical findings to a certain extent, which is evident as decentile 1 had the best performance as it outperformed the average return by 3.5 percentage points annually and decentile 10 had the worst performance as it underperformed the average return by 3.5 percentage points annually, as presented in the analysis of RoIC. The return for the portfolios in-between is very mixed. It is however worth noticing that the average annualized return of the top 5 portfolios is 12.26% and the average annualized return of the bottom 5 portfolios is 11.31%.

In the theoretical section on risk research shows that investors are generally risk averse and care as much about risk as they do about returns. No distinct evidence has been found as to whether companies with high or low RoIC values should be perceived as more or less risky. However, an argument could be made that since RoIC is an indicator of the quality of a company, companies with high returns on invested capital should be less risky. Companies with lower returns on invested capital should thus be more risky because they are in effect destroying

economic value. Furthermore, they have no competitive advantages, which should make their returns more unstable. This however builds on the assumption that returns on the invested capital lasts for long periods of time and does not take the price paid for the company into account.

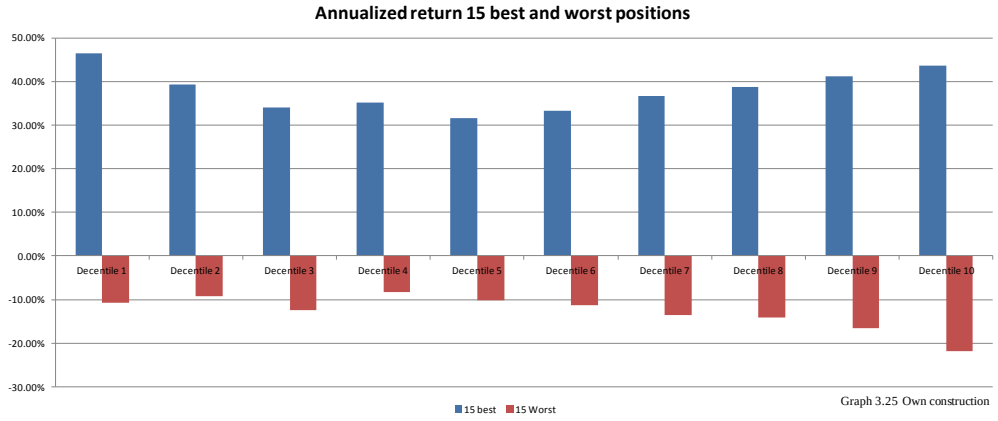
As stated earlier and contrary to this, the findings do show that the standard deviation of portfolios containing companies with high returns on invested capital is in fact larger than that of seven seven other decentiles. This suggests that there is a higher degree of risk associated with this portfolio. While this argument is not in line with the expectations stated earlier based on the fundamental theory of returns on invested capital, it does support academic research that claims returns and risk are correlated, and as such, investors cannot experience above average returns without incurring above average risk. Moreover, it must be taken into account that the standard deviation is calculated on the basis of returns. As RoIC is by no means the only influence on the price of the company, this does not necessarily have to be correlated. The most important aspect in regards to the standard deviation must be the price as earlier stated. Thus, the high risk of companies with high returns on invested capital could also be a result of their pricing.

It is considered interesting that the standard deviation for decentile 10 is 40.8%, which is significantly larger than the average of 20.8%. This supports the argument that companies that have lower returns on invested capital, and are thus inferior, should be more risky. However, once again, it must be taken into consideration that prices measures are not accounted for in this study. The results indicate that returns on invested capital are able to identify the worst performing portfolio that additionally has the largest standard deviation of its returns. In addition the beta of the decentile 6-10 is larger than the beta's of decentile 1-5 which supports the findings based on the standard deviation that the lower decentiles are more risky.

Considering the poor returns and higher risk, the poor performance of decentile 10 is not surprisingly also supported by the analysis conducted on the risk-adjusted returns. The Sharpe ratio for decentile 10 was the worst of all of the constructed portfolios. The Modigliani-squared ratio for decentile 10 of -3.2% implies that in order for a combination of the portfolio and T-bills to correlate, the volatility of the average of the return is -3.2% per year. This is significantly worse than the average. The findings of the Adjusted Sharpe ratio are generally the same for decentile 10: the rank changes one spot, which implies that the impact of kurtosis and skewness does not affect the results significantly relative to the other measures. Using beta to adjust for risk, the Jensen's alpha supports the previous findings as the average alpha of the portfolio is -4.0% - the worst return of all the investigated portfolios. Investors are by no means compensated for the increased risk measured by both standard deviation and beta. Thus, there is a clearly discernible pattern that indicates that returns on invested capital is a way to identify poor performing companies, at least on an annual basis. However, it is not considered entirely legitimate

to make any significant remarks regarding the return on invested capital's ability as a screening tool for decentiles 2-9 as results are very mixed.

Conversely, it is deemed remarkable that the portfolio containing the companies with the highest returns on invested capital indicates that the superior returns are achieved by much higher risk taking, especially when measured as standard deviation. As a result, the risk-adjusted returns are affected. This is not surprising considering the findings on risk, and as mentioned earlier, it could be a result of the pricing of the securities. Another influential factor could be that the returns on invested capital are measured in the short run, and thus might change fairly quickly. Nonetheless, the returns are considered a result of higher risks, and the portfolio's return is explained by the performance of a few stocks. It was found that the return of decentile 1 is mainly caused by the 15 best performing stocks in the portfolio. In other words, decentile 1 contains the best performing stocks, albeit it is a small fraction of the stocks within the portfolio that cause the return of the portfolio. This could be problematic when using the strategy to screen stocks as the basis for the superior performance is mainly the performance of a few stocks. Moreover, the 15 worst performing stocks within decentile 1 have an annualized return of -13.75%, which is the fifth lowest. However, this is nothing compared to decentile 10 which has an annualized return of -25.45% for the 15 worst performing stocks. This further supports the earlier results that show that the return on invested capital is indeed a good measure to find the worst performing companies. Contrary to this however, the 15 best performing stocks of decentile 10 provide an annualized return of 46.54%, which is second only to decentile 1. Thus, it seems that the return of decentile 10 is a result of a few stocks that perform much worse than its peers and some stocks that actually perform very well. The reason for this pattern could once again be that pricing is not taken into consideration. Although companies with low returns on invested capital are in essence destroying economic value, the companies could still hold some value from e.g. fixed assets. Furthermore, the returns on invested capital could be temporary. If turnarounds are made, this could cause the stock to go up significantly.



Graph 3.25 Own construction

Moreover, it is notable that the performance of decentile 10 is positively affected by sector pick, whereas it is negatively affected by stock pick. This indicates that decentile 10 is actually invested in somewhat favorable industries, yet the stocks selected are inferior. However, it must be taken into consideration that the stock contribution is a mixture of the very best and worst stock returns, and thus the result within the portfolio vary considerably. This is in stark contrast to the theory of RoIC were we found that certain sectors tend to generally have low returns on invested capital and thus destroy economic value over long periods of time, ceteris paribus. Therefore we expected a negative sector pick for the lower decentiles. It should however be mentioned that the measured time period is only one year which could mean that some sectors temporarily have low returns on invested capital which is not a good proxy for the long term returns of invested capital that drives economic value added and hence enterprise value.

It is worth noticing that in contrast to the findings using traditional forms of risk-adjusted returns, using the Omega ratio, and the Calmar ratio provide somewhat different results. According to the Omega ratio, decentile 10 would actually have been the third best portfolio for investors to invest in. As stated earlier, the reason for this performance is because there is significant amount of upside potential in the portfolio, which increases the Omega ratio. However, the upside potential is outweighed by the negative returns. It does, however, underscore the earlier point that there are some indication pointing to the fact that a few of the stocks perform very well within the portfolio, which could be due to turnaround cases. Considering the fact that decentile 1 contained the best performing stocks and that the worst stocks in the portfolio were only mediocre compared to peers, it is not surprising that decentile 1 is the best performer when measured by the Omega ratio. As expected, the Calmar ratio does show that decentile 1 performs best. This is expected because the portfolio has the highest return and the poorest performing stocks did not perform any worse than that of other portfolios' worst performers. As a result, it is also as expected that decentile 10 performs badly according to this measure as the portfolio's return were abysmal, while the downside risks were much larger than average.

As a result of these tests, it is believed that the main advantage of using RoIC as a screening tool is to identify a portfolio of stocks that will provide the worst return. However, it is important to note that some of the stocks within that portfolio do very well. Therefore, if an investor e.g. wanted to find turnaround cases, these portfolios as well as decentile 1 would be the decentiles to analyze. This is based on the results from the analysis, however, it is considered very risky as the portfolio also contains the worst performing stocks which more than outweighs the positive returns. Thereby, it is not deemed appropriate to identify quality stocks using only RoIC as the risk-adjusted returns are not convincing. Therefore if a decentile had to be analyzed our recommendation would be decentile 1 as it provides the best returns and much lower downside risk. However investors have to be aware that the return of this decentile is partly a few stocks.

From the analysis, it is clear that explanatory power of the ranking of the decentiles and the individual stocks in regard to the return varies significantly over the period. Moreover, it is evident that the relationship between the rank and the performance is insignificant. This is in addition clearly why the remaining decentiles does not provide a clear picture. Therefore, the screening tool should only be used overall to sort the stocks, and not blindside as an investment strategy since the relationship is insignificant.

Overall, the theory of RoIC clearly supports the findings that companies with low RoIC perform worse than others. In particular, McKinsey's statement that RoIC symbolizes the competiveness of a firm explains the poor performance as well as the impact of RoIC on the valuation of a firm. However, the extent to which the RoIC used in the analysis corresponds to the actual return on invested capital is debatable with the accounting issues in mind. Also, the extent to which the RoIC used in the analysis equals the return on invested capital on an ongoing basis and thereby is not affected by noise is questionable. Furthermore, in line with the theory of EV/EBIT and RoIC, there is no doubt that investors are willing to pay more for a great company (defined by a consistent high return on invested capital), ceteris paribus. However, it is critical to keep in mind that the present rankings do not include the price of the company, which clearly impacts the performance of the stocks. However, it is also important to note that further investigation is needed before making final investments decisions as accounting issues in particular need to be examined further.

4.2 EV/EBIT

Greenblatt uses the EV/EBIT as a measure to indicate how "cheap" a company is as the measure specifies how much an investor is paying for the earnings of the company. According to theory, the EV/EBIT multiple is theoretically identical to both the P/E ratio and the discounted cash flow model, although this is rarely the case in practice. The EV/EBIT multiple is dependent on growth, RoIC, weighted average cost of capital, and the tax rate. Greenblatt believes that the EV/EBIT is in fact a good measure because it enables investors to identify companies where these four factors are temporarily depressed and the future expectations of e.g. RoIC and growth are too low, which decreases the multiple. There is some empirical evidence supporting this as research shows that both companies with lower P/E ratios, EV/EBITDA, and EV/EBIT multiples tend to outperform the market. Furthermore, stocks that have high multiples tend to underperform.

The tests conducted for this thesis support these theoretical findings as it has been found that by ranking the stocks on the basis of EV/EBIT, it is possible to detect the two best performing portfolios as well as the worst performing portfolio. Decentile 1 and 2 significantly outperforms by 4.7 and 2.2 percentage points, respectively, and decentile 10 underperforms by 2.6 percentage points annually. Furthermore, the average annualized return of decentiles 1-5 is 12.9%, and the average annualized return of the bottom 5 portfolios is 10.7%. Purely based on

returns, the findings thus seem to suggest that EV/EBIT is in fact a valid measure to analyze whether companies are over or underpriced.

The theory of EV/EBIT describes the four drivers of the EV/EBIT multiples to RoIC, tax, growth, and WACC. Therefore, the performance of the best and worst performing decentiles could be based on several things. However, as stated earlier, superior risk-adjusted returns can only be achieved because multiples do not contain the real value of the company (in other words, expectations are too low towards growth and the ability to create cash flows) or in the event that the data mining at it is thus random. From a behavioral finance aspect, the reason companies could be priced wrong could be, as earlier stated: people tend to be too optimistic as well as too pessimistic about the future, and this could easily affect the perceived growth rate of the companies. In addition, the points made on RoIC are also valid in regard to EV/EBIT.

In our theoretical section on risk we found that even though returns are obviously of great importance to investors the risk is of equal importance. Furthermore we found that investors generally tend to be risk averse. Although returns are obviously of great importance in order to analyze whether EV/EBIT is more advantageous to use as a screening tool compared to RoIC, the risk must be taken into consideration. Logic would suggest that companies that can be bought cheap would be less risky as the downside risk should be lower. This argument is also supported by many professional investors; one of the more outspoken being famous investor, Howard Marks.[302] However, the opposite argument could be made as well as there are oftentimes a reason companies are priced relatively cheap – namely, the prospects of the business are poor or very risky. This suggests that the companies with lower EV/EBIT multiples should be considered very risky. This argument is in line with the theory presented in this thesis as multiples can only be low if expectations of returns on invested capital or growth are low, or if risks are high. The opposite argument could be made for companies with high multiples. They should have promising prospects and be priced accordingly, which means the value can decrease quickly if the prospects turn out to be less promising than expected. Thus, the only way risk-adjusted returns could be superior are if expectations are out of line with the forthcoming events.

The results of the tests showed that the bottom portfolios were the riskiest in terms of standard deviation. Decentiles 9 and 10 contained the two highest standard deviations. Decentiles 1 and 2 had the third and fourth highest standard deviations. The overall tendency was similar when measuring risk by beta, however decentile 1 did appear slightly more risky according to this measurement. The picture of risk was thus mixed but the finding included evidence that suggests that companies trading at high multiples were in fact riskier measured by the standard deviation. There were several reasons why this might be the case, but the most well-known theory is that as there are high expectations of companies trading at high multiples, and if these expectations are not met,

[302] 2.4 Risk

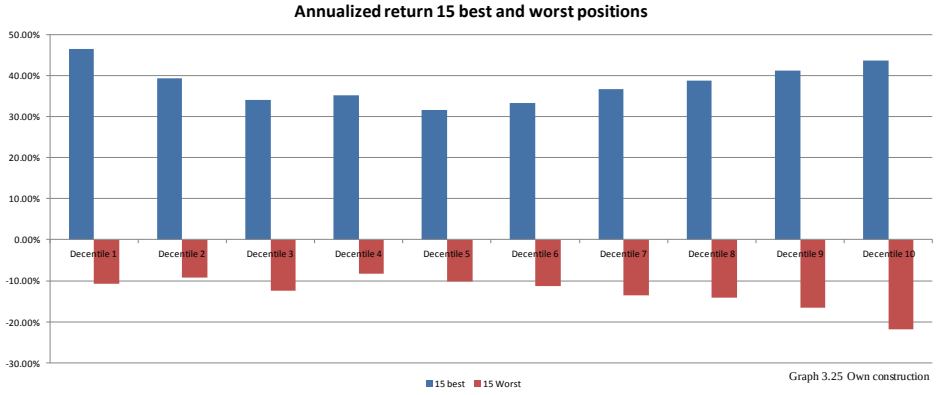
the value of the company can vary considerably. Furthermore, small deviations in expectations will have a greater impact on prices for companies with higher multiples. For the top decentiles the argument that companies trading at lower EV/EBIT multiples are in fact risky due to the business prospects is supported as standard deviations are fairly high.

In the analysis of EV/EBIT, a pattern emerged when judging the portfolios on the basis of the Sharpe ratio. Decentiles 1-2 has the best and second best Sharpe ratio, while decentiles 9-10 had the eighth and tenth best Sharpe ratio. The picture was however, blurry for the remaining decentiles. There was thus a clear indication that first and foremost, the excess returns generated by the top portfolios satisfied the risk following the strategy. Furthermore, the bottom decentiles not only provided the worst returns, they also contained the most risk. This is very interesting from the perspective of the model as a way to screen stocks as the approach find the stocks investors should not invest in, and can to some extent identify stocks that investors want to invest in. These findings were backed up by the tests conducted using the Modigliani-squared ratio. The results were not as favorable for the top portfolios, yet the pattern nonetheless remained, and it is striking that decentile 1 and 2 has an annualized M^2 of 0.57% and -0.67%, which makes them the second best and fourth preferred portfolio to be invested in. Decentile 9 and 10, on the other hand, had an annualized M^2 of -1.44% and -2.41%, respectively, which makes them the fifth worst and absolute worst portfolios to invest in. These results are also supported by the tests conducted on Adjusted Sharpe ratio, implying that the impact of kurtosis and skewness on the returns of decentile 10 are negative as well. This does not seem to be the case for decentile 1 and 2.

From the results regarding returns, risk and risk-adjusted returns based on the standard deviation, the tests indicate that EV/EBIT can be a reasonable tool to screen stocks, especially for the very top and bottom portfolios. This indication is further validated by the test's results using beta as a measure to risk-adjust the returns by using Jensen's Alpha. In those tests, decentile 10 was found to once again perform below par with an annualized alpha of -4.9%. However, decentile 1 and 2 performed well and created alpha of 3.1% and 2.8%, respectively, which was considerably better than the other portfolios (about 2.9 percentage points better than the third best.) It thus seem that EV/EBIT, like RoIC, is a favorable way to detect portfolios of stocks that perform poorly over time, both before and after risk is taken into account when using more traditional methods to assess the risks involved. The EV/EBIT multiple has an ability to identify the very top performers, both before and after the returns are risk-adjusted. This implies that the EV/EBIT multiple might have some validation as a way to determine whether stocks are over or underpriced.

It is also interesting to notice that when analyzing the performance of the 15 best stocks, decentile 1 provided the best return. More interestingly, decentile 10 provided the second best return and overall the same tendency

emerges as for EV/EBIT and RoIC namely that the returns of the 15 best stocks within the median portfolios are less impressive compared the top and bottom decentiles. Although this is the case the differences are smaller than for EV/EBIT and RoIC. However, when analyzing the 15 worst performers, decentile 10 was by far the worst portfolio to invest in, while decentile 1 was the fourth best. These results were interesting for a number of reasons. First and foremost, the reason for decentile 10's underperformance appears to be a result of the poor performance of a few select stocks. Furthermore, it is considered remarkable that decentile 10 actually contained some of the best performing stocks overall. As a matter of fact, if an investor had invested in the five top performers of decentile 1 and 10, the investor would have received almost identical returns. This implies two things; Firstly, the reason decentile 1 performs so much better is because there is much less downside risk within this portfolio, and thereby, the worst performers fare much better than the worst performers of decentile 10. Secondly, it also indicates that if EV/EBIT is used as a screening tool, investors must be aware that some of the best stock picks will be excluded as they are within the lowest decentile. The high performance of some of the stocks in the lower decentiles could be explicated in several ways. For instance, despite the fact that some of the stocks are trading at high multiples, they are considered truly extraordinary companies that can live up, and to a certain extent exceed, the expectations. Another reason could be Robert Shiller's argument that there tends to be a lot of speculation in companies with high valuations,[303] and thus, some of the stocks in the portfolio will perform very well due to speculation in the stock. This was somewhat possible to test in the combined ranking, where returns were tested for three-year holding periods. Another interesting element from the analysis of the performance of the 15 best and worst performers is that there is a tendency for the median portfolios to contain stocks that do not outperform either positively or negatively as much as the peripheral decentiles do. This is evident in the graph 3.35, where the best stocks are generally held in the top and bottom portfolios. However, the worst performing stocks actually perform better for the median portfolios. This indicates that there should be much less risk investing in the median portfolios and in particular the upper median portfolios as they have historically provided better returns. Another interesting point to make when analyzing the returns of the portfolios ranked on the basis of EV/EBIT is that the perfor-



Graph 3.25 Own construction

[303] 2.9 Is price to earnings a valid measure?

mance of decentile 1 and 2 was to a much larger extent caused by stock picks rather than sector exposure, which was also the case for decentile 10. These findings are similar to the analysis of RoIC not caused by their sector exposure but the performance of the individual stocks. Thus, although the theoretical discussion emphasized that EV/EBIT multiples would be different across sectors, this does not seem to be the basis for the difference in performance. Thus implying that EV/EBIT is not a advantageous way to sector allocation.

The returns of the different portfolios on the basis of alternative risk measures were also analyzed in the same manner as RoIC. It is worth noticing that according to the Omega ratio, the top and bottom decentiles generally perform the best and the median portfolios perform mediocrely. The subpar performance of the median portfolios is considered a result if their limited upside and downside. Due to the limited upside, these portfolios did not perform better than average. This is also the reason that the two bottom portfolios perform fairly well according to the Omega ratio. As mentioned earlier, these portfolios generally underperformed the market, however, they also contained some of the best performers which increased their upside significantly, leading to a better Omega ratio. Therefore, it was not surprising that decentile 1 performed better than decentile 10 in the Omega ratio as the upside of decentile 1 was larger and the downside was smaller.

The findings from the Calmar ratio are also quite interesting. In particular, the fact that the very top and bottom decentiles provide the worst Calmar Ratios. This is indicates that the return is higher for decentile 1 but the downside risk is also significant. This is in line with the earlier findings. Furthermore, the median decentiles fare the best, implying that these provide the best returns compared to the downside risk. It is also very interesting to note that decentile 10 is the worst performer, signifying that not only does the portfolio provides the worst return, it also has the highest risks when measured by maximum drawdown. Decentiles 5-9 present a blurry pattern.

Overall, EV/EBIT as a screenings tool is able to detect the best performing stocks as well as the worst performing stocks. Although this is the case, the annualized return of decentile 10 ranked on RoIC and EV/EBIT, respectively, is significantly contrasting. The annualized return for decentile 10 ranked on RoIC is 8.75%, and the annualized return of decentile 10 ranked on EV/EBIT is 9.65%. The return for the worst companies based solely on RoIC is thus worse but is also driven by the performance of fewer stocks.

4.3 EV/EBIT & RoIC

As mentioned earlier, return on invested capital has been selected as the preferred return measure to assess the quality of the business, and the EV/EBIT multiple has been chosen as the preferred price measure to indicate

whether the stock is “cheap” or not. The basis for this selection was the fact that these measures are in accordance with Greenblatts approach and is considered to have a solid theoretical foundation.

Based on the findings using EV/EBIT and return on invested capital as a performance indicator for stocks, it was expected that a combination of the two would be able to detect the very best and worst performing portfolios as the test is based solely on the RoIC and EV/EBIT provided these results. This should particularly be the case based on annual findings since this was the holding period used for the prior tests. Furthermore on the basis of the combination of RoIC and EV/EBIT it would be expected that the other decentiles perform in a more organized order. The reason being that the EV/EBIT has been deemed a good price measure from a theoretical point of view and was shown to detect the worst and best performing portfolios in earlier findings. This was also the case for the return on invested capital which has a solid theoretical foundation and was also a good indicator of the best and worst performing decentiles although not to the same extent as it was the case with the EV/EBIT. Therefore it should be expected that a combination of the two should be a valid methodology to find quality companies at reasonable prices which was also what Greenblatt found in his test using the approach.

This was partly the case as the combined ranking can be considered a fairly good indicator to detect the very best and worst portfolios. Of particular interest however is that there is also a clear tendency for decentiles 1-5 to be the portfolios with the 50% best returns and for decentiles 6-10 to have the 50% poorest returns. This indicates a pattern where companies with a better combination of RoIC and EV/EBIT tend to outperform companies with poorer characteristics. This tendency is valid across all holding periods as at least four of the top five performing portfolios are among the four best decentiles in all holding periods. This supports the statement that a ranking based on the return on invested capital and EV/EBIT will provide a way to determine the best groups of stocks. It should be noted however, that the decentiles are not in an ascending order indicating that the approach does not work as well with the S&P 500 index (excluding the financial and utility sector) as it was the case with larger indices as used in Greenblatts tests. One reason for this could be that the approach does not work as well when applied to large cap companies only. This is supported by Greenblatt as he finds the approach to work significantly better when using larger indices that include small cap stocks. His reasoning is that small cap stocks are not covered by as many financial experts and therefore inefficiencies occurs leading to mispricing’s which enhance the results of the approach. Another reason could be that the approach is in fact valid but that the tests do not include enough companies to replicate the test properly.

Another interesting aspect when comparing the results of the combined ranking with the rankings based solely on price and return measures is that the very top and bottom decentiles does not perform as well in terms of absolute returns. This indicate that if investors truly want to find the best absolute returns they would be better off

only investing solely on the basis of EV/EBIT and RoIC. There could be several reasons why this is the case. Firstly according to theory on price measures companies can only trade at low multiples if the business prospects are poor or if there is a lot of risk involved in the business. Thus it should be expected that companies trading at low multiples would also tend to have lower returns on invested capital as the quality of the companies should generally be lower. This negatively affects the ranking for those companies in the combined ranking as the EV/EBIT ranking will be decent but the RoIC ranking will be subpar. Contrary companies with very high returns on invested capital should trade at higher multiples because their business prospects are bright and the quality of the businesses are great. Thus those companies will also get a relatively lower ranking in the combined ranking. This could be one of the reasons that the top performers do not perform as well in the combined rank but that the top half of the decentiles generally fare better. It also indicates that some of the companies that are ranked very high in the combined ranking could perceive a lot of risk. The reason being that the only way - according to theory – that companies can have high returns on invested capital and have low EV/EBIT multiple is if the companies contain a lot of risk as it is not likely the business will have high returns on invested capital and inferior growth rates. The other explanation could be Greenblatts argument founded in Graham's philosophy and behavioral finance that the market temporarily misprices certain securities due to overly pessimistic forecasts.

Contrary this could also be the reason that the bottom portfolios do not perform as poorly as it was the case when ranking solely based on RoIC and EV/EBIT. The reason once again being that companies with high EV/EBIT multiples should have higher returns on invested capitals and vice versa making the companies ranks in the combined rankings relatively better. This is particularly interesting for two reasons. Firstly it implies that one of the reasons the strategy of the Magic Formula performs so well could be that there is in fact higher risks asserted with the higher decentiles. Secondly it implies that if investors were to find the best performing decentiles it would actually be superior to use EV/EBIT or RoIC and not a combination of the two as a screening tool when analyzing large cap companies.

Another interesting aspect when analyzing the test results is that the more frequently investors rebalance, the better the return. This is at least the case for decentile 1 where the return is highest if rebalanced every six months, and subsequently annually, and at worst, rebalanced ever third year. Contrary to this, the bottom two portfolios perform much worse if the portfolio is only rebalanced every third year. At first sight, this is in line with Greenblatts thoughts as it appears that the market quickly realizes that prices are temporarily too low, while the lower decentiles are genuinely bad companies trading on multiples that are too high. It is also interesting that the longer the holding period, the worse the returns are for lowest decentiles. The decentiles are however still the best performing decentiles indicating that the performance is not merely a short term phenomenon but is a proper way to find long term outperforming stocks. It is also interesting that the worst decentiles does relatively worse

when the holding period is three years, indicating that the companies are genuinely inferior. This is particularly interesting in regard to Robert Shillers remark that overpriced companies can keep rising in price for longer periods of time due to speculation, but will eventually fall to their fundamental value.

Annualized Return	Annualized Return Semi-Annual	Annualized Return Annualy Jan.	Annualized Return Annualy All Months	Annualized Return 3 years
Decentile 1	16.4%	14.9%	14.3%	12.1%
Decentile 2	12.0%	13.6%	14.5%	12.2%
Decentile 3	13.6%	12.3%	12.7%	12.2%
Decentile 4	12.2%	12.4%	12.7%	13.3%
Decentile 5	12.4%	11.0%	12.8%	9.2%
Decentile 6	9.8%	11.6%	11.0%	10.2%
Decentile 7	11.8%	10.7%	10.9%	11.0%
Decentile 8	11.3%	12.6%	11.7%	11.9%
Decentile 9	10.0%	8.5%	11.4%	6.8%
Decentile 10	11.8%	11.5%	11.8%	7.3%
Average	12.4%	12.3%	12.5%	10.8%

Figure 3.3312 Own construction

Another interesting aspect in the findings is the correlation between the constructed portfolios. It is interesting that decentile 1 and 10 have a negative correlation, which implies the characteristics are genuinely different between the two decentiles. This assumption was further enhanced as decentile 1 correlates most positively with decentile 2, decentile 2 correlates best with decentile 1 and 3, etc. It is this deemed plausible to infer that the portfolios have similar characteristics in terms of return. This supports Greenblatts argument that ranking the companies on a combination of EV/EBIT and RoIC does indeed present decentiles with similar characteristics, thus indicating that the measures do identify companies with certain characteristics. This is also in line with the theoretical findings in both RoIC and EV/EBIT, which state that different sectors should have different returns on invested capital, and should be priced differently. It is also intriguing – although not surprising considering the above – that the outperformance of the top and bottom portfolios occurs over significantly different time periods. This is in line with the results in especially EV/EBIT, but also partly in terms of RoIC. This was particularly the case during the Internet Bubble and is probably a result of the fact that some IT companies were trading at very high multiples in the late 1990s, while some of them did not generate money. In this period the lowest decentile provided the best performance whereas the top decentiles performed subpar. However, after the bubble burst the outperformance was opposite. This would suggest that if the combined ranking is used as a screening tool, investors would have to be aware that the stocks chosen most likely would not do well in overheated markets as stocks with very high valuation would be excluded. On the other hand, the stocks should perform relatively better once markets decrease. This was not the case to the same extent during the financial crisis.

One possible explanation for this is that the analysis does not include the financial sector which was the sector with the worst returns. Furthermore the financial crisis was not to the same extent contained to specific sectors and generally caused losses across all sectors as the crisis pushed economies into recessions.

In terms of risk for the combined ranking it would be expected that the top and bottom decentiles will contain the most risk in terms of standard deviation as this was the case in the two previous findings. Furthermore this is supported by theoretical findings. The reason being that companies trading at higher multiples should be relatively more "expensive" causing a larger potential for downside risk if the company does not live up to expectations ceteris paribus. Furthermore companies with low returns on invested capital were in the theoretical section found to be subpar companies which would indicate higher risks associated. Therefore a combination of the two should ceteris paribus lead to low quality companies that are relatively overpriced in the bottom decentiles. The opposite should however be the case for the top portfolios as these should in theory be quality companies that are relatively undervalued. The findings did provide evidence supporting the lower decentiles to be more risky indicating that the companies could be lower quality companies trading at relatively high prices. However the tests also found the top decentiles to have some of the highest standard deviations. This was according to the prior

Standard Deviation	Annual Standard Devation Ranked Semi-Annual	Annual Standard Devation Ranked Annually Jan.	Annual Standard Devation Ranked Annuly All Months	Annual Standard Devation Ranked 3 years
Decentile 1	8	8	8	5
Decentile 2	4	3	4	3
Decentile 3	5	5	1	4
Decentile 4	2	2	2	8
Decentile 5	1	1	3	1
Decentile 6	3	4	7	6
Decentile 7	6	7	5	2
Decentile 8	7	6	6	7
Decentile 9	9	9	9	9
Decentile 10	10	10	10	10

Figure 3.33 Own constuction

tests but was somewhat surprising considering the theoretical foundation. This reason for this could be the same as was the case for the testing of EV/EBIT multiples as there is typically a reason companies that are relatively "cheap" in terms of EV/EBIT multiples which is that business prospects are poor or the risk is high.

What is further interesting from the findings is that the standard deviation of the returns on decentiles 6-10 is overall larger than the standard deviations of decentiles 1-5, which clearly indicates that EV/EBIT & RoIC as a screenings tool is able to identify the best performing stocks with the lowest standard deviation, i.e. risks. The Sharpe ratio, Jensen's Alpha, Modigliani-squared ratio, and the Adjusted Sharpe ratio all support these findings.

Nonetheless, the worst performing portfolios have slightly better returns than decentile 10 based solely on RoIC, and the performance of decentiles 1 and 2 is not as good as the performance of decentile 1 and 2 on EV/EBIT.

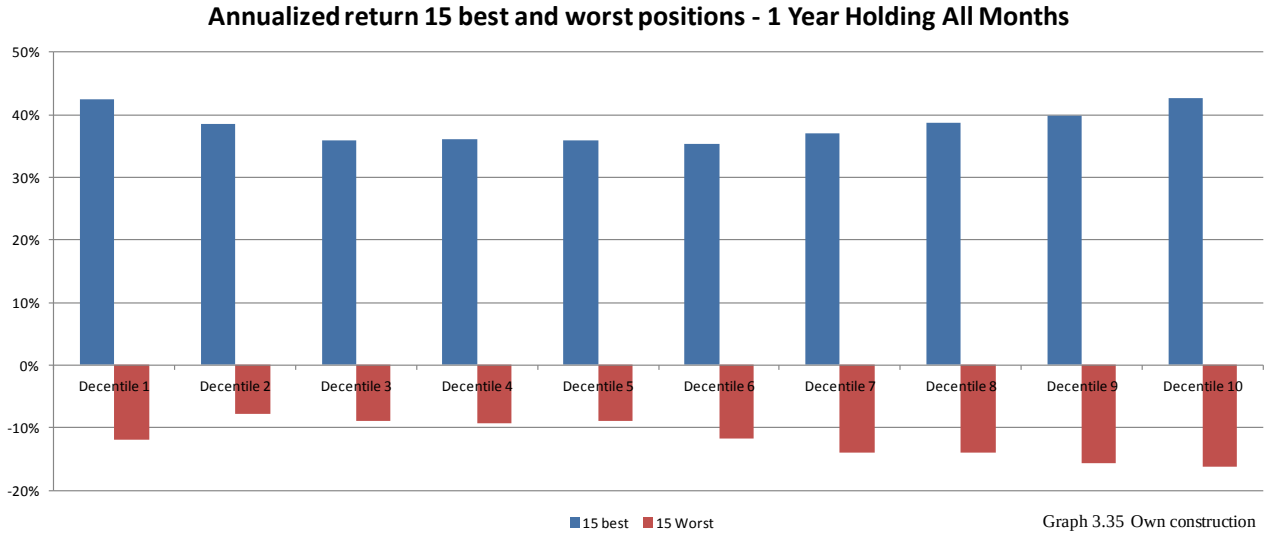
When adjusting for risk, however, the results are similar as the M^2 for decentile 10 on RoIC is -3.2% compared to -1.3% for EV/EBIT & RoIC (average of all months).

In general, it is interesting that the M^2 returns of decentiles 2-10 ranked on the basis of RoIC is negative since this is not the case for the combined ranking. Although the return is lower for the combined ranking, investors are compensated for this as the M^2 returns are better. The results are similar for Jensen's Alpha, especially when compared to rankings based on RoIC. This implies that the risk of the market has been distributed more evenly in the combined ranking. Therefore, although the absolute returns are lower for the portfolios from the combined ranking, the performance is superior when risk is taken into account. A similar pattern emerges when comparing the performance of decentiles 1-4 for EV/EBIT & RoIC against EV/EBIT. This overall pattern is notable as it to a larger extent than RoIC and EV/EBIT alone can be used to deselect a large portion of the stock, and hence increase the opportunity of finding stocks with superior performance. However, as was the case for RoIC in particular, but also EV/EBIT the Calmar ratio and the Omega ratio contradict these statements.

When analyzing the best and worst stocks of the different portfolios, it is interesting that decentiles 1and 2 provided some of the top performing stocks. Thus, this indicates that if an investor wants the highest return, those are the decentiles in which to look for stocks. What is further interesting however is that decentile actually provide the third best result when analyzing the performance of the 15 best stocks within the portfolios. What is even more interesting, however, is the performance of the 15 worst performing stocks in the different portfolios. When analyzing this, it is evident that decentile 10 might have been the second best portfolio for the best performing stocks but it also contains by far the worst performing stocks. This makes the portfolio challenging for investors as a screening tool as the portfolio contains both very good investments and very bad investments. There could be many reasons for this, however, it is considered likely that as expected with the studies of RoIC and EV/EBIT, this could be the result of turnaround cases.

Contrary to decentile 10, the top two decentiles worst performers do not fare that bad compared to the other portfolios. This is considered to make this portfolio a much better place to look to screen stocks as the downside risk is significantly smaller. The returns of the best portfolios are shaped as a skewed V, suggesting that the top and bottom portfolios find the best individual stocks. However, the negative returns of the worst performing stocks are not nearly as symmetric as the returns of the best 15 stocks. Here, the lower decentiles have by far the worst returns, i.e. decentiles 7, 8, 9, and 10 also rank accordingly when rebalanced annually. It is interesting that the patterns are similar across all different holding periods. From the viewpoint of using the model as a screening tool, the median portfolios have the lowest downside risk when analyzing the 15 worst performing stocks, however, their returns are also correspondingly poor. Therefore, the top decentiles are deemed to be the most obvious

to use for further investigation. However, this depends on the investment philosophy. Nonetheless, it should be noted that the fact that a large part of the returns stem from a few stock also carries some implicit risks. The reason being that if the model is used as a screening tool, the investor would receive a list of securities. If the return is the result of a few stocks, this means that if the investor does not pick those particular securities, his return could be significantly worse. Therefore, the median decentiles would probably contain much less risk.



Graph 3.35 Own construction

Another interesting aspect of the findings in the combined ranking is that the both positive and negative outperformances are general caused by stock contributions and not sector exposure. This is interesting for several reasons. Firstly it implies that the approach of the Magic Formula is not a proper way to decide sector allocations for investors. Secondly the results suggest that even though sectors have different returns on invested capital and EV/EBIT multiples as theory suggested this seem to be "priced in". In other words the prospects of entire sectors seem to be accounted for and thus the returns from over/underweights will not be the main force for outperformance. One significant exception to this however, is the time around the Internet bubble where the sector allocation had a significant impact.

With the theory of EV/EBIT and RoIC in mind, it is not surprising that the two measures are positively correlated. To elaborate, RoIC can be used to measure the competitive advantages of companies, companies with a RoIC close to 0 or even negative is not likely to distribute cash flows to its owners, which should lead to a low EV/EBIT multiple, ceteris paribus. This is also the reason that RoIC is one of the drivers of EV/EBIT along with the tax rate, weighted average cost of capital, and the growth rate. Accordingly, high levels of RoIC should at least theoretically lead to higher EV/EBIT multiples. Although this relation is indisputable, the penalization of higher EV/EBIT multiples is founded in empirical research, and theoretically, to the above-mentioned drivers of

EV/EBIT, the multiple can to some extent also be explained by different factors. In addition, the behavioral aspect that humans tend to be too optimistic and too pessimistic might affect these estimates. However, since the holding period in the analysis is either six months, a year, or 3 years, one could argue that long term growth possibilities in the steady state is not changed significantly. To which degree this actually is the case cannot be concluded. Furthermore, the fact that the models are theoretically equivalent requires that analysts do not use shortcuts. However, this assumption cannot be verified. These perspectives of the valuation models can to some extent explain the differences between EV/EBIT and RoIC and RoIC and EV/EBIT. The fact that RoIC as a screening tool is quite successful to identify the worst performing stocks could be explained by the relation between RoIC and enterprise value as described above. Given that the extracted RoIC is a measure of the return on invested capital in the future and that the 10% lowest RoIC values are close to or below zero, it is likely that the EVA is negative due to a higher capital charge than the operating income. Therefore, it is plausible that the present value of this negative EVA plus the invested capital is close to 0, and therefore there is a potential increase if the stock price is limited. This argument is only valid for companies with very low returns on invested capital, and hence the return on invested capital is only available to identify the worst performing stocks. Furthermore, this complies with the thoughts regarding the decentiles containing turnaround cases.

In regard to EV/EBIT & RoIC as a screening tool, the companies similar to the one in the previously mentioned example would be penalized for the poor rank of RoIC, but rewarded for the low EV/EBIT caused by the low RoIC. Therefore, the screening tool does not categorize the companies with poor return on invested capital as bad as the screening is solely conducted on RoIC, ceteris paribus, caused by the low EV/EBIT multiple. However, the success of EV/EBIT and RoIC to identify the best performing stocks and the worst performing stocks could be explained by the above-mentioned fact combined with the arguments for EV/EBIT. As such, the penalizing factor for the poor return on invested capital combined with the rewarding factor for EV/EBIT tends to take advantage of the misalignment between RoIC and EV/EBIT. To elaborate, the RoIC should be able to explain a part of the EV/EBIT, and given that the proportions between these two measures are exactly the same for the companies, the overall return of the decentile should be the same. By focusing on how the rank of RoIC and EV/EBIT is within the market, variations of the proportions are able to be detected which the different returns of the decentiles supports. However, it is impossible to isolate the cause of difference between RoIC, growth rate, tax rate, or WACC, or a combination of all.

5. Conclusion

The aim of this assignment has been to answer the research question:

To which extent can an investment strategy based on price measures and return measures be used as a screening tool for stock selection?

To do this, the Magic Formula has been examined as well as the investment philosophy underlining it. It was found that the strategy rests on the belief that if investors could invest in quality companies at "cheap" prices, a superior return should be achieved. As a measure of quality, the strategy uses Return on tangible Capital (ROC) to determine the quality of a company and EV/EBIT as to indicate the price. Greenblatt reasons that the return on tangible capital is the best measure as it estimates the return companies can get on their investments which should be a good proxy for the quality. Furthermore, he considers it the easiest measure to obtain. EV/EBIT is used instead of the more commonly used P/E because it eliminates the effect of leverage. Furthermore, he considers it a better measure than EV/EBITDA because he believes that depreciation and amortization are highly relevant.

As the aim of the assignment was to test the Magic Formula, the intent was to use similar price and quality measures that were based on the same investment principles as Greenblatts. However, it was also considered important to ensure that the measures used were based on solid theoretical evidence. Based on the theoretical review of price measures, it was decided to use the EV/EBIT multiple. There were several motives behind this choice. First and foremost, due to the fact that leverage can distort the results significantly, it was decided to omit the use of equity measure such as the price earnings measure. It was deemed of great importance that the price measure focused on cash flows to the enterprise created from core operation. The EV/EBIT fulfilled this criterion as enterprise value is used as the price indicator and the operating earnings before tax is used as the earnings measure. Another important aspect was that EV/EBIT is easily retrieved which makes the data more reliable. Last but not least, the EV/EBIT multiple is theoretically identical to other valuation approaches, such as the DCF model, EVA, and the P/E ratio. From the derivation, it became evident that the EV/EBIT multiple is driven by four factors: The growth rate, the return on invested capital (RoIC), weighted average cost of capital (WACC), and the tax rate. This served two purposes: it permitted an analysis of the underlying reasons EV/EBIT varies across companies, and it made it possible to make a distinction between the price measure and the preferred quality measure RoIC.

As a quality measure, return on invested capital was selected as the preferred measure for numerous reasons. First and foremost, return on invested capital captures the value that is created by the core operations. This is a good measure of quality as it indicates the return a company gets when investing in their core business. Further-

more, overwhelmingly support by academic research was found that suggested that it was a good indicator for the quality of a business as theory linked high RoIC values to competitive advantages. Moreover, the return on invested capital is a widely accepted measure for economic value added, which can in turn be used to estimate the value of a company, indicating that the measure is also a good measure for economic value. This is the case both for the EVA model, and it is also one of the fundamental drivers of EV/EBIT. The return on invested capital is also a firm measure unlike e.g. return on equity, which is an equity measure. As the intent was to use enterprise value as the foundation of the analysis, this was considered an important aspect. Return on invested capital was chosen over Greenblatts preferred measure, return on tangible capital, for numerous reasons. Most importantly, return on invested capital is considered to be a better measure for future cash flows for the company, and thus the quality of the company. Greenblatts reason for choosing return on tangible capital over the return in invested capital is that it is easier to retrieve as there are less accounting issues. This is deemed a valid point; however, the benefits of using RoIC are considered to significantly outweigh the disadvantages associated with accounting issues, as it is a better measure for the quality of the companies. The accounting issues have been acknowledged, and as such, the problems associated with these have been discussed in the theoretical section. The tests of the strategy were divided into three parts; In the first test, the companies were ranked solely on return on invested capital, the second test ranked companies solely on EV/EBIT, and in the final test, companies were ranked according to a combination of EV/EBIT and RoIC.

The first test results showed that based on return, RoIC was a fairly good tool to find stocks that provided great returns and stocks that provided abysmal returns. However, this was only the case for the very top and bottom portfolios, and the test did not give any indication for the remaining portfolios. This was only further validated once the returns were adjusted for risks. It was however very interesting that the bottom portfolio not only provided the worst returns but also contained the most risk. As a result, it has been argued that RoIC can be a good measure to deselect the companies with the lowest returns on invested capital. The characteristics were quite interesting. As expected from the theoretical review, the different decentiles had vastly different sector allocations. This among other things resulted in the fact that there was a negative correlation between the outperformance of the best and the worst decentiles, and the fact that the decentiles close in proximity had the highest correlation, thereby supporting the statement that the portfolios had similar characteristics. Last but not least, it was remarkable that the analysis of the best and worst performing stocks within the portfolio gave a clear indication that the best performing stocks are in the very top and bottom portfolios. The bottom portfolios, however, also contained the worst performers by far, whereas the worst stocks in the top portfolios performed according to average. This is considered to be a possibly contradictory argument as to remove stocks with very low return on capital as some have in fact performed very well. The median portfolios had the lowest returns from single stock

movements but also had the least losses from the poorly performing stocks within the portfolio. Nonetheless, this was found to be quite risky as the majority of securities vastly underperformed the market, but in the end, it comes down to the investment philosophy of the investor.

The second test results of EV/EBIT revealed that the price measure was a good way to identify the very worst performing stocks as well as the best performing stocks. This was especially the case for the bottom and top two portfolios. When adjusted for risk, this pattern remained the same. The reason for this was twofold. First of all, the risk measured by standard deviation was highest for the very top and bottom portfolios and lowest for the median portfolios as was the case with the first test. This meant that the risk-adjusted returns for the bottom portfolios became even worse as they not only provided poor returns but also contained the highest risk. For the top portfolios, however, the returns were so superior that even though the portfolios were perceived to be riskier, they still provided the best risk-adjusted returns. The characteristics of the different portfolios were in line with the theoretical review. The sector allocation was thus vastly different across the portfolios, and the over and underweights were as expected. Furthermore, the outperformance of decentile 1 and 10 were negatively correlated, and the portfolios had the best correlation with portfolios in close proximity. The returns of the best and worst performing stocks provided a similar image as was found in the first test on return on invested capital. The best performing stocks were found in the top and bottom decentiles, however, once again the bottom decentiles also had the worst performing stocks, while the worst performing stocks from the top decentile performed as its peers. The median portfolios had the lowest return from returns of their best stocks but also had the lowest negative returns from their worst performing stocks. Thus, based on the findings from this test, it would seem that EV/EBIT would be a valid way to screen stocks as a clear pattern emerges based on return, risk, and risk-adjusted returns. However, investors should keep in mind that some of the best performing stocks are in the bottom decentiles, and a lot of the superior performance of the best decentiles is driven by a few stocks.

The last test performed was a combination of the two measures and tested Greenblatts investment strategy. Purely based on returns, it was discovered that decentile 1 was the best or second best performer when the holding period was either six months or a year. Furthermore, at least four of the five best performing portfolios were present in the top five portfolios across all holding periods. The bottom decentiles performed poorly, although decentile 10 performed much better than it did in the initial test. However, overall the bottom portfolios were also the worst portfolios based on return. The results thus provided a much clearer pattern than the findings in RoIC and EV/EBIT as the returns were somewhat in order. However the absolute returns of the best portfolios were not as impressive as it was case when solely ranking on the basis of EV/EBIT and RoIC. The findings on risks were very similar to the findings in the first two tests. The top and bottom portfolios appeared to be the riskiest for the combined measures, however, the bottom two portfolios ranked as the two worst according to

risk. The median portfolios appeared to have the lowest risk when measured by the standard deviation. Accordingly, when measured by risk-adjusted returns, the bottom portfolios performed worst as they had returns that were below par and contained most risk. The risk also resulted in a mediocre performance for decentile 1 as the increased risks offset the better return. However, this was only the case with risk-adjusted returns that were based on the standard deviation as a measure for risks as the top decentile provided the best risk-adjusted return according to Jensen's Alpha due to a lower relative beta. Overall, according to the Sharpe ratio, the top five decentiles contained at least four out of the best five performing portfolios. The results were generally mixed for Jensen's Alpha, however, there was a tendency that the best portfolios performed best and the worst portfolios had the worst performance. The various portfolios were found to have very different characteristics. It is considered interesting that the top and bottom portfolios once again had a negative correlation. Furthermore, the analysis of the best and worst performing stocks within the portfolios yielded an almost identical result compared to the two earlier findings.

Based on the overall findings, it is believed that a model based on EV/EBIT and return on invested capital can provide some valuable insights and a good starting point as to which stocks should be singled out. However, it is not conceded that a strategy based purely on this approach is feasible as the performance of the different decentiles has been found to be significantly affected by a few stocks. In the event that these stocks are not chosen, the results will differ significantly. Therefore, the model is deemed appropriate to serve as a starting point to find those well performing stocks, rather than a definite measure.

6. Perspectives

There are several ways to use screening tools related to investments strategies. They can be used as a way to decrease the number of stocks to analyze in greater depth, or be used as a cornerstone in an investment strategy. Especially the former is considered advantageous as by excluding companies that do not perform as well as the ones recommend to be focused on, the likelihood for selecting strong performing stocks is increased. This is particularly important in the modern world were a vast amount of information about an ever increasing amount of securities is available to investors. Therefore the purpose of the RoIC and EV/EBIT as a screening tool is to limit the amount of stocks that needs further investigation. The strategy has been found valid for this purpose as companies with a higher rank has generally outperformed stocks with lower rankings. RoIC as a screening tool is helpful to isolate strong and poorly performing companies, which can, among other things, be used to identify companies with a competitive advantage or turnaround cases. EV/EBIT on the other hand identifies companies that are priced expensively and inexpensively, and the strategy can, among other things, be used to include or exclude companies that, with the drivers of EV/EBIT in mind, are perceived as fast growing, strong cash gener-

ating, etc., or vice versa. EV/EBIT and RoIC as a combined screening tool combines the above mentioned options and considered is useful for many different investment strategies, especially due to the fact that the strategy is able to detect overall strongly and poorly performing portfolios. It should be noted though that it is not recommended to invest just on the basis of the ranking of companies. Rather the strategy should be used as a starting point to further research companies that does well according to the test.

7. Suggestions for Future Research

More than six months of research has come to an end. In this process, several areas have been encountered which would have been highly interesting to further study in direct relation to this thesis. First and foremost, it would be interesting to include additional measures in the analysis. For instance, to include the free cash flow and fundamental risk measures as the Altman Z-score. Moreover, the price measure could be adjusted to decrease the exposure towards certain sectors. The impact of tax and transaction costs would also be highly relevant to analyze as this is of great importance to investors. Furthermore, it would be interesting in the future to perform similar analysis on different indices as more data becomes available. Another issue that would be interesting to research further is if the strategy works on small cap stocks as opposed to large cap stocks as there seem to be some evidence of different results. It would also be interesting to analyze into greater depth how the four drivers of the EV/EBIT multiple affect the pricing of securities and whether securities with certain characteristics e.g. higher growth rates or risk in regard to the EV/EBIT perform better/worse than others. Further it would be interesting to do further analysis on the top 15 and bottom 15 performers of the different decentiles and especially decentile 1 & 10 as these contain the best and worst performers to see whether specific securities have any similarities that would make them distinguishable from one another thereby making it possible to improve the screening process.

8. Reflections and Final Remarks

Naturally, the findings can be challenged. However, this does not change the tremendous amount of learning accumulated over the course of writing this thesis. The key learning point is the usefulness of the screening tool during the last bull and bear markets over the last 20 years, and the inherent risks embodied in the screening tool**.**

With these words, this master's thesis hereby comes to a conclusion, and acknowledgement and gratitude is given to those whom have gone through the effort of reading it.

9. Bibliography

Books:

Richard A. Brealey, Stewart C. Meyers & Franklin Allen, Principles of Corporate Finance (2008)

Barry J. Epstein, Ralph Nach & Steven M. Bragg, GAAP 2009 Interpretation & Application of Generally Accepted Accounting Principles (2008)

Michael Christensen, Obligations Investering (2009)

Aswath Damodaran, Investment Valuation Tools & Techniques for Determining the Value of Any Asset (2012)

Alan Agresti & Christine Franklin, Statistics The Art & Science of Learning From Data (2008)

Benjamin Graham, The Intelligent Investor (2006)

Joel Greenblatt, The Little Book That Still Beats the Market (2010)

Michael R. Harwell, Research Design in Qualitative/Quantitative/Mixed Methods (2011)

John C. Hull, Options, Futures & Other Derivatives (2011)

Zvi Bodie, Alex Kane & Alan J. Marcus, Investments & Portfolio Management (2011)

Howard Marks, The Most Important Thing (2011)

Charles MacKay, Extraordinary Popular Delusions and The Madness of Crowds (2013)

Christian V. Petersen & Thomas Plenborg, Financial Statement Analysis (2011)

Robert J. Shiller, Irrational Exuberance (2006)

George A. Akerlof & Robert J. Shiller, Animal Spirits (2010)

Frank Sortino & Stephen Satchell, Managing Downside Risk in Financial Markets (2011)

Nassim Nicholas Taleb, The Black Swan (2010)

Kenneth A. Merchant & Wim A. Van der Stede, Management Control Systems (2007)

Tim Koller, Marc Goedhard & David Wessels, Valuation Measuring & Managing the Value of Companies 20109

Reports:

Amazon: Q2 2013 Amazon.com, Inc. Earnings Conference Call Slides (2013)

Ernst & Young, US GAAP versus IFRS The Basics (2011)

McGraw-Hill Annual report 2012

Nicklas Selender & Victor Person, Back testing the ”Magic Formula” in the Nordic region (2009)

PWC, Financial reporting in the power & utilities industry (2011)

Articles:

Glenn E. Atkins, Capital Structures, P/E Ratios & Cash Flow (2001)

Carl Bacon, How sharp is the Sharp ratio? – Risk-adjusted Performance Measures (2009)

S. Basu, Journal of Finance Vol. 32 (1977)

CBOE, The CBOE VOLATILITY INDEX – VIX (2009)

Jerry A. Collins, Integrated Tail Risk Hedging: The Last Line of Defense in Investment Risk Management (2009)

Aswath Damodaran, Estimating Risk-free Rates (2008)

Aswath Damodaran, Return on Capital (ROC), Return on Invested Capital (ROIC) & Return on Equity (ROE): Measurement & Implications (2008)

Marcus Davidsson, Expected Return & Portfolio Rebalancing Peter Suozzo, Stephen Cooper, Gillian Sutherl& & Zhen Deng, UBS Warburg – Valuation Multiples (2011)

Michael Finke, Seeking high performance with low risk (2012)

Robert J. Frey, On the Ω-Ratio (2009)

W. V. Harlow, Asset Allocation in a Downside-Risk Framework (1991)

Dan Herms, Logical Basis of Hypothesis Testing in Scientific Research (2003)

Roy D. Henriksson & Robert C. Merton, On Market Timing & Investment Performance. II. Statistical Procedures for Evaluating Forecasting Skills* (1981)

James Montier, The little note that beats the market (2010)

Jean-Sébastien Michel & J. Ari Pandes, Are Analysts Really To Optimistic? (2011)

Martin Eling & Frank Schumacher, Does the choice of performance measure influence the evaluation of hedge funds? (2007)

Con Keating & William F. Shadwick, A Universal Performance Measure (2002)

William Sharpe, Mutual Fund Performance (1966)

Ravi Shukla, Risk of Investing in the S&P 500 Index (2008)

Véronique Le Sourd, Performance Measurement for Traditional Investment (2007)

Meir Stratman, How Many Stocks Make a Diversified Portfolio? (1987)

Jing Liu, Doron Nissim & Jacob B. Thomas, Equity Valuations Using Multiples (2001)

Daniel Kahneman &Amos Tversky, Prospect Theory: An Analysis of Decision under Risk (1979)

Jaksa Cvitanic, Ali Lazrak & Tan Wang, Implications of the Sharpe Ratio as a Performance Measure in Multi-Period Settings (2007)

Jacques Pézier & Anthony White, The Relative Merits of Investable Hedge Fund Indices & of Funds of Hedge Funds in Optimal Passive Portfolios (2006)

Website:

http://www.aaii.com/computerizedinvesting/article/3-using-the-magic-formulafor-investing

http://www.aaii.com/files/PDF/8791_the-sortino-ratio.pdf
http://www.berkshirehathaway.com/letters/1989.html

http://www.bloomberg.com/news/2011-02-21/bhp-buys-chesapeake-unit-for-4-75-billion-adding-u-s-shale-gas-assets.html

http://www.forbes.com/2010/04/16/formula-s-&-p-500-intelligent-investing-greenblatt.html

http://www.ft.com/intl/cms/s/0/2e7f76aa-e361-11e0-8f47-00144feabdc0.html#axzz2f5Ng5nCd

http://www.ft.com/intl/cms/s/0/5410a554-8bd7-11e2-b001-00144feabdc0.html?siteedition=intl
http://lexicon.ft.com/Term?term=price/earnings-ratio

http://www.mckinsey.com/insights/corporate_finance/equity_analysts_still_too_bullish
http://www.nytimes.com/2009/11/15/business/media/15bloom.html?pagewanted=2&_r=2&hp/&

http://pages.stern.nyu.edu/~adamodar/

http://pages.stern.nyu.edu/~adamodar/New_Home_Page/invfables/peratio.htm

http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/earnmult.pdf

http://www.palisade.com/articles/motta_preftheory-asp

http://people.stern.nyu.edu/adamodar/pdfiles/pbv.pdf

http://research.stlouisfed.org/fred2/categories/116
http://www.stanford.edu/~wfsharpe/art/sr/sr.htm
http://www.st&ard&poors.com/indices/sp-500/en/us/?indexId=spusa-500-usduf--p-us-l--

http://www.valuewalk.com/joel-greenblatt-resource-page-bio-books-quotes-interviews-videos/