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Wien, den 10.02.2017 Anna Georgieva

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1. Introduction and Problem Statement

"Value Investing has been around as an investment philosophy since the early 1930s."[1] It has yielded superior results for a longer period than any competing investment strategy.[2] The strategy has three main benefits.[3] Value Investing can decrease the risk of a portfolio.[4] In addition, it exhibits the benefit of reducing trading costs.[5] The bottom line is that the actual reward from this strategy is measured in actual monetary inflows.[6] Hence, this topic attracts the attention of a lot of researchers. Piotroski (2000) combines a fundamental strategy with a value investing strategy by developing a simple accounting-based measure and applying it to a broad sample of high Book-to-Market (value) firms.[7] Based on his approach and F-Score measure, the author manages to identify the companies with the strongest financial positions, which are expected to have therefore the lowest risk of all value stocks.[8] In that manner, Piotroski (2000) boosts the mean return of the composed high Book-to-Market portfolio by at least 7.5 % annually, without increasing the risk exposure.[9] The high magnitude of the resulting abnormal returns triggers a lot of criticism with respect to his approach.[10] Elliason, Malik and Österlund (2010) state, that the ability of each of the nine fundamental signals in Piotroski's (2000) F-Score to explain future returns is not necessarily constant over time.[11] This dispute leads to the topic of this research.

This master thesis investigates the real determinants of value investment returns based on financial statement and portfolio analysis. We achieve that by focusing on Piotroski's F-Score measure for portfolio construction and on an A-Score Approach for portfolio construction, which we develop in this master thesis. Both types of portfolio formation strategies are applied to a sample of high Book-to-Market STOXX Europe 600 companies. In order to analyze the real determinants of value investment returns on a portfolio level, we form F-Score Portfolios and A-Score Portfolios. The F-Score Portfolios are based on Piotroski's (2000) F-Score

[1] Browne (2007), Introduction, p. xxiv
[2] See Browne (2007), Introduction, p. xxiv
[3] See Brandes (2004), p. 32
[4] See Brandes (2004), p. 32
[5] See Brandes (2004), p. 32
[6] See Brandes (2004), p. 32
[7] See Piotroski (2000), p. 37
[8] See Rathjens/Schellhove (2011), p. 2
[9] See Piotroski (2000), p. 37
[10] See Guay (2000), p. 12
[11] See Elliason/Malik/Österlund (2010), p. 3

Approach for investment strategies. The A-Score Portfolios are based on our A-Score Approach for portfolio construction. This A-Score Method is built upon fundamental variables, which exhibit significance in explaining the stocks' returns. We select them in a complex regression modeling process and use them to predict the returns of the selected companies. The goal is to compare the performance of the F-Score Portfolios and the A-Score Portfolios by selecting the companies with the highest F-Score signals and the highest predicted returns, respectively. In addition, we construct each portfolio based on equal weight and on capitalization weight in order to control for weight-based differences in our results.

This master thesis presents, in a structured manner, the completed analysis and process in defining real determinants of value investments returns. Chapter two includes a literature and theoretical overview on value investment, fundamental analysis and portfolio management topics. The methodology and the distinct steps in our research process are clarified in Chapter three. The emphasis of Chapter four is on our empirical results for the different types of portfolios, which we analyze in order to conclude on our research problem. Chapter five summarizes the key steps of the investment strategy of the A-Score Approach. At the end follow the conclusion and future possible research prospects.

2. Literature Review and Theoretical Background

This chapter focuses on literature analysis and theoretical background on topics, which are relevant for this research. It begins with a precise explanation of the concept of value investing strategy. Consequently, it analyzes the notion of fundamental analysis. In that manner, it explains the structure and previous use of fundamental variables, which are implemented in our master thesis. In the end, it describes portfolio management concepts, which we apply later in the methodology part of our research.

2.1. Value Investing Strategy

Originally defined by Benjamin Graham and David Dodd, value investing is an investment strategy, which is based on three key characteristics of financial markets.[12] First, financial securities' prices fluctuate, because the financial market overreacts to good and bad news.[13] The second important characteristic is that many of the financial assets have fundamental economic or intrinsic values, which are often defined as stable in contrast to their capricious market prices.[14] Intrinsic value and market price may be corresponding, but they often deviate.[15] That breach between value and price is called "the margin of safety".[16] This leads to the third important characteristic of financial markets. It states that "a strategy of buying securities only when their market prices are significantly below the calculated intrinsic value will produce superior returns on the long run".[17]

Considering these assumptions, a value investor appraises the fundamental value of a financial security and compares it to its current market price.[18] A value investor will buy this security only if it is undervalued compared to its financial statements or its value is with a significant margin of safety relative to its price.[19]

Important aspect of this investment strategy is that value investors focus on the long run and have therefore a long-term holding period.[20] They value the underlying business, future potential and growth of a company.[21] A growth at a reasonable price business is seen as the

[12] See Greenwald/Kahn/Sonkin/Biema (2001), p.3
[13] See Greenwald/Kahn/Sonkin/Biema (2001), p.3
[14] See Greenwald/Kahn/Sonkin/Biema (2001), p.3
[15] See Greenwald/Kahn/Sonkin/Biema (2001), p.3
[16] See Greenwald/Kahn/Sonkin/Biema (2001), p.3-4
[17] Greenwald/Kahn/Sonkin/Biema (2001), p.3
[18] See Greenwald/Kahn/Sonkin/Biema (2001), p.4
[19] See Graham/Zweig (1973), p.537
[20] See Investopedia: The Value Investor's Handbook
[21] See Gad (2009), p.168

investment that a value investor is aiming at.[22] The logic behind that is that "If you buy a security today and that business continues to earn greater profitability and free cash flow, the intrinsic value also will grow. And as that intrinsic value grows, the investment becomes more and more undervalued from the price paid."[23]

There are various techniques in identifying undervalued stocks, but the most widely used are related to the Price-to-Earnings and Book-to-Market Ratios.[24] Fama and French (1998) state that investment managers classify companies that have a high book-to-market ratio, earnings-to-price ratio or cash-flow-to-price ratio as value stocks.[25] A high Book-to-Market companies' portfolio outperforms a portfolio of low Book-to-Market firms according to a vast prior research. Rosenberg, Reid and Lanstein (1985) reported a statistically significant abnormal performance explained by the Book-to-Market Ratio.[26] In the time period 1980-1984, they selected 1400 of the largest Computstat stocks and performed an investment strategy in buying high Book-to-Market stocks and selling low Book-to-Market stocks.[27] The researchers showed that the high Book-to-Market stocks generated much higher returns than the low Book-to-Market stocks.[28] Fama and French (1992) identified the Book-to-Market Ratio as the most significant determinant of the cross-sectional expected returns on the US stock market in the period between 1963 and 1990.[29] They observed a rise of 0.30 % per month for the lowest Book-to-Market portfolio and 1.83 % per month for the highest Book-to-Market portfolio, resulting in a high difference between the highest and lowest quantile.[30] Lakonishok, Shleifer, and Vishny (1994) also found a statistically significant predictive power of the Book-to-Market ratio for the average return for the highest 20 % NYSE-Amex stocks in the period 1963-1990.[31] They also confirmed the concept that high Book-to-Market portfolios outperform lower Book-to-Market portfolios.[32] This idea has been successfully tested on the European market as well, where Lischewski and Voronkova (2010) supported the hypothesis that the

[22] See Gad (2009), p.168
[23] Gad (2009), p.168
[24] See Schroders (2011): Successful value investing: the long-term approach
[25] See Fama/French (1998), p.1975
[26] See Rosenberg/Reid/Lanstein (1985), p. 9
[27] See Rosenberg/Reid/Lanstein (1985), p. 9
[28] See Rosenberg/Reid/Lanstein (1985), p. 9
[29] See Fama/French (1992), p. 427
[30] See Fama/French (1992), p. 441
[31] See Lakonishok/Shleifer/Vishny (1994), p. 1559
[32] See Lakonishok/Shleifer/Vishny (1994), p. 1575

Book-to-Market Ratio has high explanatory power for returns on the emerging Polish stock market.[33]

Overall, value investors resist the crowd psychology and perform in-depth and fundamental analysis of a company in implementing their comprehensive investment philosophy.[34]

2.2. Fundamental Analysis

Fundamental analysis is a method of evaluating a security in an attempt to measure its intrinsic value.[35] It examines related economic, financial and other qualitative and quantitative factors.[36] The biggest part of fundamental analysis involves performing a *financial statement analysis*.[37]

2.2.1. Financial Statements

In order to be able to perform a financial statement analysis we have to explain the main types of financial statements. The Balance Sheet, Profit and Loss Statement and Cash Flow Statement are the most widely analyzed among them.[38] The *Balance Sheet* includes the resource owned by a company (assets), its obligations to lenders and further creditors (liabilities) and the amount attributable to company's owners (equity) at a specific point of time, respectively.[39] The *Profit and Loss Statement* reports revenue, other income and expenses in generating the company's income over a period of time, respectively.[40] The *Cash Flow Statement* provides information about the cash flows from operating activities, the cash flows from investing activities, and cash flows from financing activities of a company at a specific point of time.[41] This information allows for more accurate understanding of the financial variables that we analyze further in this research.

2.2.2. Book-to-Market Ratio

The *Book-to-Market Ratio* as a fundamental variable compares the book value of a company to its market value.[42] The *book value* of a company is calculated by deducting liabilities from

[33] See Lischewski/Voronkova (2010), p. 18
[34] See Graham/Dodd (2009): Klarman: *The timeless wisdom of Graham and Dodd*
[35] See Investopedia: Fundamental analysis
[36] See Investopedia: Fundamental analysis
[37] See Investopedia: Introduction to Fundamental Analysis
[38] See CFA Program 2017 Curriculum Level 1, Study Session 6, Reading 21, p. 12
[39] See CFA Program 2017 Curriculum Level 1, Study Session 6, Reading 21, p. 12
[40] See CFA Program 2017 Curriculum Level 1, Study Session 6, Reading 21, p. 16
[41] See CFA Program 2017 Curriculum Level 1, Study Session 6, Reading 21, p. 22
[42] Investopedia: Book-to-Market Ratio

the assets of this company.[43] Market Value refers to the *market capitalization* of a company, which denotes the company's share outstanding multiplied by the current market price of one share.[44] The ratio identifies undervaluation or overvaluation.[45] If it is above one, the stock is undervalued.[46] If it is less than one, the security is overvalued.[47] It has a high explanatory power in predicting the stocks' return according to a wide range of literature. In addition, Lukács (2002) proves a significant relationship between the distribution of stocks' returns and the market capitalization of the stocks.[48] The *Book Value to Total Assets* ratio also exhibits explanatory power for stocks' returns, as well.[49]

2.2.3. Fundamental Variables in Piotroski's (2000) F-Score[50]

An important accounting-based indicator in determining financial strength of a company is Piotroski's (2000) F-Score measure. It is integrated on a wide range of internet stock screeners and is commonly used by investment managers.[51] This research includes the variables in Piotroski's (2000) F-Score, because they represent a useful source of information in signaling the condition of a company and its return, respectively.

The F-Score is constructed when summing nine binary variables in order to indicate the financial performance of a firm. Four of the variables are selected to capture profitability. Three variables are allocated to signal leverage, liquidity, and source of funds, respectively. Further two variables signal the operating efficiency of the screened company. Given that Piotroski (2000) considers nine underlying signals, the F-Score can range from a low of zero to a high of nine. A high F-Score represents a company with good signals in the most fields of interest. A low F-score is marked by a firm with few good signals.

Profitability is represented by *net income before extraordinary items*, *cash flow from operations*, *change in net income before extraordinary items,* and *accruals*. *Net Income (Loss) before Extraordinary Items* is documented on the company's income statement and shows the income or loss from extraordinary events and transaction.[52] Extraordinary items are a result of

[43] See Gad (2009), p. 23
[44] See Investopedia: Market Capitalization
[45] See Investopedia: Book-to-Market Ratio
[46] See Investopedia: Book-to-Market Ratio
[47] See Investopedia: Book-to-Market Ratio
[48] See Lukács (2002), p. 147-148
[49] See Drobetz/Erdmann/Zimmermann (2007), p. 24
[50] See Piotroski (2000), p. 7-10
[51] See Novy-Marx (2014), p.7
[52] See Investopedia: Extraordinary Item

unforeseen and atypical events and are usually explained further in the notes to the financial statements.[53] *Cash Flow from Operations* represents the net amount of cash provided from operating or regular business activities.[54] It is reported on the firm's cash flow statement.[55] The four variables are scaled by total assets. *Total Assets* are stated on the company's balance sheet.[56] They include resources, which are controlled by a company as a result of past events and from which future economic benefits to the company are expected to flow.[57] *Change in net income before extraordinary items* is defined as the current year's net income before extraordinary items less the prior year's net income before extraordinary items. *Accruals* are defined as current year's net income before extraordinary items less cash flow from operations. If the company's net income before extraordinary items or cash flow from operations are positive, they are classified as equal to one, otherwise zero. If the change in net income before extraordinary items is greater than zero, it is equal to one. Otherwise it equates to zero. Since profits greater than cash flow from operations suggest a bad signal for future profitability and returns of a company, the accruals are equal to one if cash flow from operations are greater than net income before extraordinary items. Otherwise the signal is valued at zero.

Leverage is captured by the ratio of *total long-term debt scaled by average total assets*. Long-term Debt comprises of loans and financial obligations over one year and is presented on the balance sheet of a company.[58] The precise variable is defined as current year's ratio less prior year's ratio. An increase in financial leverage is seen as a negative signal. In this manner, a decrease in this ratio is equal to one. An increase in financial leverage equates to zero.

Liquidity is measured by the *current ratio*, which equals current assets divided by current liabilities. *Current Assets* are recorded on the company's balance sheet and include cash and cash equivalents, accounts receivable, inventory, marketable securities, prepaid expenses, and other liquid assets that can be converted into cash within one year.[59] *Current Liabilities* are documented on the firm's balance sheet and contain the short-term debt, accounts payable, accrued liabilities, and other debts that are due within one year.[60] Piotroski's variable is defined as *change in the current ratio* and calculates the company's current ratio between the current

[53] See Investopedia: Extraordinary Item
[54] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-5
[55] See Investopedia: Cash Flow from Operating Activities (CFO)
[56] See Investopedia: Assets
[57] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-2
[58] See Investopedia: Long-term Debt
[59] See Investopedia: Current Assets
[60] See Investopedia: Current Liabilities

and prior year. An improvement in liquidity is considered a good signal. Therefore, in that scenario this concrete variable is equal to one. The opposite scenario equates to zero.

Source of funds is measured by the *equity offering*. An increase in shares issued might designate financial distress. When the share price of a company is low, equity issuance does come along with high cost of capital, which the firm has to accept. Therefore, a decrease or no change in the shares outstanding is equal to one. The contradicting scenario equates to zero.

Operating efficiency is measured by the *change in gross margin ratio* and the *change in asset turnover ratio*. The *gross margin ratio* is represented by gross profit scaled by total sales. *Gross profit* shows the difference between total sales and costs of goods sold. *Total sales* represent the amount charged for the delivery of goods or services in the ordinary activities of a business over a stated period.[61] They are documented on the income statement of a company and are calculated by multiplying the price of the goods or service by the number of units sold.[62] *Cost of Goods Sold* measures the direct costs for materials and the direct labor costs attributable to the production of the goods sold by a company.[63] They are issued on the company's income statement.[64] The change in gross margin ratio is represented by the current year's gross margin ratio less the prior year's gross margin ratio. *Asset turnover ratio* is the ratio between total sales and total assets. The change in asset turnover ratio refers to current year's asset turnover ratio less the prior year's asset turnover ratio. If the change in gross margin ratio or the change in the asset turnover ratio is positive, then the indicator variable equals one. Otherwise, it is considered to be zero.

2.2.4. Additional Fundamental Variables

Besides the nine F-Score's fundamentals, this master thesis includes additional fundamental variables. Their performance and interpretation is used commonly in the literature of value investing or in explaining stocks' returns. Therefore, we select and include them in the process of our research.

Greenblatt (2010) states that the earnings yield and the return on invested capital are essential metrics in buying good companies at bargain price.[65] The *Earnings Yield* as a fundamental variable measures the pre-tax operating earnings (EBIT) divided by the enterprise

[61] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-28
[62] See Investopedia: Revenue
[63] See Investopedia: Cost of Goods Sold – COGS
[64] See Investopedia: Cost of Goods Sold – COGS
[65] See Greenblatt (2010), p. 47

value.[66] *EBIT* represents the earnings before interest and tax of a company. It is calculated by the revenue minus expenses, excluding interest and tax and is part of the company's income statement.[67] The *enterprise value* is composed of the market value of equity and the net interest-bearing debt of a company.[68] The ratio interprets how much a business earns in comparison to its purchase price.[69] *Return on Invested Capital* characterizes the ratio between EBIT and tangible capital.[70] The *tangible capital* corresponds to the sum of property, plant and equipment, and the net working capital.[71] The *Net Working Capital* signifies the difference between current assets and current liabilities.[72]

Grantham through his firm GMO (2004) states that the high and stable returns are important criteria in the investment process.[73] They can be represented by return on equity and the standard deviation of return on equity.[74] The *Return on Equity* (ROE) is calculated by dividing the net income by the book value of equity.[75] The *Standard Deviation of ROE* represents the dispersion of a set of data from the mean of ROE.[76]

Sloan (1996) proves that the level of accruals in a company is a negative cross-sectional predictor of abnormal stock returns.[77] *Sloan's Accruals* are calculated as historical change in current assets, excluding historical change in cash and cash equivalents, minus the historical change in current liabilities, excluding debt in short-term liabilities and the historical change in income tax payable, minus the depreciation and amortization.[78] *Cash and Cash Equivalents* represent the cash on hand and the very liquid short-term investments.[79] They denote a balance sheet account, as well.[80] The *Income Tax Payable* signifies the income tax owed by the company on the basis of taxable income and indicates a balance sheet account.[81] *Depreciation and Amortization* are non-cash expenses, which are recorded on the company's income

[66] See Greenblatt (2006), p. 141
[67] See Investopedia: Earnings before Interest & Tax – EBIT
[68] See Greenblatt (2006), p. 141
[69] See Greenblatt (2006), p. 141
[70] See Novy-Marx (2014), p. 30
[71] See Novy-Marx (2014), p. 30
[72] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-35
[73] See GMO (2004), p. 2
[74] See Novy-Marx (2014), p. 5, 8
[75] See Damodaran (2012), p. 289
[76] See Investopedia: Standard Deviation
[77] See Sloan (1996), p. 290
[78] See Sloan (1996), p. 293
[79] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-5
[80] See Investopedia: Cash & Cash Equivalents – CCE
[81] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-16

statement.[82] They characterize the allocation of cost of a tangible asset over its useful life and the deduction of capital expense over the life of an intangible long-term asset, respectively.[83] Of further importance is Simutin's (2009) finding of a positive relationship between corporate excess cash holdings and future stock returns.[84] In addition, Lewellen and Resutek (2016) demonstrate that nontransaction accruals, such as depreciation and amortization, have strong predictive power for subsequent stocks' returns.[85]

The *difference between Net Working Capital and Long-term Debt* is used by Graham (1973) as an important criterion for the selection of specific common stocks.[86] It signals the financial condition of a company.[87] According to Graham debt should not exceed the working capital of a firm.[88]

The Gross Profit to Total Assets measure is supported by Novy-Marx (2013) with respect to its explanatory power in predicting the cross-section of average stock return.[89] The author demonstrates that this measure has roughly as much power as the Book-to-Market Ratio in predicting the relative performance of different stocks.[90] *Revenue* and *Costs of Goods Sold*, respectively, have direct impact on the gross profit metric.[91] In addition, Dita and Murtaqi (2014) show that the profit margin ratio can have significant relationship to the stock returns.[92] Jegadeesh and Livnat (2004) find significant positive relation between revenue surprises and stocks' returns.[93]

Hasintongan (2010) proves the existence of a positive relationship between *current ratio* and stocks returns and a negative relationship between *asset turnover ratio* and stocks returns.[94]

Bhandari (1988) states that there is a positive relationship between leverage and average return.[95]

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[82] Investopedia: What is the difference between amortization and depreciation?
[83] Investopedia: Depreciation, Depletion and Amortization -DD&A
[84] See Simutin (2009), p. 213
[85] See Lewellen/Resutek (2016), p. 1079
[86] See Graham/Zweig (1973), p. 348
[87] See Graham/Zweig (1973), p. 348
[88] See Graham/Zweig (1973), p. 348
[89] See Novy-Marx (2013), p. 28
[90] See Novy-Marx (2013), p. 28
[91] See Dechow/Ge/Larson/Sloan (2011), p.19
[92] See Dita/Murtaqi (2004), p. 313
[93] See Jegadeesh/Livnat (2004), p. 148
[94] See Hasintongan (2010), p. 14
[95] See Bhandari (1988), p. 507

The Enterprise Value to EBITDA multiple or *EBITDA to Enterprise value* is supported by Loughran and Wellman (2010) as a strong determinant of stocks' returns.[96]

According to Faurel (2008), capital expenditures are significantly positively correlated to future stocks returns.[97]*Capital Expenditures (CAPEX)* represent company's expenditures on physical assets.[98] They can be found on the cash flow statement of a company.[99] Capital Expenditures tend to be understated in financial statements.[100]

Net Assets from Acquisitions are defined as total assets minus total liabilities.[101] Hence, they are equal to the value of owner's equity of the acquired firm.[102] Kumar, Kuo, and Ramchand (2012) state that other things held constant the merger and acquisitions activity is positively related to company's recent stock return.[103]

Research and Development Expenses are documented on the income statement of a firm.[104] They characterize an expense with respect to the research and development process of a company's goods and services.[105] Lev and Sougiannis (1999) verify that the research and development expenses of a company are associated with its subsequent stock return.[106]

2.3. Portfolio Management

Portfolio management's main idea is to manage various securities and create an investment objective for individuals.[107] It refers to the process of selecting the best investment plan for an investor.[108]

2.3.1. Security and Portfolio Analysis

Portfolio management requires profound understanding of the individual securities and their potential as a joint configuration. That expertise is derived on the grounds of security and

[96] See Loughran/Wellman (2010), p. 1
[97] See Faurel (2008), p. 34
[98] See CFA Program 2017 Curriculum Level 1, Study Session 13, Glossary, p. G-4
[99] See Investopedia: Capital Expenditure (CAPEX)
[100] See Faurel (2008), p. 3
[101] See Weil/Maher (2005), p. 96
[102] See Weil/Maher (2005), p. 96
[103] See Kumar/Kuo/Ramchand (2012), p. 3
[104] See Investopedia: Understanding the Income Statement
[105] See Investopedia: Research & Development (R&D) Expenses
[106] See Lev/Souggiannis (1999), p.
[107] See http://www.managementstudyguide.com/security-analysis-and-portfolio-management.htm [seen on 15.10.2016]
[108] See http://www.managementstudyguide.com/security-analysis-and-portfolio-management.htm [seen on 15.10.2016]

portfolio analysis. *Security analysis* are related to the analysis of individual stocks within the framework of return and risk.[109] In that manner, they identify the fairly priced or underpriced stocks that are most likely to produce the required outcomes from the investment decision-makers.[110] *Portfolio analysis* on the other side, makes analysis of the securities in their combined configuration.[111] It considers return and risk in holding various combinations of securities.[112] Portfolio managers and risk analysts in banks base their risk-optimizing strategies on portfolio theory.[113]

2.3.2. Modern Portfolio Theory

Modern Portfolio Theory is an important concept in portfolio management, which allows for a logical decision making process with respect to portfolio construction topics. It defines ways of diversifying and allocating assets in a financial portfolio in order to maximize the portfolio's expected return given the owner's risk tolerance.[114] Markowitz (1952, 1959) is considered the father of the modern portfolio theory.[115] According to this author, the individual characteristics of an asset do not present the full information.[116] It is important to consider how those securities co-move in order to derive important information for the condition of a potential portfolio.[117] A central rule is that the expected return is considered a desirable thing and the variance of return an undesirable effect.[118] Logically, the expected return and the variance of return represent essential parameters in portfolio management according to modern portfolio theory.

2.3.3. Expected Return and Risk

The *expected return of a portfolio* is the weighted average of the expected return of its individual securities.[119] Equation 2.1 represents the formula for the expected return of a portfolio.

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[109] See Thangamani, p. 87
[110] See Bhat (2008), p. 235
[111] See Thangamani, p. 87
[112] See Thangamani, p. 87
[113] See Schäfer/Kruschwitz/Schwake (2012), p. 143
[114] See Investopedia: Modern Portfolio Theory
[115] See Elton/Gruber (1998), p. 2
[116] See Markowitz (1959), p. 3
[117] See Markowitz (1959), p. 3
[118] See Markowitz (1952), p. 77
[119] See Berk/DeMarzo (2014), p. 353

$$E[R_p] = \sum_i x_i E[R_i] \tag{2.1}$$

where $E[R_p]$ expected return of a portfolio

$E[R_i]$ expected return of security i

$R_i \; or \; R_p$ return of security i or portfolio

x_i fraction invested in security i

Another important term in the process of portfolio analysis is the variance of a portfolio. Its calculation requires a profound understanding of the metric covariance. *Covariance* is the expected product of the deviations of two returns from their means.[120] Equation 2.2 provides the formula for the covariance.

$$Cov(R_i, R_j) = E\big[(R_i - E[R_i])(R_j - E\big[R_j\big])\big] \tag{2.2}$$

where $E[R_i]$ or $\mathrm{E}\big[R_j\big]$ expected return of security i or j

$R_i \; or \; R_j$ return of security i or j

The *variance of a portfolio* represents the weighted average covariance of each stock with the portfolio.[121] Equation 2.3 corresponds to the variance of a portfolio.

$$Var(R_p) = \sum_i \sum_j x_i x_j Cov(R_i, R_j) \tag{2.3}$$

where $Var[R_p]$ variance of a portfolio

$Cov[R_i, R_j]$ covariance between returns of security i and j

$R_i \; or \; R_p$ return of security i or portfolio

x_i or x_j fraction invested in security or j

The standard deviation of a portfolio is the square root of the variance of the portfolio.[122] Equation 2.4 presents the standard deviation of a portfolio.

$$\sigma(R_p) = \sqrt{Var(R_p)} \tag{2.4}$$

[120] See Berk/DeMarzo (2014), p. 354
[121] See Berk/DeMarzo (2014), p. 359
[122] See Taylor (2005), p. 154, See Berk/DeMarzo (2014), p. 361

where $\sigma(R_p)$ standard deviation (risk or volatility) of a portfolio

$Var(R_p)$ variance of a portfolio

2.3.4. Portfolio weight

Another important topic in portfolio management is the portfolio weight. It represents the percentage composition of a particular holding in the portfolio.[123] A variety of weighting schemes are possible in determining the weighting percentages.[124] The most common options are equal weighting and capitalization weighting.[125] Both of them have certain advantages and disadvantages.

Equal weighting offers a portfolio with the same percentage for each stock regardless of the stock's market capitalization.[126] It allows for calculating a *portfolio mean return* and a *portfolio standard deviation*. Equation 2.5 provides the formula for equal weighting in a portfolio.

$$x_i^E = \frac{1}{N} \tag{2.5}$$

where x_i fraction of the portfolio that is allocated to security i or weight of security i

N number of securities in the portfolio

Equal-weighted portfolios have the benefit of being very well diversified with all stocks within the portfolio equally weighted.[127] Another advantage is their ability not to overweight and underweight highly and lowly priced stocks, respectively.[128] They also offer the benefit of simplicity.[129] Securities that constitute a large fraction of the market, might be underrepresented by the equal weight, which positions the equal weighting at a disadvantage.[130] The stocks that correspond to a small fraction of the target market might be overrepresented, respectively.[131]

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[123] See Investopedia: Portfolio Weight
[124] See Fabozzi (1998), p. 135
[125] See Fabozzi (1998), p. 135
[126] See Fabozzi (1998), p. 135, See CFA Program 2017 Curriculum Level 1, Study Session 13, p. 83
[127] See http://www.galoor.com/investing/2025114-portfolio-formation-strategies-the-equally-weighted-portfolio [seen on 05.11.2016]
[128] See http://www.galoor.com/investing/2025114-portfolio-formation-strategies-the-equally-weighted-portfolio [seen on 05.11.2016]
[129] See CFA Program 2017 Curriculum Level 1, Study Session 13, p. 83
[130] See CFA Program 2017 Curriculum Level 1, Study Session 13, p. 83
[131] See CFA Program 2017 Curriculum Level 1, Study Session 13, p. 83

Capitalization weighting is dependent on the market capitalization of the selected stocks for a portfolio. This scheme presents a portfolio, where each stock is weighted according to its market capitalization's percentage of the total market capitalization of the portfolio.[132] It contributes in measuring the *portfolio weighted return* and the *portfolio weighted standard deviation*. Equation 2.6 presents the formulation for capitalization weight of a portfolio.

$$x_i^M = \frac{Q_i P_i}{\sum_{j=1}^{N} Q_j P_j} \tag{2.6}$$

where x_i fraction of the portfolio that is allocated to security i or weight of security i

Q_i number of shares outstanding of security i

P_i share price of security i

An advantage of the capitalization-weighted portfolios is their attribute to diminish liquidity uncertainties for the portfolio holders.[133] This is because capitalization weighting assigns the greatest weights to the largest companies.[134] Since market capitalization is highly correlated with liquidity, this type of weighting ensures a majority of investments in highly liquid stocks.[135] Furthermore, a capitalization weighting makes replicating and buy and hold strategy easier to realize.[136] An important disadvantage of this scheme of weighting is related to the concept of risk aversion.[137] Capitalization weighting might decrease the diversification effect in a portfolio, since it might cause investing too much capital in one specific stock.[138] Moreover, it might place too much weight on some sectors of the market compared to the average portfolio holder.[139]

2.3.5. Risk Tolerance

Portfolio investors can be divided in different types with respect to their risk tolerance. We observe risk-seeking, risk-averse and risk-neutral investors.[140] A risk-averse investor will

[132] See Fabozzi (1998), p. 135, See CFA Program 2017 Curriculum Level 1, Study Session 13, p. 83
[133] See Fabozzi (1998), p. 135
[134] See Hsu (2006), p. 1
[135] See Hsu (2006), p. 1
[136] See Fabozzi (1998), p. 135
[137] See Fabozzi (1998), p. 135
[138] See Fabozzi (1998), p. 135
[139] See Fabozzi (1998), p. 136
[140] See Fischer (2002), p. 41

always choose the portfolio with the minimum risk.[141] Similarly, this investor expects higher expected return for each additional percent of risk.[142] A risk-seeker accepts a decrease in the expected return in the case of higher risk.[143] A risk-neutral investor agrees to the same expected return in the event of higher portfolio risk. [144] The risk tolerance of an individual investor contributes to choosing the most tolerable investment strategy.

2.3.6. Buy and Hold Investment Strategy

The investment strategy is an essential point in portfolio management. In this master thesis we focus on the buy and hold investment strategy. It is a passive investment strategy, where an investor buys securities and holds them for a long period of time, regardless of the market's price movements.[145] The short-term fluctuations of the price or other short-term indicators are not of primary concern for this kind of strategy.[146] The buy and hold returns represent an important metric in this strategy. Barber and Lyon (1997) show that the buy and hold returns measure the returns gained by investors when they buy stock and hold it for the specified period.[147]

[141] See Fischer/Keber/Maringer (2003), p. 74
[142] See Fischer (2002), p. 41
[143] See Fischer (2002), p. 41
[144] See Fischer (2002), p. 41
[145] See Investopedia: Buy and Hold
[146] See Investopedia: Buy and Hold
[147] See Barber/Lyon (1997), p. 369-370

3. Data and Methodology

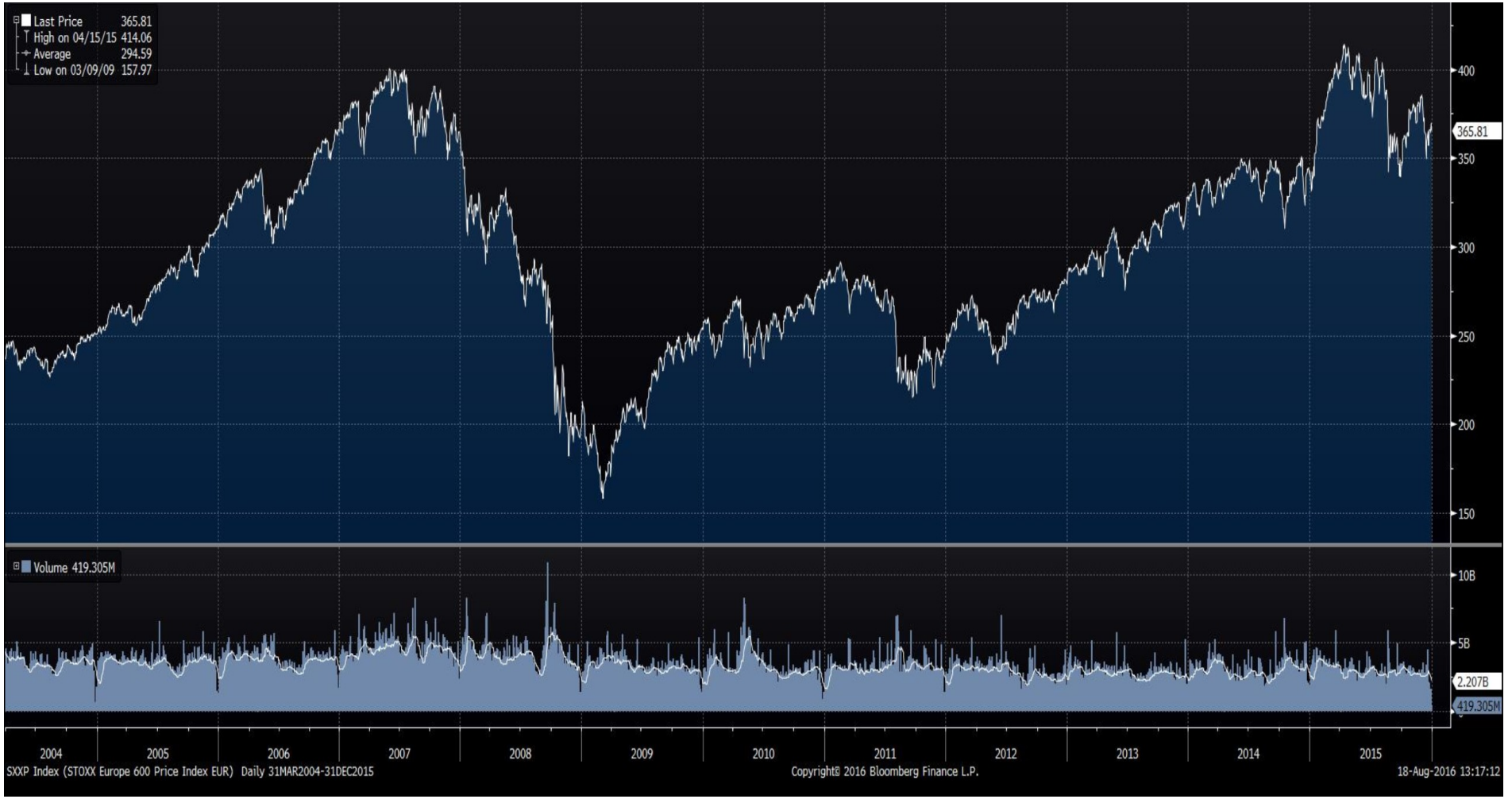
Chapter three focuses on the research strategy of this master thesis. It starts with a brief description of the STOXX Europe 600 Index, thus allowing for a smooth understanding of our gross database. Subsequently, it describes the sample selection process and leads briefly through the methodology of this research. It explains the formation process of the F-Score Portfolios. In addition, it describes the regression modeling process and our choice of regression model, which we adopt in order to explain the origin of our A-Score Portfolios. Those steps allow for comparison of the performance level between F-Score and A-Score Portfolios.

3.1. STOXX Europe 600

STOXX Europe 600, as a significant European index, represents an important benchmark for portfolios on the European market. It includes a fixed number of 600 components and represents large, mid, and small capitalization companies across the European region.[148] At present, it covers 17 countries.[149] They include Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.[150] The Index is weighted according to free-float market capitalization.[151] The STOXX Europe 600 combines 19 Supersectors, according to the ICB industry classification.[152] They include Oil & Gas, Chemicals, Basic Resources, Construction & Materials, Industrial Goods & Services, Automobiles & Parts, Food & Beverage, Personal & Household Goods, Health Care, Retail, Media, Travel & Leisure, Telecommunications, Utilities, Banks, Insurance, Real Estate, Financial Services, and Technology.[153] In addition, the index is reviewed on quarterly basis.[154] Its present free-float market capitalization equates to EUR 7,176.5bn and is followed by a full index market capitalization of EUR 8,860.4bn.[155] Figure 3.1 shows the STOXX Europe 600 and its performance over the period of interest from 2004 to 2015.

[148] See https://www.stoxx.com/index-details?symbol=SXXP [seen on 10.11.2016]
[149] See https://www.stoxx.com/index-details?symbol=SXXP [seen on 10.11.2016]
[150] See https://www.stoxx.com/index-details?symbol=SXXP [seen on 10.11.2016]
[151] See STOXX INDEX METHODOLOGY GUIDE, p. 40
[152] See STOXX INDEX METHODOLOGY GUIDE, p. 165
[153] See STOXX INDEX METHODOLOGY GUIDE, p. 165
[154] See STOXX INDEX METHODOLOGY GUIDE, p. 40
[155] See STOXX EUROPE 600 INDEX, p. 1

Figure 3.1: STOXX Europe 600 Index's Price in EUR (2004-2015) (Source: Bloomberg)



3.2. Sample Selection and Descriptive Statistics

This research selects financial data for the full set of companies in the STOXX Europe 600 Index each year between 2004 and 2015. We use Bloomberg and Datastream (Thomson Reuters) to attain the necessary data. Each financial parameter is gathered as of end of each fiscal year. In addition, it is obtained or adapted in millions of euro, except for ratios and values per share. Furthermore, the first-time adoption of International Financial Reporting Standards for a period beginning on or after 1 January 2004 contributes to less regulatory issues and differences in the selected database.[156] During this research we use the statistical software STATA, which allows for realizing the consequent practical steps.

The outcome suggests data for 19 industries in the European region, which represent the STOXX Europe 600 Index. Table 3.1 presents the starting number of 7,200 observations prior to the following adjustments in the sample. It shows, that Industrial Goods & Services (1,320) and Banks (576), signify the highest number of observations in our original dataset.

[156] See http://www.iasplus.com/en/standards/effective-dates/effective-ifrs [seen on 10.11.2016]

Table 3.1: Initial Sample without Adjustments per Industry

Industry	Freq.	Percent	Cum.
Automobiles & Parts	192	2.67	2.67
Banks	576	8.00	10.67
Basic Resources	216	3.00	13.67
Chemicals	312	4.33	18.00
Construction & Materials	252	3.50	21.50
Financial Services	360	5.00	26.50
Food & Beverage	264	3.67	30.17
Health Care	480	6.67	36.83
Industrial Goods & Services	1,320	18.33	55.17
Insurance	420	5.83	61.00
Media	336	4.67	65.67
Oil & Gas	240	3.33	69.00
Personal & Household Goods	420	5.83	74.83
Real Estate	336	4.67	79.50
Retail	360	5.00	84.50
Technology	264	3.67	88.17
Telecommunications	264	3.67	91.83
Travel & Leisure	276	3.83	95.67
Utilities	312	4.33	100.00
Total	7,200	100.00	

Subsequently we clear the gross database for problematic factors.

Firstly, we exclude the firms allocated to Financial Services, Banks and Insurance from the sample. This step is performed due to reporting differences between financial intermediaries and industrial companies.

Secondly, all the firms with missing values for Book-to-Market Ratio and their corresponding data, are excluded from the sample. The Book-to-Market Ratios are coded as BM. (See Appendix C) The resulting number of 5,263 observations and their distribution by industries, after controlling for financial intermediaries and missing Book-to-Market values, is shown in Table 3.2.

Table 3.2: Sample without Financial Intermediaries per Industry

Industry	Freq.	Percent	Cum.
Automobiles & Parts	168	3.19	3.19
Basic Resources	193	3.67	6.86
Chemicals	268	5.09	11.95
Construction & Materials	252	4.79	16.74
Food & Beverage	248	4.71	21.45
Health Care	419	7.96	29.41
Industrial Goods & Services	1,190	22.61	52.02
Media	292	5.55	57.57
Oil & Gas	235	4.47	62.04
Personal & Household Goods	391	7.43	69.47
Real Estate	298	5.66	75.13
Retail	293	5.57	80.70
Technology	262	4.98	85.67
Telecommunications	214	4.07	89.74
Travel & Leisure	235	4.47	94.20
Utilities	305	5.80	100.00
Total	5,263	100.00	

Thirdly, the 20 % companies with highest Book-to-Market Ratios for each year in the defined period, are selected as our final sample after sorting the Book-to-Market Ratios into quintiles. This approach is based on Piotroski's (2000) classification strategy.[157] Table 3.3 shows the Book-to-Market data structured into quintiles.

Table 3.3: Descriptive Statistics for Book-to-Market Ratios according to Quintile

	Book-to-Market Ratio		
Quintiles	Mean	Median	Std. Dev.
1 (1-20 %)	.1295239	.1457832	.1197212
2 (21 - 40 %)	.2924118	.2864878	.060154
3 (41 - 60 %)	.4278707	.4076724	.0925203
4 (61 - 80 %)	.622052	.5903885	.1546522
5 (81 - 100 %)	1.151692	.9720536	.8249499
Total	.5238214	.4087639	.5193489

As expected the highest quintile demonstrates a considerably higher mean for Book-to-Market Ratios compared to the other quintiles. Our final selected sample an unbalanced panel data of 1,048 observations. Table 3.4 presents the resulting sample of 1,048 observations per

[157] See Piotroski (2000), p. 11

industry. The highest number of observations stems from Real Estate (234), Industrial Goods & Services (156), Automobiles & Parts (76), and Utilities Companies (71).

Table 3.4: Final Sample with Top 20 % Book-to-Market Companies without Financial Intermediaries per Industry

Industry	Freq.	Percent	Cum.
Automobiles & Parts	76	7.25	7.25
Basic Resources	69	6.58	13.84
Chemicals	31	2.96	16.79
Construction & Materials	58	5.53	22.33
Food & Beverage	19	1.81	24.14
Health Care	8	0.76	24.90
Industrial Goods & Services	156	14.89	39.79
Media	25	2.39	42.18
Oil & Gas	55	5.25	47.42
Personal & Household Goods	67	6.39	53.82
Real Estate	234	22.33	76.15
Retail	49	4.68	80.82
Technology	35	3.34	84.16
Telecommunications	43	4.10	88.26
Travel & Leisure	52	4.96	93.23
Utilities	71	6.77	100.00
Total	1,048	100.00	

The resulting sample of 1,048 observations and their distribution according to industry and year can be found in Table 1 in the Appendix D.

3.3. Calculation of Variables and Adjustments

The selection and calculation of necessary financial data is a central step in this research. As such, the obtained financial data is adapted with respect to the formation of F-Score Portfolios and A-Score Portfolios. If the data required for our calculations is not pre-calculated by the relevant data sources, we compute this data, based on the input variables we attain. In addition, if the variables are not in anticipated form after our calculation, we adapt these variables by applying ratios, scaling to total assets or calculating their logarithmic values. In the process of adjusting for historical differences, we omit year 2014 from the sample data.

Initially, we compute the F-Score financial variables. The list of F-Score variables is based on fundamentals, which correspond to net income before extraordinary items, cash flow from

operations, historical change in net income before extraordinary items, accrual, historical change in long-term debt, historical change in current ratio, historical change in shares outstanding, historical change in gross margin ratio, and historical change in asset turnover ratio. Respectively, it consists of ROAm, CFOm, CH_ROAm, ACCRUALm, CH_LEVERm, CH_LIQUIDm, CH_SH_OUTm, CH_MARGINm, and CH_TURNm. (See Appendix C) We extract the 9 F-Score signals, considering these variables. The list of F-Score performance measures includes F_ROA, F_CFO, F_CH_ROA, F_ACCRUAL, F_CH_LEVER, F_CH_LIQUID, F_EQ_OFFER, F_CH_MARGIN, and F_CH_TURN. (See Appendix C) They participate in calculating the aggregate F_SCORE performance measure. (See Appendix C)

In addition, we enrich our list of variables by adding further important financial data based on the literature in our research. This step allows for a larger range of variables, which we test for significance in our initial regression model. These additional variables include market-adjusted return, earnings yield, the difference between net working capital and long-term debt, return on equity, standard deviation for return on equity, return on invested capital, Sloan's accruals, gross profit, market capitalization, current ratio, book value, costs of goods sold, gross margin ratio, asset turnover ratio, historical change in short-term debt, historical change in cash and cash equivalents, depreciation and amortization, EBITDA, CAPEX, net assets from acquisitions and, research and development. We define them as m_adj_return, EY, NWC_LTD_TA, ROE, stdROE, ROIC, Sloan_Accruals, GROSS_PROFIT_ASSETS, LHMCAP, CUR_RATIO, BV_TA, LCGS, GMR, TURN, CH_DEBT_CL_TA, CH_CASH_TA, DA_TA, EBITDA_HEV, CAPEX_TA, NAFAM_TA, and RDM_TA, respectively. (See Appendix C)

Furthermore, we form dummy variables for each industry after controlling for financial intermediaries. This step is follows on our consideration that our sample data reflects different types of industries. The list of dummy variables includes di1, di2, di3, di4, di5, di6, di7, di8, di9, di10, di11, di12, di13, di14, di15, di16. (See Appendix C)

3.4. F-Score Portfolio

The F-Score Portfolio represent the first possibility in the pursued comparison process. It is based on Piotroski's (2000) F-Score measure for portfolio formation, which is derived from the sum of nine binary F-Score signals.[158] Each individual signal is measured as one, if it

[158] See Piotroski (2000), p. 7-10

denotes a positive movement, and as zero, otherwise. Supporting Piotroski's approach, we form our F-Score Portfolios based on profitability, financial leverage, liquidity, source of funds and operating efficiency measures.

The indicator of a company's *profitability* is captured by four different signals. F_ROA is measured at one (zero), if firm's net income before extraordinary items scaled by total assets is positive (otherwise). F_CFO is measured at one (zero), if firm's cash flow from operations scaled by total assets are positive (otherwise). F_CH_ROA is equal to one (zero), if the historical change in firm's net income before extraordinary items scaled by total assets between current and prior year is positive (otherwise). F_ACCRUAL equates to one (zero), if firm's cash flow from operations scaled by total assets are larger than firm's net income before extraordinary items (otherwise).

The *financial leverage* signal for each company corresponds to the variable F_CH_LEVER. It equates to one (zero), if the historical change in firm's long-term debt, scaled by total assets between current and prior year, is negative (otherwise).

As a further important measure, the *liquidity* signal, is captured in the variable F_CH_LIQUID. It is set at one (zero), if the historical change in the firm's current ratio between current and prior year is positive (otherwise).

The *source of funds* signal is attributed to the variable F_EQ_OFFER. It adopts the value one (zero), if the historical change in the firm's shares outstanding between current and prior year is negative (otherwise).

The remaining two signals are categorized as *operating efficiency* measures. F_CH_MARGIN adopts the value of one (zero), if the historical change in firm's gross margin ratio between current and prior year is positive (otherwise). Furthermore, F_CH_TURN is set at one (zero), if the historical change in firm's asset turnover ratio between current and prior year is positive (otherwise).

Once the nine binary signals are calculated, their sum per company and year is captured in the variable F_SCORE. (See Appendix C) The range of its values is expected to be between 1 and 9. Table 3.5 presents the resulting number of 739 F-Score observations and their distribution in the sampled data. The resulting F-Score values vary from 2 to 9 and are classified accordingly. A F-Score value of 2 (9) corresponds to a firm, which exhibits the lowest (highest) aggregate performance for a specific year between 2005 and 2015.

Table 3.5: F-Score Classification and Distribution

based on sample data

F_SCORE	Freq.	Percent	Cum.
2	11	1.49	1.49
3	45	6.09	7.58
4	140	18.94	26.52
5	203	27.47	53.99
6	172	23.27	77.27
7	116	15.70	92.96
8	43	5.82	98.78
9	9	1.22	100.00
Total	739	100.00	

In order to form F-Score Portfolios based on best performing companies, this research focuses on the highest F-Score firms. We generate 22 F-Score Portfolios, which comprise of 11 equally weighted and 11 capitalization-weighted F-Score Portfolios. For each F-Score Portfolio we select the 15 highest F-Score companies per year. The embraced number of companies per portfolio is based on the selection of companies with high F-Score results, while allowing for a sufficient quantity of entities per portfolio simultaneously. Once we select the companies for each F-Score Portfolio, we calculate its portfolio mean return and portfolio weighted return with respect to equal weight and capitalization weight. The performance metrics are corresponding to f_score_portf_mean and cap_weighted_f_score_porf_ret. (See Appendix C) We calculate similarly the portfolio standard deviation and portfolio weighted standard deviation. They are coded as f_score_portf_std and cap_weighted_f_score_portf_std, respectively. (See Appendix C) Each portfolio follows a buy and hold strategy and a holding period of one year. Ultimately, we end up with an equally weighted and capitalization-weighted F-Score Portfolio with performance metrics for each year between 2005 and 2015. An equally weighted and capitalization-weighted F-Score Portfolio with a holding period within the same years, contains an equivalent list of companies, but deviates on the grounds of weight's percentage per company in a portfolio.

3.5. Regression Modeling

In order to construct the A-Score Portfolios, we complete a complex regression modelling process. Initially, we select the potential fundamental variables in explaining stocks' returns based on our literature review. We include them in a multiple linear regression model. Subsequently, we perform multicollinearity tests, forward selection and backward elimination

methods. Those steps allow avoiding multicollinearity issues and screening the fundamentals with significant power in explaining stocks' return. As a final step in our regression modeling process, we control for fixed company, industry and year effects and choose the optimal regression model.

3.5.1. Multiple Linear Regression

Initially, we select fundamental variables based on our literature, which we include in a preliminary multiple linear regression model. A *Multiple Linear Regression* is a statistical method which uses several explanatory (independent) variables to predict the outcome of one response (dependent) variable.[159] It illustrates the relationship between each independent variable and the dependent variable.[160] In the general model the variables are related through a linear equation.[161] Equation 3.1 demonstrates the concept of multiple linear regression model for a panel data.

$$y_{it} = \beta_0 + \beta_{1it} x_{1it} + \cdots + \beta_{kit} x_{kit} + e_{it} \tag{3.1}$$

where y_{it} dependent (response) variable for company i at time t (i = 1, …, N; t = 1, …, T)

$x_{1it \ldots kit}$ independent (explanatory) variable k for company i at time t (i = 1, …, N; t = 1, …, T)

$\beta_{1it \ldots kit}$ regression coefficient k for explanatory variables $x_{1it \ldots kit}$ (i = 1, …, N; t = 1, …, T)

β_o intercept parameter

e_{it} random error term for company i at time t (i = 1, …, N; t = 1, …, T)

Each regression coefficient measures the effect of a change in the corresponding independent variable upon the expected value of the dependent variable in the case when all other variables are held constant.[162] The intercept equates the value of the dependent variable when each of the independent variables is equal to zero.[163] It should be usually included in the regression equation.[164] Otherwise its absence can lead to a model that fits the data poorly and has less predictive power.[165] In some special cases the intercept may be omitted.[166] Our initially selected fundamental variables include LCGS, LHMCAP, GMR, ROAm, BV_TA, TURN,

[159] See Investopedia: Multiple Linear Regression – MLR
[160] See Investopedia: Multiple Linear Regression – MLR
[161] See Hill/Griffiths/Lim (2011), p. 172-173
[162] See Hill/Griffiths/Lim (2011), p. 172
[163] See Hill/Griffiths/Lim (2011), p. 169
[164] See Hill/Griffiths/Lim (2011), p. 169
[165] See Hill/Griffiths/Lim (2011), p. 169
[166] See Hill/Griffiths/Lim (2011), p. 169

GROSS_PROFIT_ASSETS, BM, NWC_LTD_TA, CUR_RATIO, ACCRUALm, CH_LIQUIDm, CH_MARGINm, Sloan_Accruals, RDM_TA, CH_DEBT_CL_TA, DA_TA, ROE, EY, CH_ROAm, CH_LEVERm, CH_CASH_TA, EBITDA_HEV, stdROE, CAPEX_TA, CH_TURNm, NAFAM_TA, CH_SH_OUTm, and ROIC. (See Appendix C) We implement them in the preliminary regression model as independent variables.

3.5.2. Correlation Matrix and Multicollinearity Test

In the next step, we test the selected variables for multicollinearity issues. *Multicollinearity* is a statistical problem that results in a regression model having difficulties telling which independent variable is influencing the dependent variable.[167] That effect appears due to a high correlation of some of the independent variables with each other.[168] Usually low t-statistics and therefore high P-Values signal a multicollinearity problem.[169] As a result, those coefficients are considered as insignificant and should be omitted from the regression equation together with the corresponding independent variables.[170] According to the statistical literature, multicollinearity can be often quantified by examining a Correlation Coefficient Matrix and by performing a Variance Inflation Factor Test.[171]

A *Correlation Coefficient Matrix* determines the correlation between two independent variables in a regression.[172] It combines all the Pearson Correlation Coefficients or the bivariate statistic that measures how strongly two variables are related to one another.[173] Equation 3.2 presents the basic form of a Correlation Coefficient Matrix.

$$R = \begin{bmatrix} h_1^2 & r_{12} & r_{13} & \cdots & r_{1n} \\ r_{21} & h_2^2 & r_{23} & \cdots & r_{2n} \\ r_{31} & r_{32} & h_3^2 & \cdots & r_{3n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_n 2 & r_{n3} & \cdots & h_n^2 \end{bmatrix} \tag{3.2}$$

where R Correlation Matrix

h_j^2 Pearson Correlation Coefficient between independent variables j and j

r_{ij} Pearson Correlation Coefficient between independent variables i and j

[167] See Koop (2005), p.100
[168] See Koop (2005), p.100
[169] See Koop (2005), p.100
[170] See Koop (2005), p.100
[171] See Dormann et al. (2013), p. 30
[172] See Katz (2006), p. 69
[173] See Harman (1976), p. 71

The Pearson Correlation Coefficients exhibit the correlation between two independent variables in the regression.[174] Equation 3.3 presents the formula for the Pearson Correlation Coefficients.

$$r_{ij} = \frac{\sum x_i x_j}{\sqrt{\left(\sum x_i^2\right)\left(\sum x_j^2\right)}} \tag{3.3}$$

where r_{ij} Pearson Correlation Coefficient between independent variable i and j

x_i *or* x_j independent variables i and j

A Correlation Coefficient lies generally between -1 and 1.[175] The rule states that variables with a correlation larger than 0.8 may cause multicollinearity problems in the regression model.[176] Table 4, Appendix D, provides a correlation matrix of all potential independent variables before our selection process. The correlation matrix does not encounter potential multicollinearity problems between the selected variables, since it presents correlation coefficients not higher than 0.7. Nevertheless, the problematic of a correlation matrix consists in assessing only the relationship between two variables, without adjustment for the other variables.[177] This issue imposes on searching for other approaches with respect to multicollinearity complications.

The next step in our regression modeling process is the *Variance Inflation Factor Test* or the *VIF-Test*. It represents an important option in quantifying the multicollinearity problem among our independent variables. The Variance Inflation Factors are calculated from the correlation matrix of the independent variables.[178] They represent the diagonal elements of the inverse of that matrix.[179] Moreover, the variance inflation factors are denoted in Equation 3.4.[180]

$$VIF_j = \frac{1}{1 - R_j^2} \tag{3.4}$$

[174] See Hill/Griffiths/Lim (2011), p. 242
[175] See Brooks (2008), p. 107
[176] See Katz (2006), p. 69
[177] See Katz (2006), p. 69
[178] See Rawlings/Pantula/Dickey (1998), p. 372
[179] See Berk (1997), p. 864
[180] See Rawlings/Pantula/Dickey (1998), p. 372

where VIF_j variance inflation factor for regression coefficient j

R_j^2 coefficient of determination from the regression of independent variable j on other independent variables

$1 - R_j^2$ tolerance

The coefficient of determination measures the proportion of variance in a concrete independent variable that is explained by the other independent variables.[181] The tolerance signifies the proportion of the variance in a concrete independent variable that is not related to the other independent variables in the model.[182] The variance inflation factor is measured in terms of coefficient of determination, since it represents a precise measure of the collinearity of a concrete independent variable and the other independent variables.[183] A VIF value greater than 10 is considered a strict sign of multicollinearity.[184] If certain variables from the regression model reach the specified threshold level, some of the variables should be omitted until the VIF Test shows no values above 10.[185] Table 5, Appendix D, shows the VIF values once we perform the VIF Test.) 3 from 29 overall included variables exhibit VIF values higher than 10. The problematic variables comprise of LCGS, LHMCAP, and GMR and display VIF values of 61.35, 60.22, and 12.81, respectively. We omit them from the list of potential independent variables in the regression model. Table 6, Appendix D, presents the VIF values of the remaining components after we exclude those three variables and shows the reduced fixed set of variables. The repetition of the VIF Test presents VIF values for the selected variables, that do not exceed 10.

3.5.3. Forward Selection and Backward Elimination

Once the multicollinearity problem is resolved, we perform stepwise variable selection procedures. Those approaches start with an initial set of variables, which should be confined to a reasonably small number based on an initial screen.[186] Table 6, Appendix D, shows our downsized list of variables based on the VIF Test. The resulting fixed set of independent variables is subsequently incorporated in a regression model, whereas we test each selected variable for inclusion. The pursued objective is to develop a model that predicts the stocks'

[181] See O'Brien (2007), p. 673
[182] See O'Brien (2007), p. 674
[183] See O'Brien (2007), p. 674
[184] See Marquardt (1970), p. 610
[185] See O'Brien (2007), p. 674
[186] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node40.html [seen on 10.12.2016]

returns in our sample. From a range of different stepwise techniques, we focus on the Forward Selection and Backward Elimination methods.

In the first stage we apply the *Forward Selection* algorithm on our downsized list of variables. This approach starts with an empty regression equation.[187] At each step it tests for inclusion and adds one variable at a time.[188] It starts with the most significant variable from the specified list.[189] Subsequently it continues adding variables until none of the remaining variables exhibit significance when added to the regression model.[190] In statistical terms it incorporates variables until their P-Values are below the chosen significance level.[191] We specify a high significance level of 0.10 in order to avoid missing variables whose relevance might be revealed in a multiple linear regression.[192] Figure 1, Appendix E, shows the results of the Forward Selection algorithm, which we perform. The results imply that BM, CH_ROAm, CH_TURNm, CAPEX_TA, CH_LEVERm, CH_DEBT_CL_TA, ACCRUALm, ROAm, BV_TA, and ROIC exhibit significance at a significance level of 0.10. The Forward Selection method suggests that they should be included as independent variables in our official regression model. The submitted result might be biased, because in the Forward Selection approach each incorporation of a new variable may render one or more of the already included variables non-significant.[193]

In the next stage we implement the *Backward Elimination* algorithm, which avoids the specified problem.[194] The Backward Elimination method starts with a full regression equation.[195] Initially it removes the least significant variable.[196] Successively it continues eliminating one variable at a time.[197] A variable stays excluded from the regression equation as long as it shows non-significance at the specified significance level.[198] Sequentially the algorithm continues re-fitting the reduced models and applying the same rule until all the remaining variables exhibit statistical significance.[199] We stipulate a significance level of 0.10

[187] See Gefeller/Muche (2011), p. 803
[188] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node41.html [seen on 10.12.2016]
[189] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node41.html [seen on 10.12.2016]
[190] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node41.html [seen on 10.12.2016]
[191] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node41.html [seen on 10.12.2016]
[192] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node40.html [seen on 10.12.2016]
[193] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node42.html [seen on 11.12.2016]
[194] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node42.html [seen on 11.12.2016]
[195] See Gefeller/Muche (2011), p. 803
[196] See Gefeller/Muche (2011), p. 803
[197] See Gefeller/Muche (2011), p. 803
[198] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node42.html [seen on 11.12.2016]
[199] See https://www.stat.ubc.ca/~rollin/teach/643w04/lec/node42.html [seen on 11.12.2016]

and apply the method on the same downsized list of variables. The aim is to review if the previous result will be confirmed. Figure 2, Appendix E, presents the results of the Backward Elimination algorithm. The second approach indicates that the variables BM, CH_TURNm, CAPEX_TA, CH_LEVERm, CH_DEBT_CL_TA, ACCRUALm, ROAm, BV_TA, and ROIC perform significant results at significance level of 0.10. The Backward Elimination approach suggests that they should be included in the official regression model.

The illustrated models can imply different official regression equations even when applied on the same dataset.[200] In our research both algorithms suggest analogous results. In order to achieve more accurate results, we consider only the variables that are proposed simultaneously by both models. Correspondingly, we select BM, CH_TURNm, CAPEX_TA, CH_LEVERm, CH_DEBT_CL_TA, ACCRUALm, ROAm, BV_TA, and ROIC to be included as independent variables in our official regression equation.

3.5.4. Fixed Effects and potential Econometric Models

After we select the final set of independent variables, the next logical step in this research is to choose the best fitting multiple linear regression model. We begin with a basic multiple linear regression model. Due to the panel structure of our final sample, we also consider different fixed effect control opportunities.[201] The panel data allows for other separate regression equations, which control for industry, company and year fixed effects, respectively. We create the fixed effects by allowing the intercept of the regression equations to vary across companies or time.[202] In order to generate the fixed effects regression models we build upon our initial basic model.

The initial econometric model represents a *basic multiple linear regression equation*. Equation 3.5 shows its structure.

$$m\_adj\_return = \beta_0 + \beta_1 BM + \beta_2 ROAm + \beta_3 ACCRUALm + \beta_4 ROIC + \beta_5 CH\_LEVERm + \beta_6 BV\_TA + \beta_7 CAPEX\_TA + \beta_8 CH\_DEBT\_CL\_TA + \beta_9 CH\_TURNm + \varepsilon_t \quad (3.5)$$

Our independent variable is characterized by m_adj_return. Table 2 and 3 summarize the descriptive statistics for one year buy and hold return and market adjusted return with respect

[200] See Gefeller/Muche (2011), p. 803-804
[201] See Brooks (2008), p. 490
[202] See Gujarati (2004), p. 642

to F-Score measure, respectively. (See Appendix D) The included independent variables consist of BM, CH_TURNm, CAPEX_TA, CH_LEVERm, CH_DEBT_CL_TA, ACCRUALm, ROAm, BV_TA, and ROIC. (See Appendix C) Figure 3 shows the regression algorithm in Stata. (See Appendix E)

The second econometric model, which we generate, controls for *industry fixed effects*. An industry fixed effects model controls the effects of omitted variables that differ between industries, but persist constant over company and time.[203] Therefore, an important assumption states that the intercept should vary from industry to industry, but should be constant over company and time.[204] We perform an industry fixed effect simulation by adding industry dummy variables into our basic multiple linear regression equation. The list of industry dummies includes di1, di2, di3, di4, di5, di6, di7, di8, di9, di10, di11, di12, di13, di14, di15, and di16. (See Appendix C) As additional independent variables they control for different industry characteristics. Figure 4, Appendix E, presents the regression algorithm in Stata, which performs a dummy simulation of a regression model with industry fixed effects.

The third multivariate regression model, which we develop, controls for *company fixed effects*. Similarly, a company fixed effects model controls the effects of omitted variables that differ between company, but remain constant over time.[205] It assumes that the intercept varies in cross-sectional dimensions, but stays constant over time.[206] We execute the new regression model based on our basic multiple linear regression equation after adapting the structure of the panel data in STATA for company fixed effects. Figure 5, Appendix E, shows the regression algorithm in Stata, which generates a company fixed effects regression model.

The fourth multivariate regression model, which we generate, controls for *time fixed effects*. A time fixed effects model controls the effects of omitted variables that differ between time, but not cross-sectionally.[207] Therefore, the intercept is allowed to vary over time, but is assumed to be the same across companies at each given point of time.[208] We perform the time fixed effects model based on our basic multiple linear regression equation after adapting the structure of the panel data for time fixed effects. Figure 6, Appendix E, presents the regression algorithm in Stata, which generates a time fixed effects model.

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[203] See Tadeu/Silva (2014), p. 121
[204] See Tadeu/Silva (2014), p. 121
[205] See Tadeu/Silva (2014), p. 121
[206] See Tadeu/Silva (2014), p. 121
[207] See Brooks (2008), p. 493
[208] See Brooks (2008), p. 493

The outcome of the regression modeling process proposes four multiple linear regression equations. The pursued aim is to select the model with the best fit to our data. The common measure in that direction is maximizing the goodness of fit or R^2.[209] It quantifies the proportion of outcome variation that a model's predictors explain.[210] A common strategy is to compare the R^2 among candidate models and select the model, which exhibits the highest R^2.[211] An undesirable aspect of the R^2 is that it does not decrease if we add further independent variables in the regression equation.[212] Adjusted R^2 deals with that situation, since it takes into account the loss of degrees of freedom associated with incorporating additional variables.[213] Hence, we focus on adjusted R^2 measures of the four regression models in order to choose the best fitting model in our research. Table 3.6 presents the outcomes of the four regression models. The first column demonstrates the results of our basic multiple linear regression. The second column shows the results of the regression model, which controls for industry fixed effects. The third column displays the outcome of the regression model, which controls for company fixed effects. The regression model with time fixed effects embraces the fourth column. The third model signifies an adjusted R^2 value of 0.234 and embodies therefore the model with the highest measure. The other regression models exhibit lower values, which account for 0.189, 0.169 and 0.159, respectively. Based on those measures the multivariate regression equation, which controls for company fixed effects, outperforms the other model. It represents the model, which offers the best fit to our data. We choose it as our official regression model. Table 7, Appendix D, presents descriptive statistics for the final set of variables in our official regression model.

[209] See Abu-Mostafa/LeBaron/Lo/Weigend (1999), p. 173
[210] See Singer/Willett (2003): Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence, Doing Data Analysis with the Multilevel Model for Change, p. 35
[211] See Abu-Mostafa/LeBaron/Lo/Weigend (1999), p. 173
[212] See Brooks (2008), p. 110
[213] See Brooks (2008), p. 110

Table 3.6: Multiple Linear Regression Models – Basic, Industry, Company and Time Fixed Effects

	(1) m_adj_return	(2) m_adj_return	(3) m_adj_return	(4) m_adj_return
BM	-0.0746***	-0.0836***	-0.125***	-0.0671**
	(-3.73)	(-4.30)	(-3.48)	(-2.76)
ROAm	0.891**	1.263***	1.516***	1.028**
	(2.11)	(2.85)	(2.64)	(2.68)
ACCRUALm	0.0516	-0.339	-0.695	0.172
	(0.17)	(-0.99)	(-1.23)	(0.57)
ROIC	-0.0219	-0.0170	-0.0235**	-0.0224*
	(-1.60)	(-1.21)	(-2.05)	(-2.18)
CH_LEVERm	-0.0145***	-0.0138***	-0.0155***	-0.0129**
	(-4.35)	(-4.07)	(-4.18)	(-3.09)
BV_TA	0.0314	-0.0799	-0.518	0.0402
	(0.44)	(-0.87)	(-1.54)	(0.42)
CAPEX_TA	0.961**	0.919**	1.878**	0.777
	(2.56)	(2.43)	(2.08)	(1.61)
CH_DEBT_CL_TA	-1.263***	-1.259***	-1.511***	-1.185**
	(-3.13)	(-3.14)	(-4.05)	(-2.54)
CH_TURNm	-0.293***	-0.290***	-0.350**	-0.223
	(-3.46)	(-3.46)	(-2.53)	(-1.57)
_cons	-0.0106	0.0609	0.276*	-0.0284
	(-0.22)	(0.48)	(1.79)	(-0.50)
N	851	851	851	851
R^2	0.177	0.212	0.242	0.165
adj. R^2	0.169	0.189	0.234	0.156

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.6. A-Score Portfolio

The second option in our portfolio comparison process is the A-Score Portfolio. We use the multiple linear regression model to compose it. This model also controls for company fixed effects. The procedure includes predicting the returns of the companies in our selected high Book-to-Market companies sample. We focus on the firms with the highest predicted returns, in order to compose portfolios, which are based on best performing companies.

We form 22 A-Score Portfolios overall, which include 11 equally weighted and 11 capitalization-weighted A-Score Portfolios. For each portfolio we select the 15 companies with the highest predicted returns. Once we select the companies for each A-Score Portfolio, we compute the portfolio mean return or portfolio weighted return with respect to an equally weighted and capitalization-weighted version. Those performance metrics are represented by a_score_portf_mean and cap_weighted_a_score_portf_ret, respectively. (See Appendix C) In addition, we also include portfolio standard deviation or portfolio weighted standard deviation. They are coded as a_score_portf_std and cap_weighted_a_score_portf_std. (See Appendix C) Each portfolio follows a buy and hold investment strategy and exhibits a one year holding period. This fact delivers an equally weighted and capitalization-weighted A-Score Portfolio with performance metrics for each year between 2005 and 2015. Equally weighted and capitalization-weighted A-Score Portfolios, which are held in the same period of years, consist of an equivalent list of companies. The only deviating point is their weight's percentage allocation. We choose the number of companies and the buy and hold year accordingly, so that they allow for comparison between a F-Score Portfolio and a corresponding A-Score Portfolio. The four metrics of the A-Score Portfolios are compared with the corresponding metrics of the F-Score Portfolios.

4. Empirical Results

Chapter four presents the empirical results of our research. Based on the methodology steps that we perform, our empirical results consist in comparing the F-Score and the A-Score Portfolios. In addition, we split the F-Score Portfolios into equally weighted and capitalization-weighted portfolios. The A-Score Portfolios are divided on the ground of the same strategy. We compare the equally weighted F-Score and A-Score Portfolios on year basis and on overall aggregated performance. The capitalization-weighted F-Score and A-Score Portfolios are compared in reference to the same technique. We perform the following comparison processes conditional on central portfolio performance measures.

4.1. Equally Weighted F-Score versus A-Score Portfolio

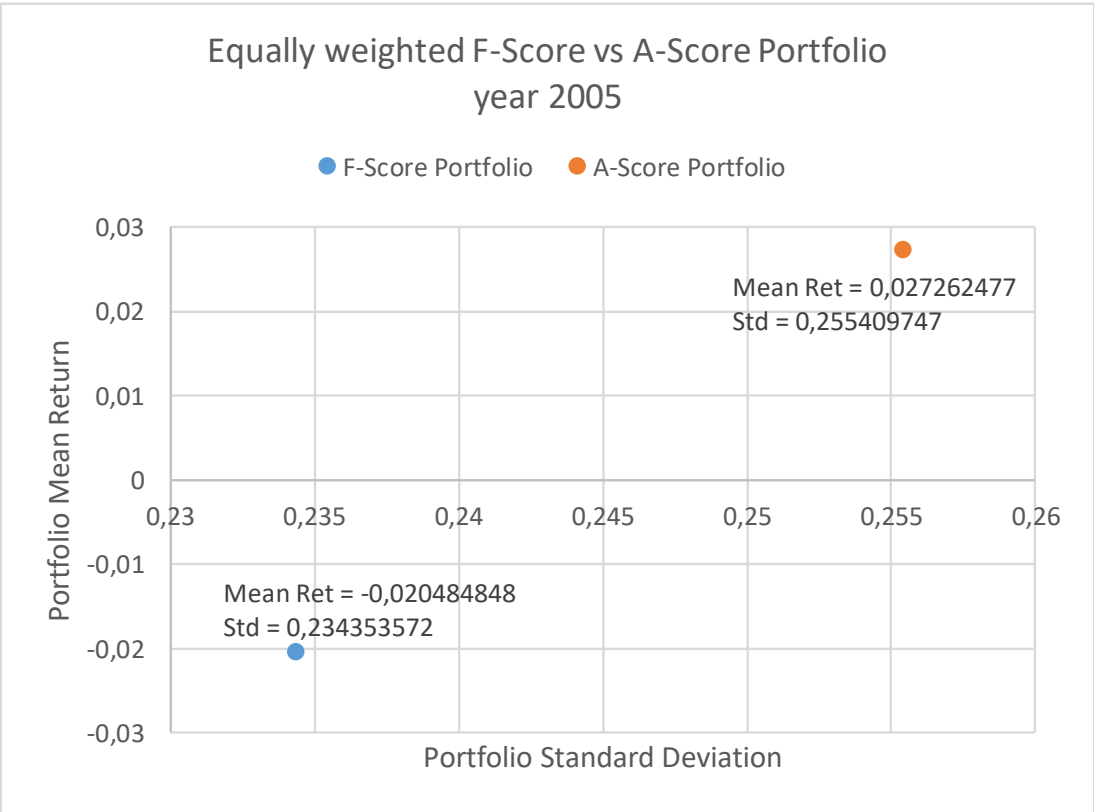
Once we form the equally weighted F-Score and A-Score Portfolios, we perform a comparison based on year and on overall performance, respectively.

4.1.1. Comparison based on year performance

The comparison process between equally weighted F-Score and A-Score Portfolios based on year performance provides interesting empirical results. We compare corresponding pairs of equally weighted portfolios with performance metrics for each year between 2005 and 2015. Important measures in that scenario represent the portfolio mean return and the portfolio standard deviation.

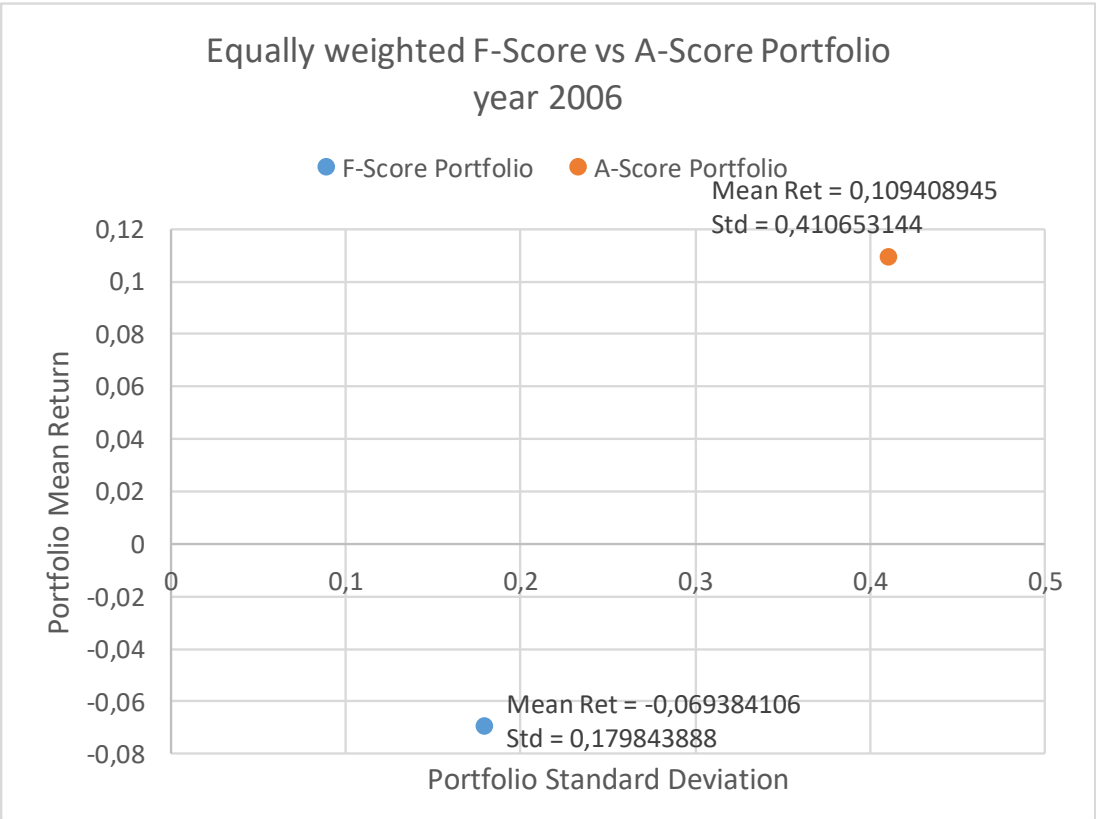
Initially, we compare an equally weighted F-Score Portfolio for year 2005 with an equally weighted A-Score Portfolio for year 2005. The performance results are revealed in Figure 4.1. The F-Score Portfolio exhibits a negative mean return of -0.02 and a standard deviation of 0.23. The corresponding A-Score Portfolio displays a positive mean return of 0.03 and a standard deviation of 0.26. The A-Score Portfolio for 2005 offers substantially higher mean return than the F-Score Portfolio and a slightly higher standard deviation. The resulting outperformance of the positive mean return compared to the negative mean return compensates for the higher realized risk of the A-Score Portfolio.

Figure 4.1: Equally weighted F-Score versus A-Score Portfolio in year 2005



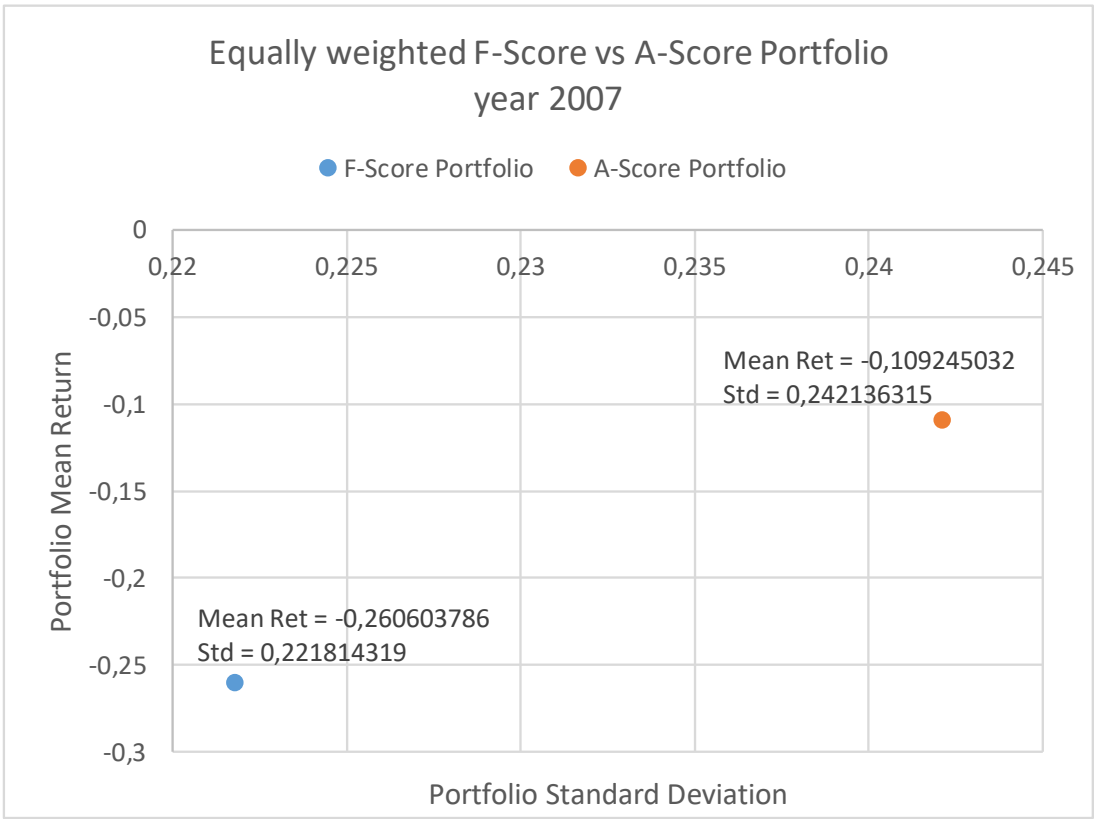
An equally weighted F-Score Portfolio for 2006 is compared to a corresponding equally weighted A-Score Portfolio in Figure 4.2. The F-Score Portfolio exhibits a negative mean return of -0.07 in comparison to a positive mean return of 0.11 for the A-Score Portfolio. In addition, the F-Score Portfolio shows considerably lower standard deviation versus the standard deviation of the A-Score Portfolio. The values are marked by 0.18 and 0.41, respectively. The A-Score Portfolio outperforms the F-Score Portfolio in terms of return, but is related to a higher standard deviation.

Figure 4.2: Equally weighted F-Score versus A-Score Portfolio in year 2006



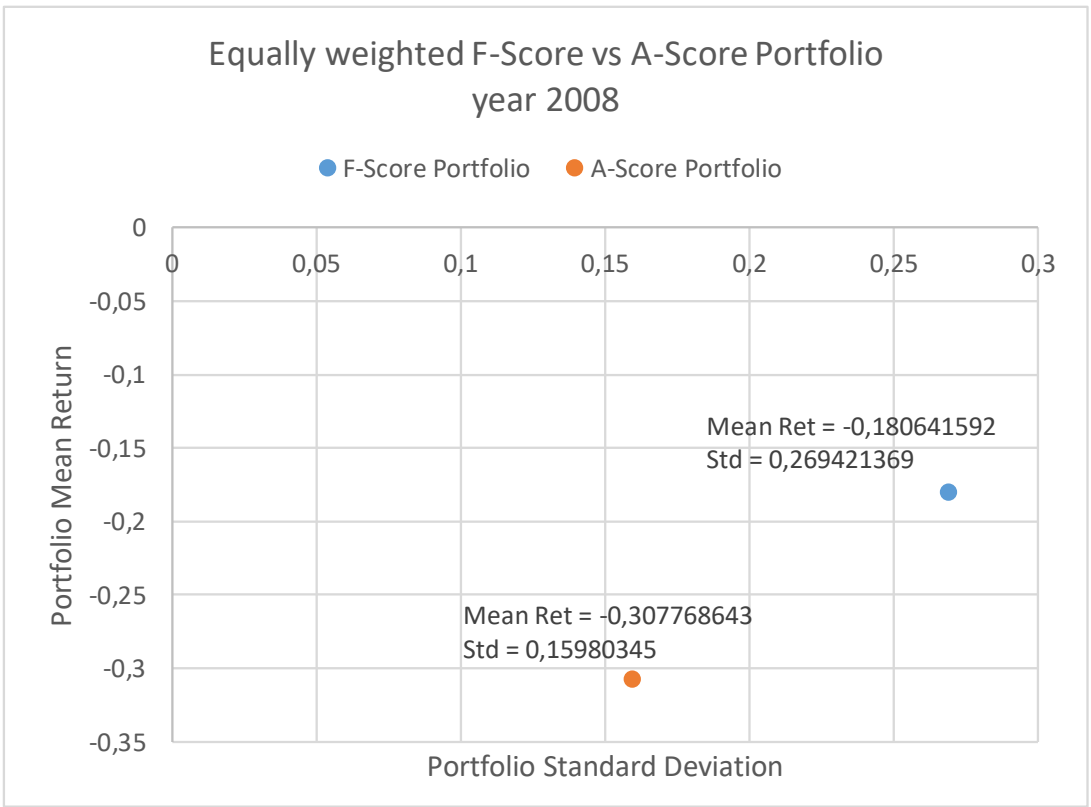
The comparison results between an equally weighted F-Score and an equally weighted A-Score Portfolio in year 2007 present a similar outcome. Their mean returns and standard deviations are revealed in Figure 4.3. The A-Score Portfolio offers a mean return of – 0.11 and a standard deviation of 0.24. The F-Score Portfolio exhibits on the other hand lower mean return at -0.26 and slightly lower standard deviation at 0.22. The A-Score Portfolio outperforms the F-Score Portfolio considerably in terms of return, while presenting a similar risk value.

Figure 4.3: Equally weighted F-Score versus A-Score Portfolio in year 2007



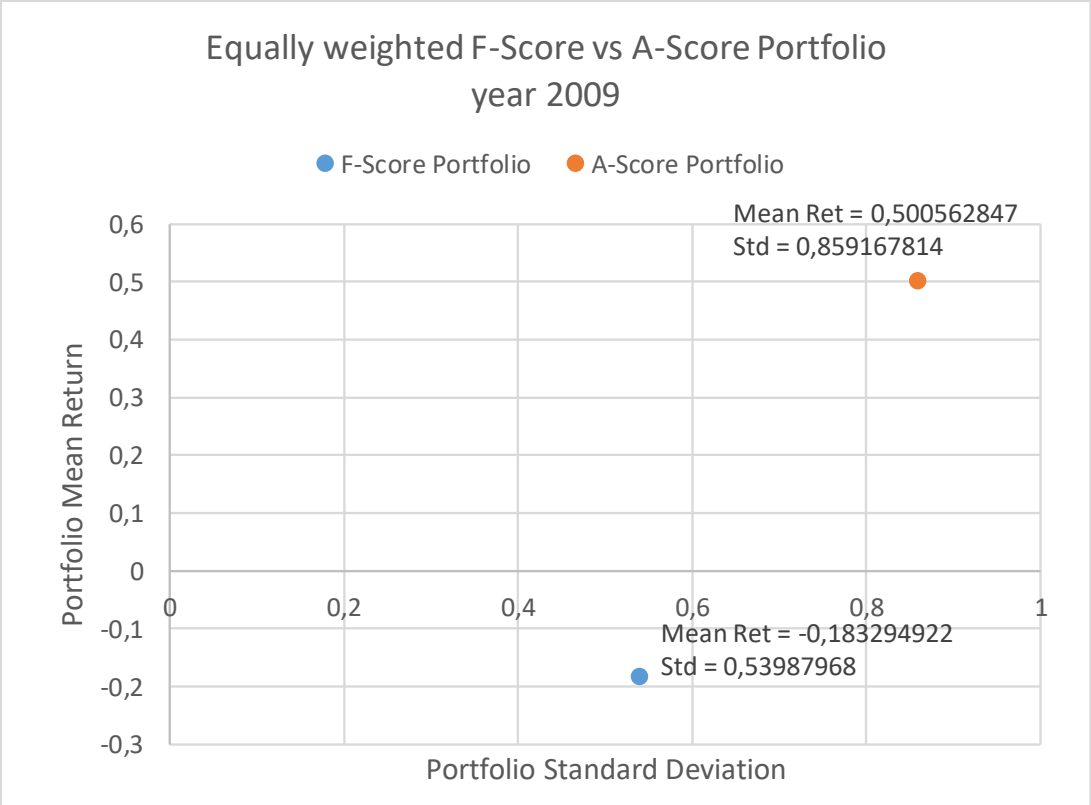
The empirical results between an equally weighted F-Score and an equally weighted A-Score Portfolio for 2008 show a reverse performance outcome. Their performance metrics are shown in Figure 4.4. The A-Score Portfolio signifies a negative mean return of -0.31 and a standard deviation of 0.16. The F-Score Portfolio exhibits a negative mean return of -0.18 and a standard deviation of 0.27. In conclusion, the F-Score Portfolio, in the outburst of the financial crisis, dominates the A-Score Portfolio in terms of mean return, but offers a considerably higher risk for the acquired return.

Figure 4.4: Equally weighted F-Score versus A-Score Portfolio in year 2008



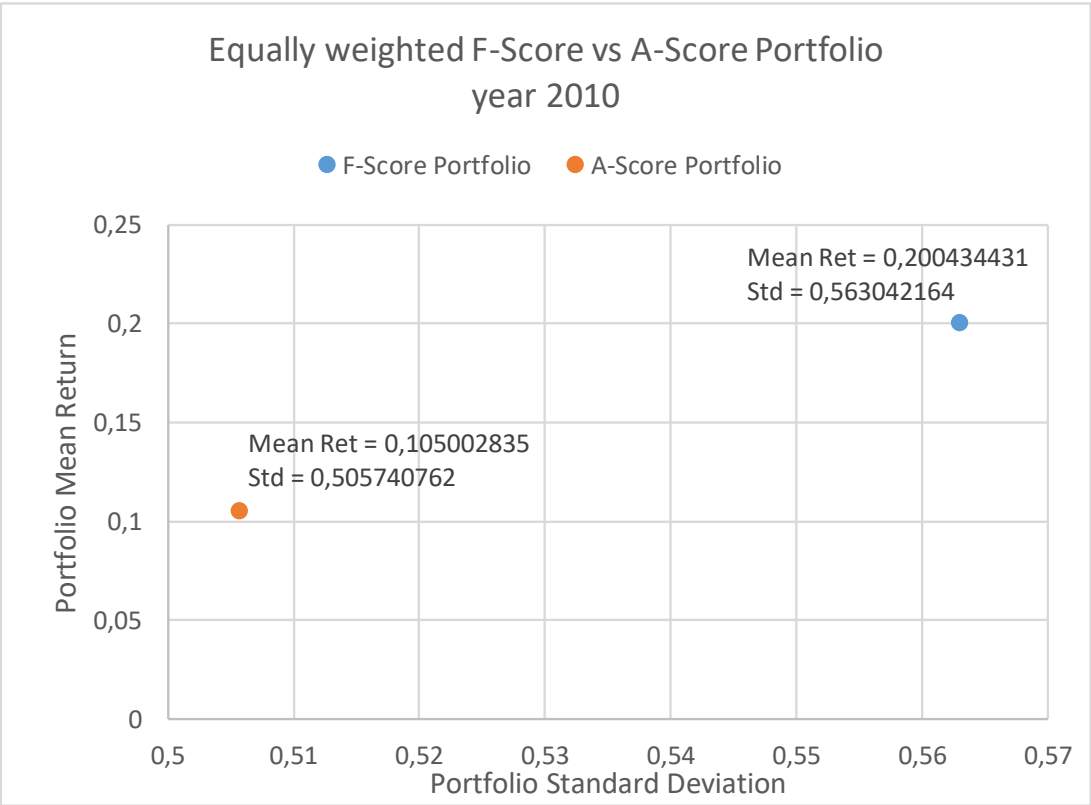
The equally weighted A-Score Portfolio and F-Score Portfolio in 2009 present another outcome in Figure 4.5. The A-Score Portfolio provides a mean return of 0.50 and a standard deviation of 0.86. The F-Score Portfolio on the other hand exhibits a negative return of -0.18 and a standard deviation of 0.54. The results suggest that in 2009 the A-Score Portfolio outperforms the F-Score Portfolio in terms of return, but offers a considerably higher risk for the realized return.

Figure 4.5: Equally weighted F-Score versus A-Score Portfolio in year 2009



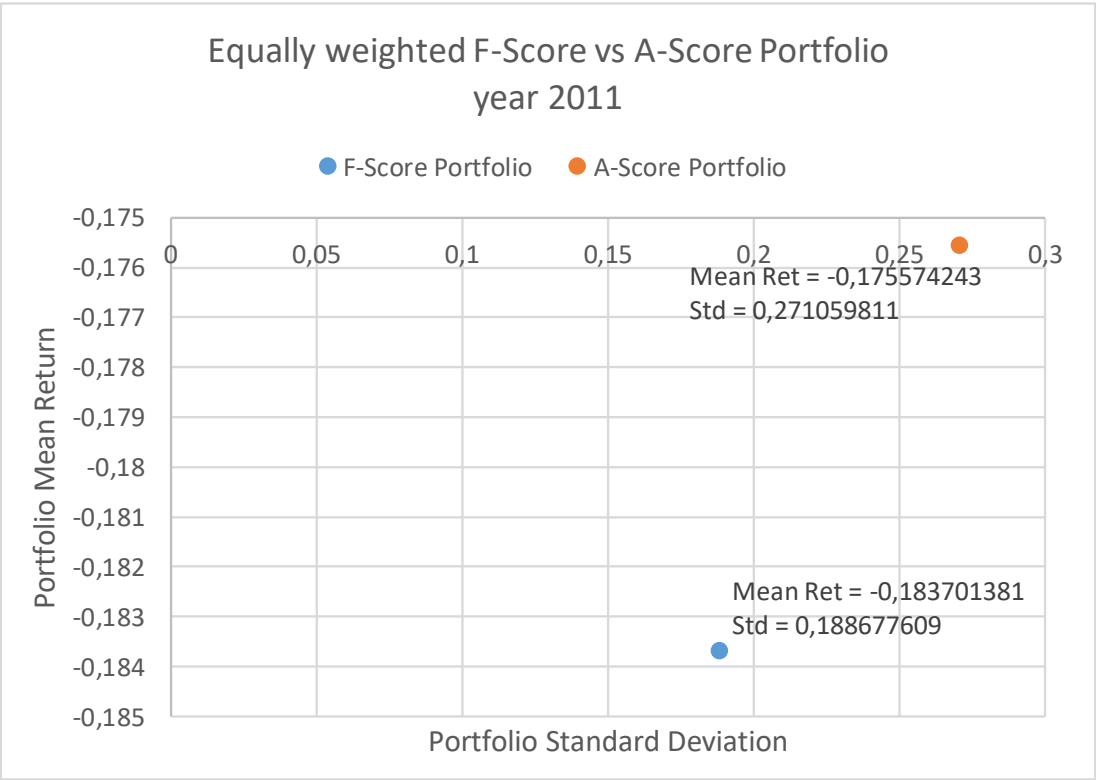
The comparison between the A-Score Portfolio in year 2010 and the F-Score Portfolio in 2010 leads to a different outcome in contrast to the previous year. Figure 4.6 presents the performance metric of the equally weighted F-Score and A-Score Portfolio in 2010. The A-Score Portfolio underperforms the F-Score Portfolio in terms of return in 2010. The mean return values state 0.11 and 0.20, respectively. Logically, the A-Score Portfolio offers a lower standard deviation compared to the standard deviation of the F-Score Portfolio. The risk values signify 0.50 and 0.56, respectively.

Figure 4.6: Equally weighted F-Score versus A-Score Portfolio in year 2010



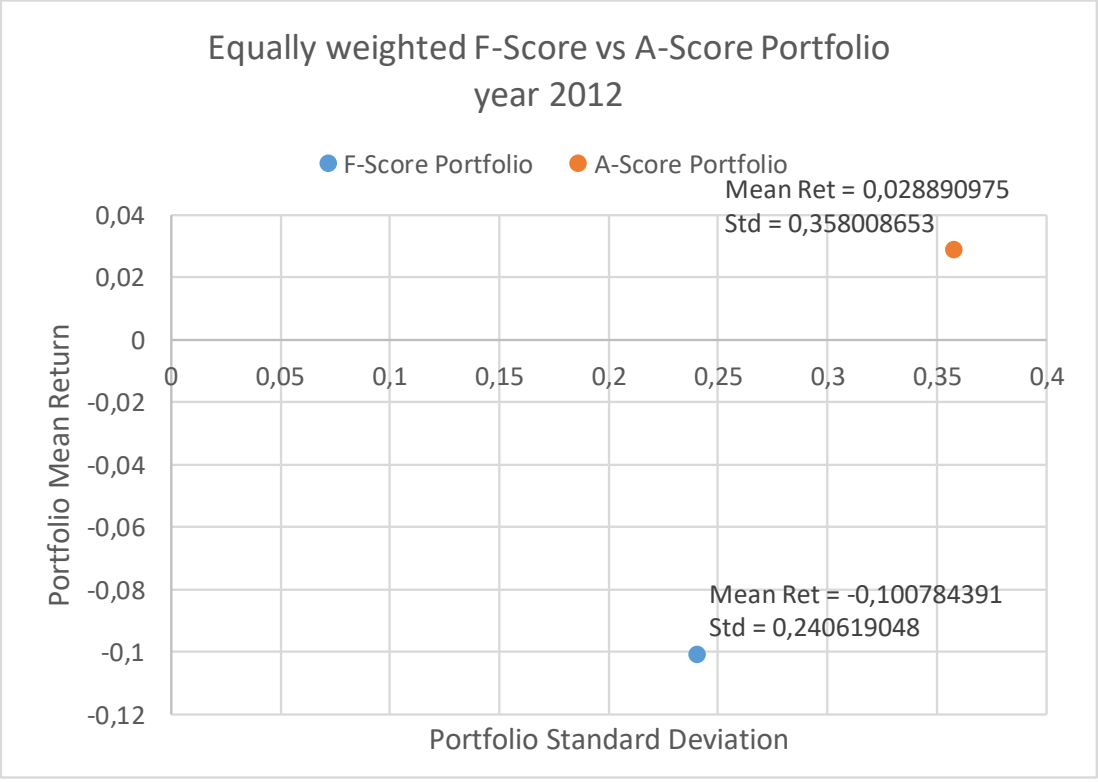
The empirical results between an equally weighted F-Score and an equally weighted A-Score Portfolio for 2011 suggest the converse outcome. Figure 4.7 offers the mean return and standard deviation metric for both equally weighted portfolios in 2011. The A-Score Portfolio exhibits a negative return of -0.175 and a standard deviation of 0.27. The F-Score Portfolio presents a negative mean return of -0.184 and a standard deviation of 0.19. The overall comparison in 2011 suggests that the A-Score Portfolio offers a slightly higher return for a slightly higher risk.

Figure 4.7: Equally weighted F-Score versus A-Score Portfolio in year 2011



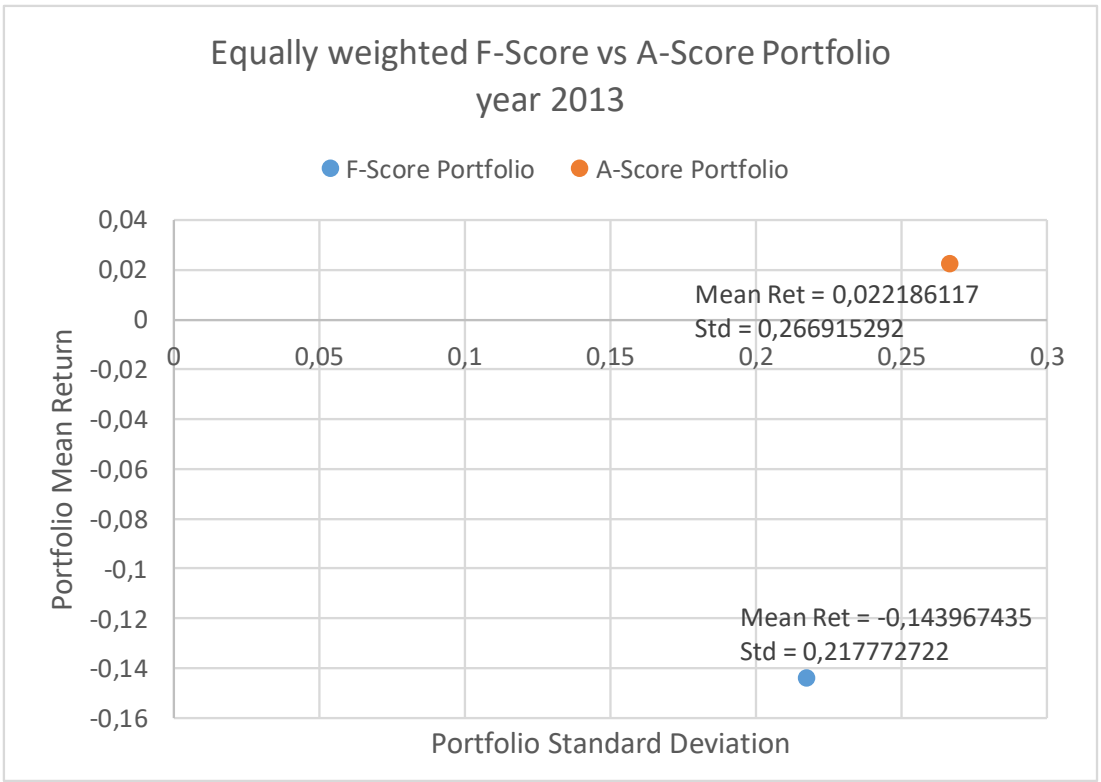
The comparison between an equally weighted F-Score and equally weighted A-Score Portfolio in year 2012 leads the interpretation in the same direction. Figure 4.8 presents the performance metrics for both equally weighted portfolios in 2012. The A-Score Portfolio exhibits a mean return of 0.03 and a standard deviation of 0.36. The F-Score Portfolio offers a negative mean return of -0.10 and a standard deviation of 0.24. The overall outcome for 2012 suggest that the A-Score Portfolio outperforms the F-Score Portfolio in terms of return and exhibits in that direction higher risk for the offered return.

Figure 4.8: Equally weighted F-Score versus A-Score Portfolio in year 2012



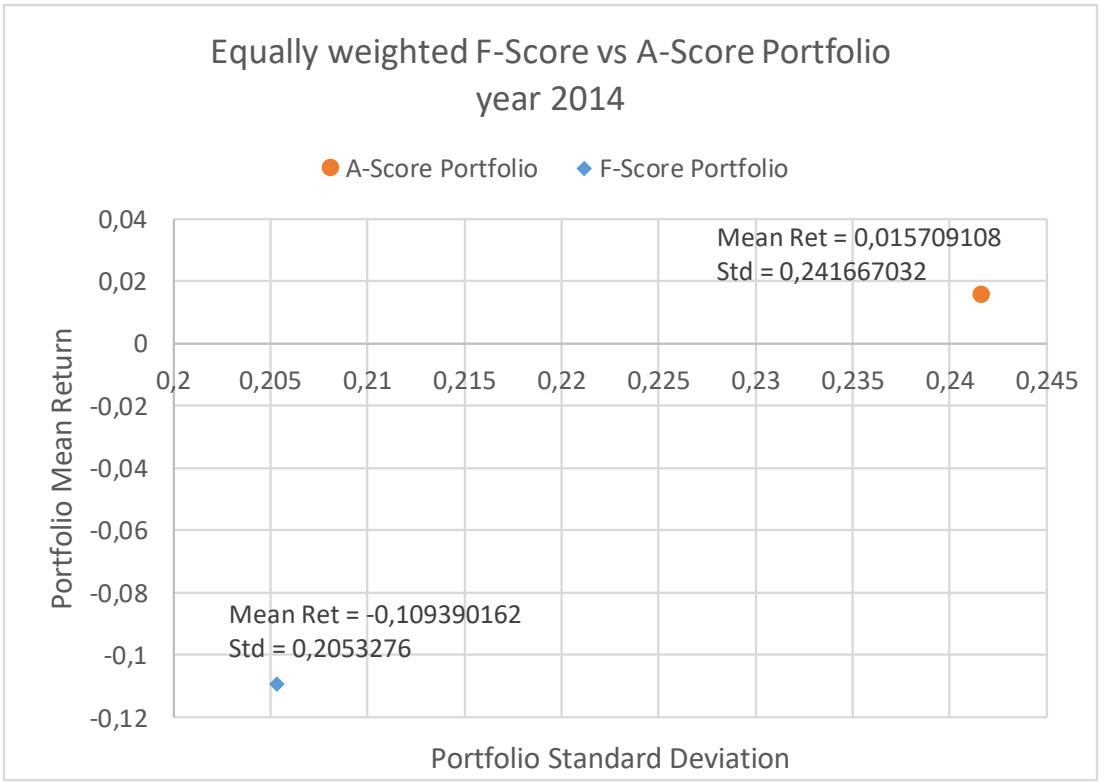
The comparison metrics between an equally weighted F-Score and an equally weighted Portfolio in year 2013 are presented in Figure 4.9. The A-Score Portfolio delivers a mean return of 0.02 and a standard deviation of 0.27. The F-Score Portfolio offers a negative mean return of -0.14 and a standard deviation of 0.22. Based on those metrics in 2013 the A-Score Portfolio outperforms the F-Score Portfolio in terms of return delivers therefore a higher standard deviation for the developed return.

Figure 4.9: Equally weighted F-Score versus A-Score Portfolio in year 2013



An equally weighted F-Score Portfolio in 2014 is compared to a corresponding equally weighted F-Score Portfolio. The performance metrics of the two equally weighted portfolios are shown in Figure 4.10. The A-Score Portfolio exhibits a mean return of 0.02 and a standard deviation of 0.24. The F-Score Portfolio presents a negative mean return of -0.11 and a standard deviation of 0.21. The outcome suggests that in 2014 the A-Score Portfolio outruns the F-Score Portfolio considerably in terms of return. For that high difference in terms of mean return the A-Score Portfolio delivers slightly higher risk compared to the risk of the F-Score Portfolio.

Figure 4.10: Equally weighted F-Score versus A-Score Portfolio in year 2014



The comparison metrics between an equally weighted F-Score Portfolio and equally weighted A-Score Portfolio in year 2015 are presented in Figure 4.11. The A-Score Portfolio exhibits a mean return of -0.121 and a standard deviation of 0.29. The F-Score Portfolio delivers a mean return of -0.123 and a standard deviation of 0.27. Both portfolios achieve similar results in 2015, whereas the A-Score Portfolio achieves slightly higher return for a slightly higher risk in comparison to the F-Score Portfolio.

Figure 4.11: Equally weighted F-Score versus A-Score Portfolio in year 2015

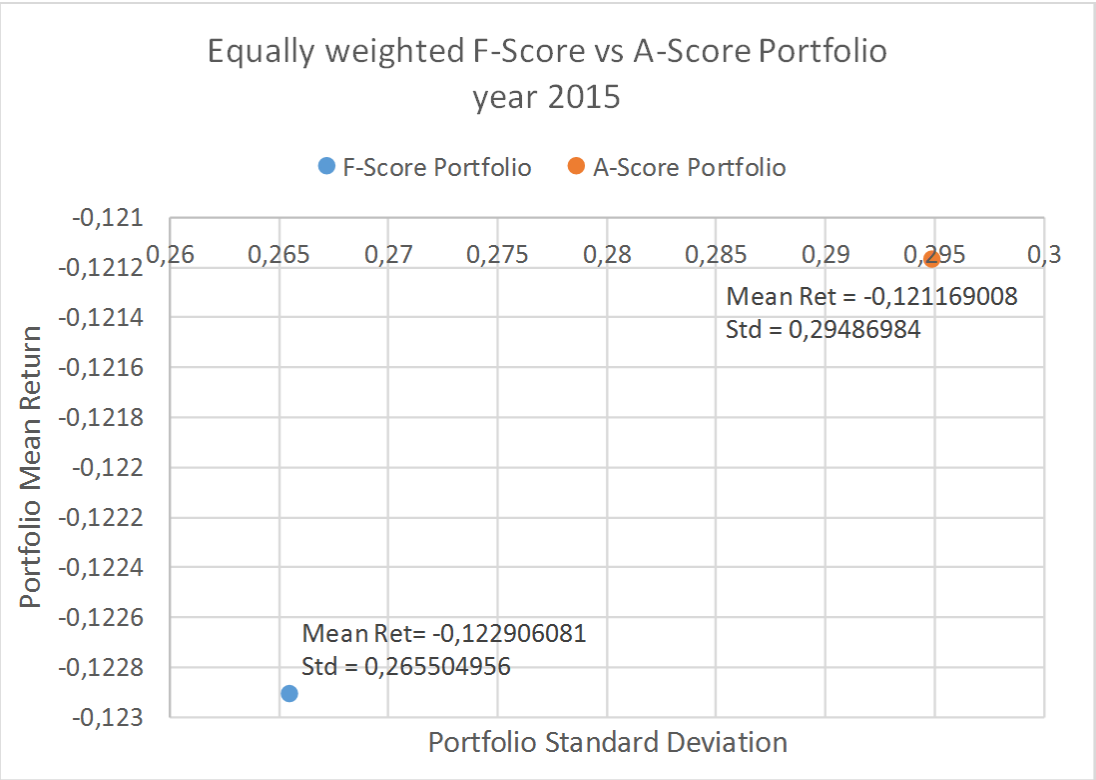


Table 4.1 shows the full list of performance metrics for equally weighted F-Score and A-Score Portfolios. The equally weighted F-Score Portfolios deliver negative return in 10 of 11 observable years, whereas the equally weighted A-Score Portfolios suggest negative return in 6 of 11 observable periods. In conclusion, the equally weighted A-Score Portfolios outperform the equally weighted F-Score Portfolios in most years between 2005 and 2015. In 7 of 11 compared portfolio pairs, the equally weighted A-Score Portfolios deliver higher return than the equally weighted F-Score Portfolios at the cost of higher or similar risk. The 2011 and 2015 observable periods present equally weighted A-Score Portfolios that offer similar return and higher risk compared to the corresponding equally weighted F-Score Portfolios. In year 2008, which signifies the outburst of the financial crisis, the equally weighted F-Score

Portfolio outruns the equally weighted A-Score Portfolio. It shows higher return and greater risk compared to the equally weighted A-Score Portfolio. This result is confirmed in year 2010, as well. In most years, the A-Score Portfolio will be preferred by a risk-seeking investor, since it offers higher return and risk. Correspondingly, in those years the F-Score Portfolio will be preferred by a risk-averse investor due to the lower offered risk. In three observable pairs the F-score Portfolio will be favored by a risk-seeking investor and the A-Score Portfolio by risk-averse investor.

Table 4.1: Central Performance Metrics for Equally Weighted F-Score and A-Score Portfolios

	Equally Weighted Portfolios			
	F-Score Portfolio		A-Score Portfolio	
Year	Portfolio Mean Return	Portfolio Std. Dev.	Portfolio Mean Return	Portfolio Std. Dev.
2005	-0,020484848	0,234353572	0,027262477	0,255409747
2006	-0,069384106	0,179843888	0,109408945	0,410653144
2007	-0,260603786	0,221814319	-0,109245032	0,242136315
2008	-0,180641592	0,269421369	-0,307768643	0,159803450
2009	-0,183294922	0,539879680	0,500562847	0,859167814
2010	0,200434431	0,563042164	0,105002835	0,505740762
2011	-0,183701381	0,188677609	-0,175574243	0,271059811
2012	-0,100784391	0,240619048	0,028890975	0,358008653
2013	-0,143967435	0,217772722	0,022186117	0,266915292
2014	-0,109390162	0,205327600	0,015709108	0,241667032
2015	-0,122906081	0,265504956	-0,121169008	0,294869840

4.1.2. Comparison based on overall performance

In a broader context, we interpret the results between the equally weighted F-Score and A-Score Portfolios based on aggregated overall performance for the full range of years between 2005 and 2015. The comparison of the overall performance of the means between the equally weighted F-Score and A-Score Portfolio is based on a T-test.

The results are presented in Figure 4.12. The F-Score Portfolios are coded at 1 and the A-Score Portfolios at 0. We observe two hypotheses. The *null hypothesis* assumes that the difference between the mean performance of the 11 observable equally weighted A-Score Portfolios and the mean performance of the 11 observable equally weighted F-Score Portfolios is equal to 0. The *alternative hypothesis* assumes that the difference between the mean performance of the 11 observable equally weighted A-Score Portfolios and the mean performance of the 11 observable equally weighted F-Score Portfolios is not equal to zero. The result of the T-test shows that the P-Value of the alternative hypothesis is equal to 0.4314 and therefore higher than 0.05. In that manner, we fail to reject the null hypothesis and do not find statistical difference between the means of the equally weighted F-Score and A-Score Portfolios. The outcome suggests no under- or overperformance of any of the two types of equally weighted portfolios. The two-sided T-tests similarly suggest no rejection of the null hypothesis.

Figure 4.12: T-test for overall performance comparison between equally weighted F-Score vs A-Score Portfolios

```
Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	11	-.0118845	.0476859	.1581562	-.1181353	.0943663
1	11	-.0657185	.0471108	.1562488	-.1706878	.0392509
combined	22	-.0388015	.0332318	.1558709	-.1079107	.0303078
diff		.053834	.0670326		-.0859936	.1936615

```
    diff = mean(0) - mean(1)                                      t =   0.8031
Ho: diff = 0                     degrees of freedom =       20

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7843         Pr(|T| > |t|) = 0.4314          Pr(T > t) = 0.2157
```

4.2. Capitalization-weighted F-Score versus A-Score Portfolio

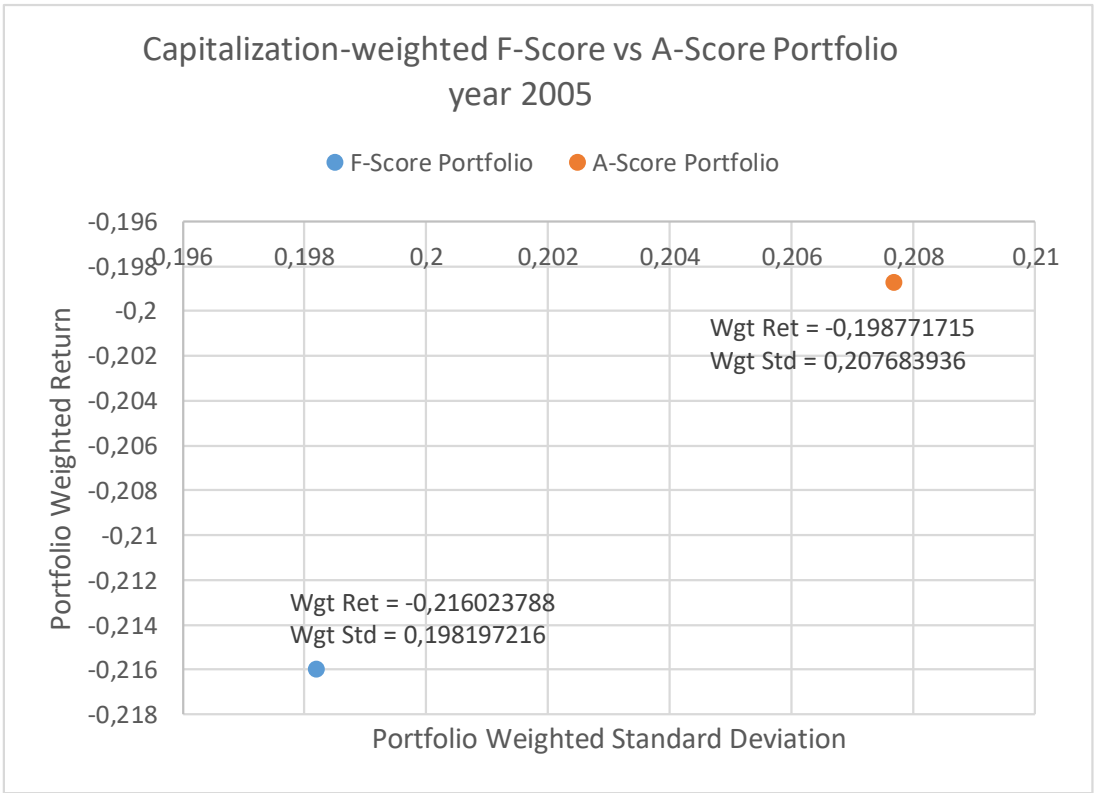
Once we form the capitalization-weighted F-Score Portfolios and the capitalization-weighted A-Score Portfolios, we compare them based on their yearly and overall performance.

4.2.1. Comparison based on yearly performance

Further valuable empirical results are demonstrated during the yearly based comparison process between the capitalization-weighted F-Score Portfolios and the capitalization-weighted A-Score Portfolios. We focus on 11 pairs of capitalization-weighted portfolios for each year between 2005 and 2015. Table 8, Appendix D, and Table 10, Appendix D, present capitalization weight's percentage per company and year in the F-Score Portfolios and descriptive statistics of the capitalization weights for the F-Score Portfolios. Table 9, Appendix D, and Table 11, Appendix D, demonstrate the capitalization weight's percentage per company and year in the A-Score Portfolios and descriptive statistics of capitalization weights for the A-Score Portfolios. The interpretation analyses are based on performance metrics as portfolio weighted return and portfolio weighted standard deviation.

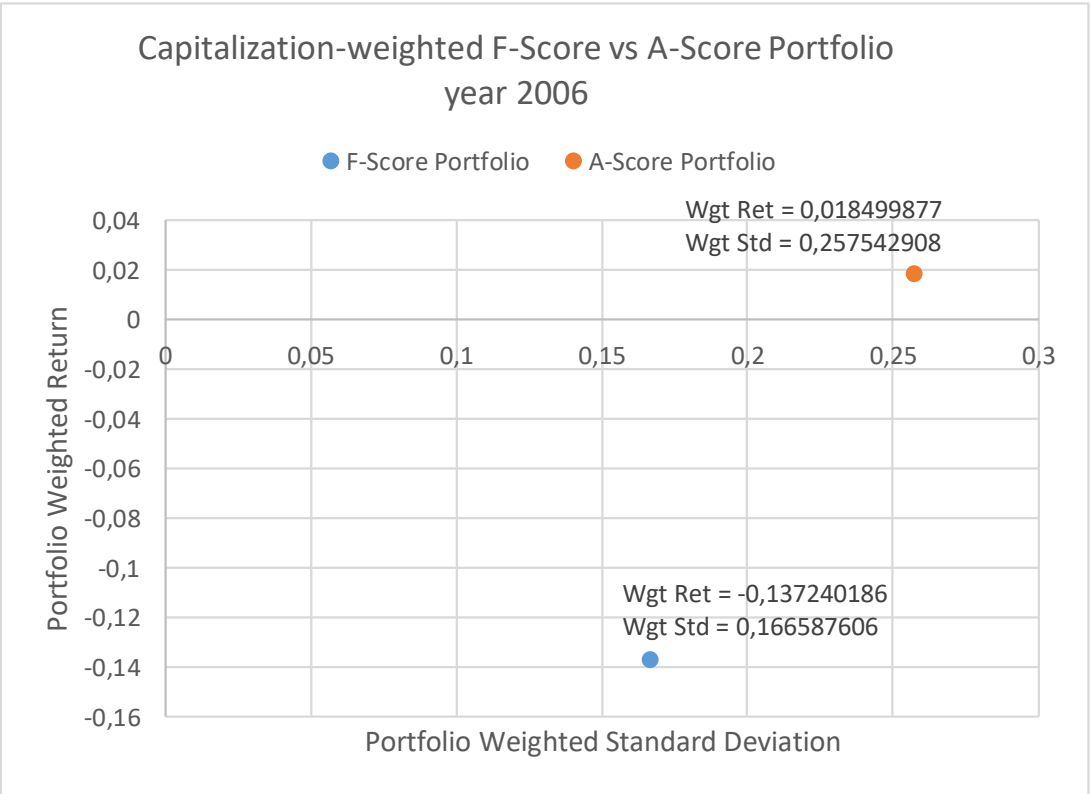
We compare a capitalization-weighted F-Score Portfolio and a capitalization-weighted A-Score Portfolio in year 2005. Figure 4.13 presents the weighted return and the weighted standard deviation for each capitalization-weighted portfolio in year 2005. The A-Score Portfolio exhibits a weighted return of -0.198 and a standard deviation of 0.207. The F-Score Portfolio delivers a weighted return of -0.216 and a standard deviation of 0.198. Both capitalization-weighted portfolios in 2005 offer similar performance measures. The A-Score Portfolio slightly outruns slightly the F-Score Portfolio by offering slightly marginally higher return at the cost of slightly higher risk.

Figure 4.13: Capitalization-weighted F-Score versus A-Score Portfolio in year 2005



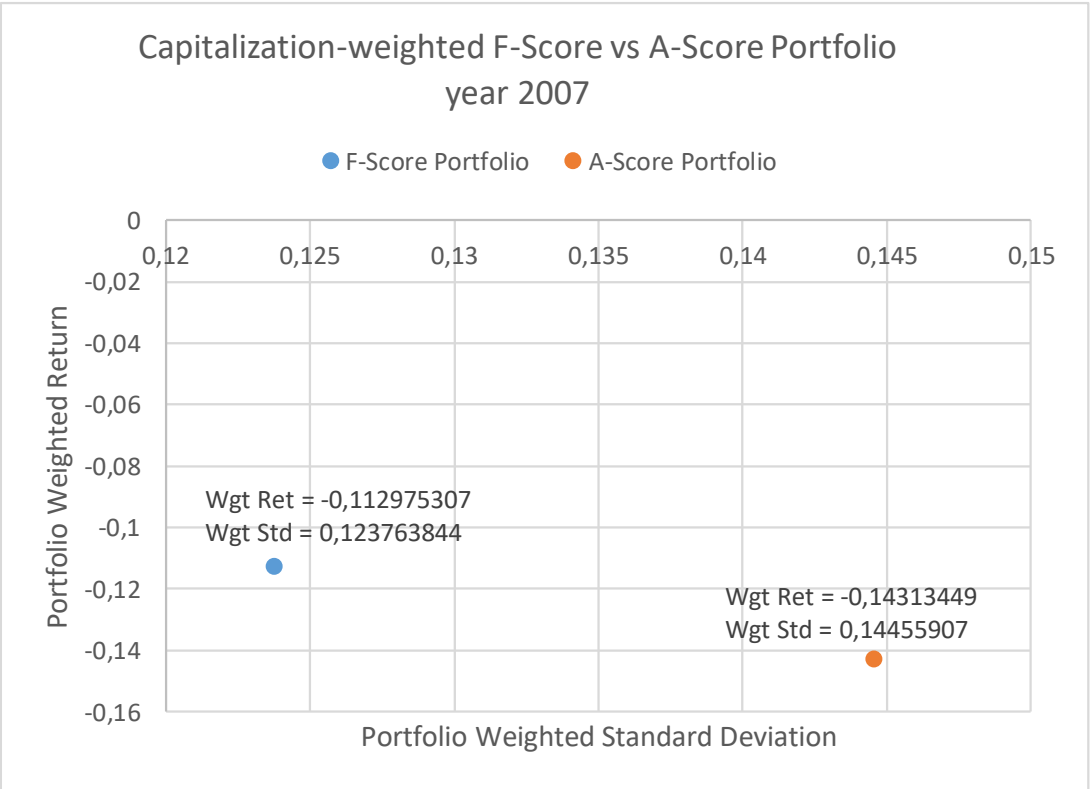
A capitalization-weighted F-Score Portfolio in 2006 is compared to a corresponding capitalization-weighted A-Score Portfolio. The performance metrics for each capitalization portfolio in 2006 are exposed in Figure 4.14. The A-Score Portfolio offers a weighted return of 0.02, whereas the F-Score Portfolio exhibits a negative weighted return of -0.14. In terms of weighted standard deviation, the A-Score Portfolio and the F-Score Portfolio deliver values at 0.26 and 0.17, respectively. For year 2006 the A-Score Portfolio outperforms the F-Score Portfolio by offering considerably higher return at the cost of higher risk.

Figure 4.14: Capitalization-weighted F-Score versus A-Score Portfolio in year 2006



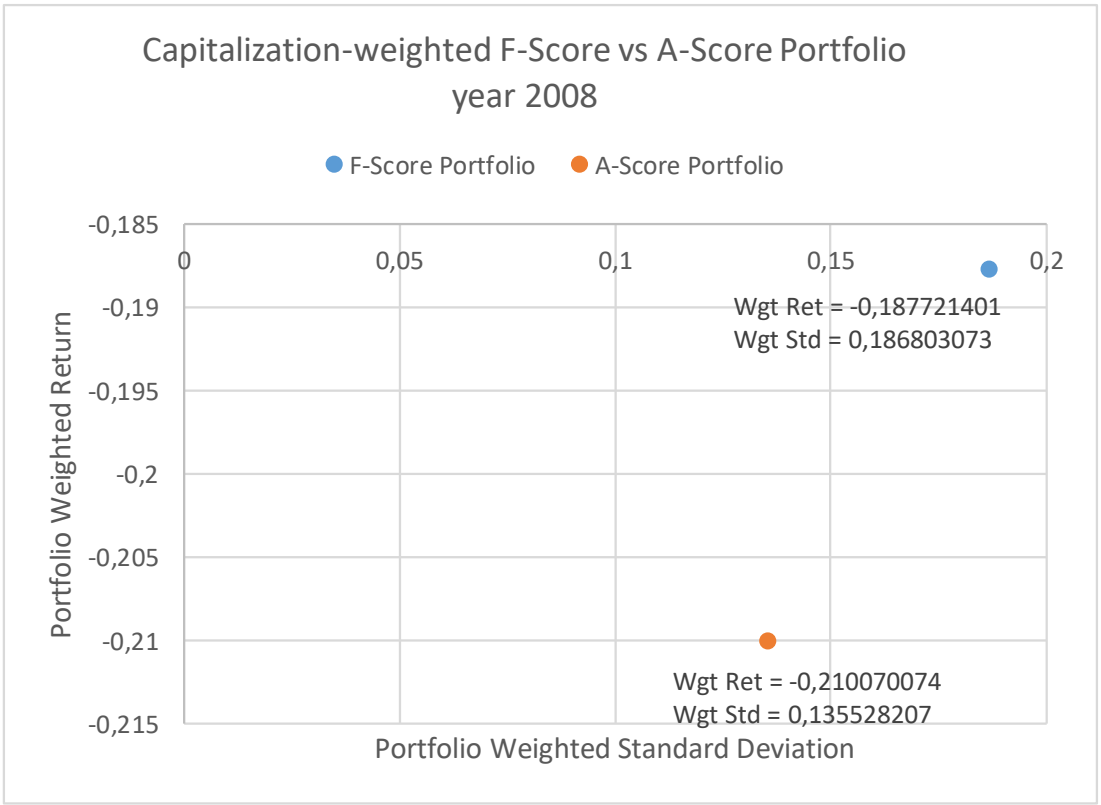
The comparison metrics between a capitalization-weighted F-Score Portfolio and a capitalization-weighted A-Score Portfolio in year 2007 are presented in Figure 4.15. The A-Score Portfolio offers a weighted return of -0.14 and a weighted standard deviation of 0.14. The F-Score Portfolio exhibits a weighted return of -0.11 and a weighted standard deviation of 0.12. The comparison metrics for each capitalization portfolio in 2007 demonstrate results in favor of the F-Score Portfolio. The F-Score Portfolio delivers higher return and lower risk compared to the A-Score Portfolio, which positions the A-Score Portfolio at inferior performance.

Figure 4.15: Capitalization-weighted F-Score versus A-Score Portfolio in year 2007



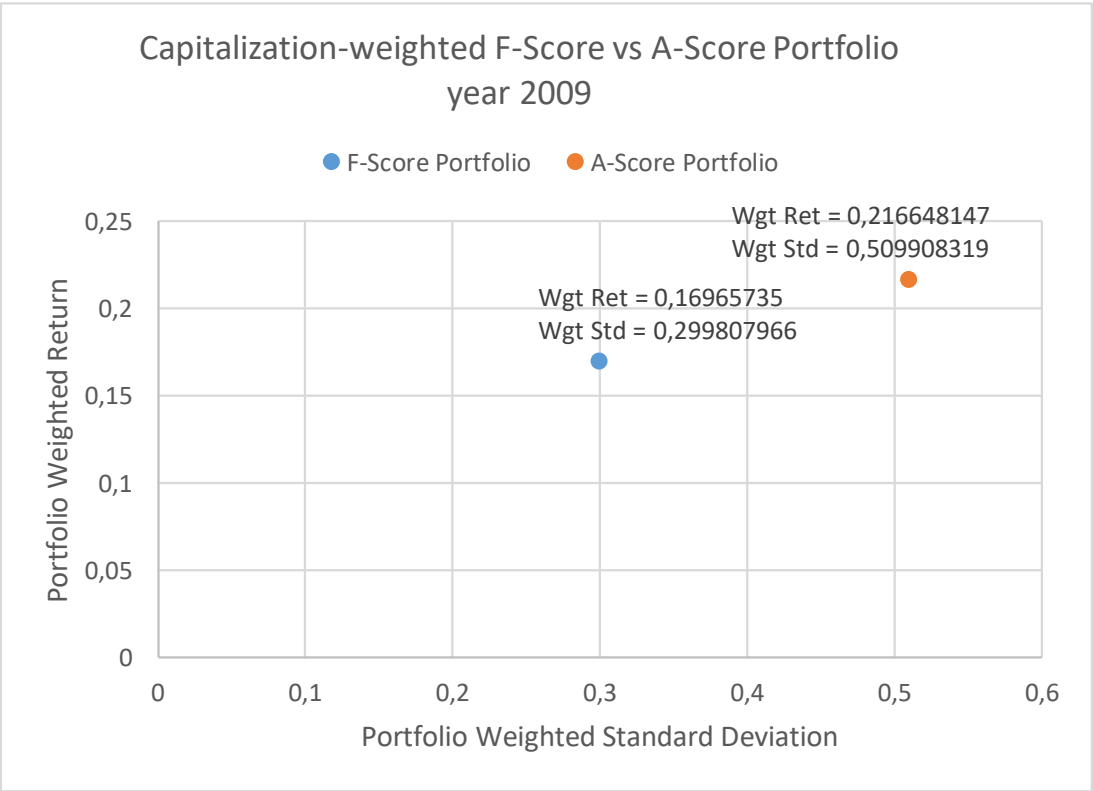
We also compare a capitalization-weighted F-Score Portfolio in 2008 to a capitalization-weighted A-Score Portfolio in 2008. Figure 4.16 delivers the weighted return and the weighted standard deviation for each portfolio in year 2008. The A-Score Portfolio exhibits a negative weighted return of -0.21 and a weighted standard deviation of 0.14. The F-Score Portfolio presents a negative weighted return of -0.19 and a standard deviation of 0.19. Based on those metrics in the outburst of the financial crisis, the F-Score Portfolio offers slightly higher return compared to the A-Score Portfolio. This return is offset by a higher risk for the F-Score Portfolio.

Figure 4.16: Capitalization-weighted F-Score versus A-Score Portfolio in year 2008



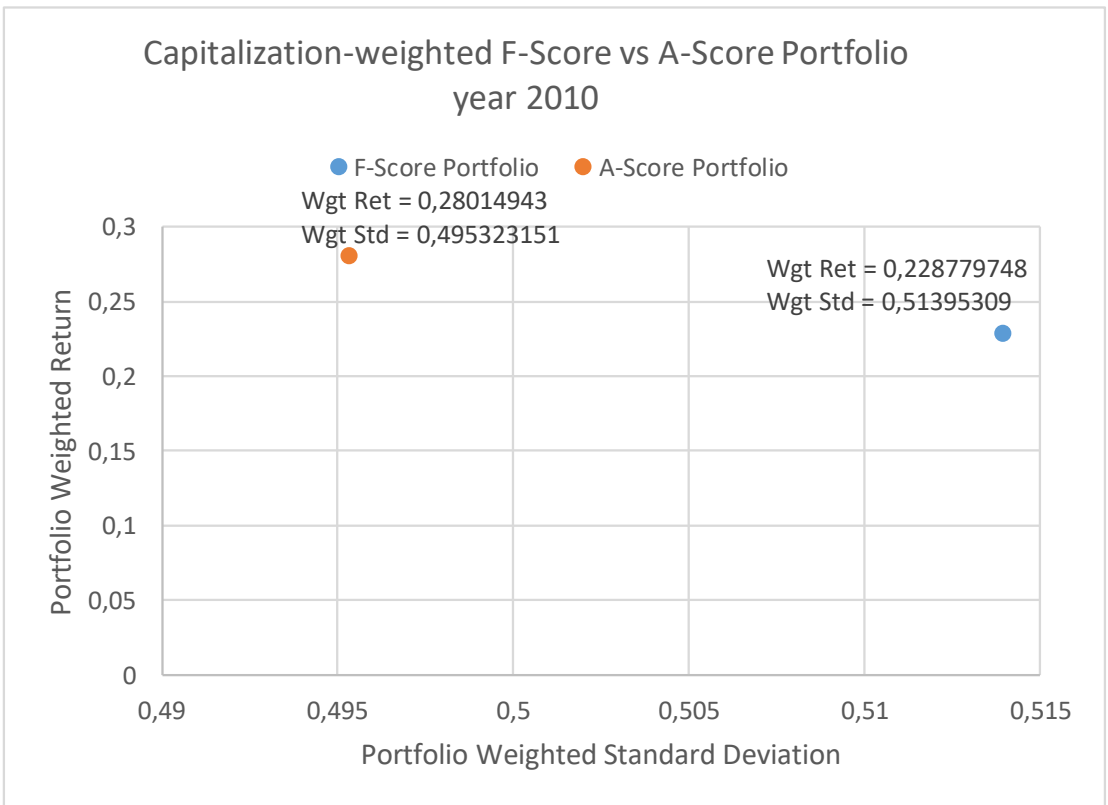
The empirical results of a capitalization-weighted F-Score Portfolio and a capitalization-weighted A-Score Portfolio in 2009 suggest the inverse outcome. Figure 4.17 presents the performance metrics for each capitalization portfolio in 2009. The A-Score Portfolio exhibits a weighted return of 0.22 and a weighted standard deviation of 0.51. The F-Score Portfolio offers a weighted return of 0.17 and a weighted standard deviation of 0.30. In year 2009 the A-Score Portfolio outperforms the F-Score Portfolio in terms of return. It also provides substantially higher risk, which compensates for the achieved return.

Figure 4.17: Capitalization-weighted F-Score versus A-Score Portfolio in year 2009



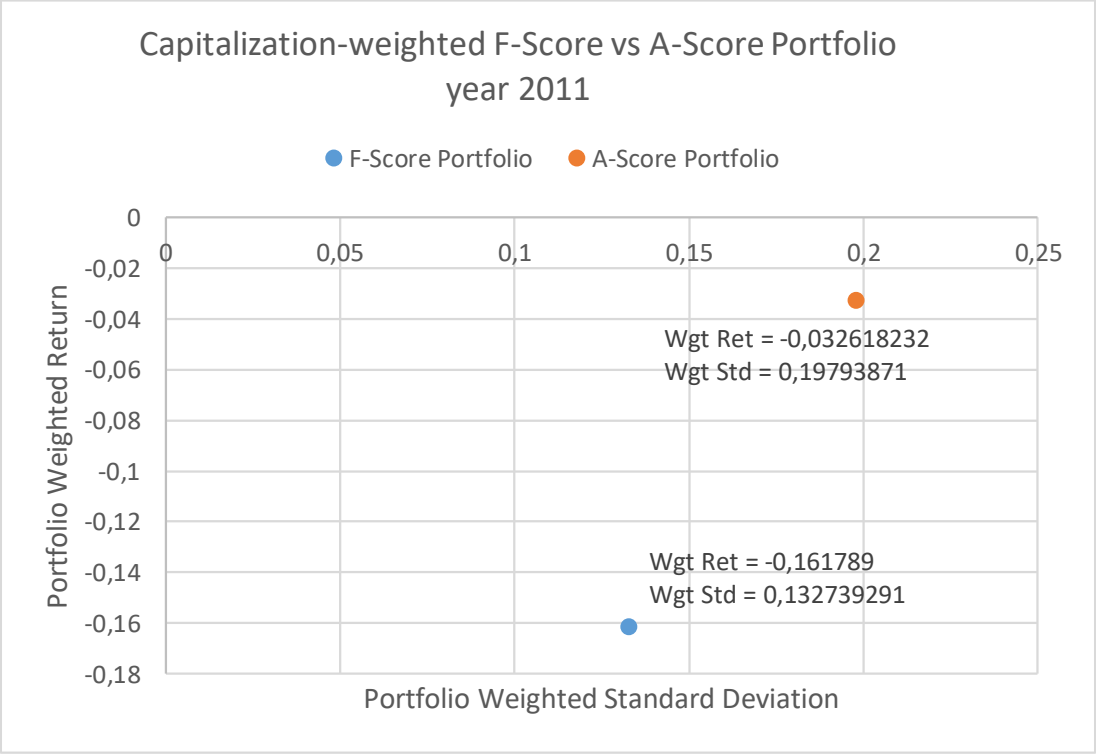
A capitalization-weighted F-Score Portfolio in 2010 is also compared to a corresponding capitalization-weighted A-Score Portfolio. The weighted return and the standard deviation for each portfolio is exposed in Figure 4.18. The A-Score Portfolio exhibits a weighted return of 0.28 and a weighted standard deviation of 0.50. The F-Score Portfolio presents a weighted return of 0.23 and a weighted standard deviation of 0.51. In year 2010, the A-Score Portfolio outperforms the F-Score Portfolio. It delivers higher return for a similar value of risk and suggests inferior performance for the F-Score Portfolio.

Figure 4.18: Capitalization-weighted F-Score versus A-Score Portfolio in year 2010



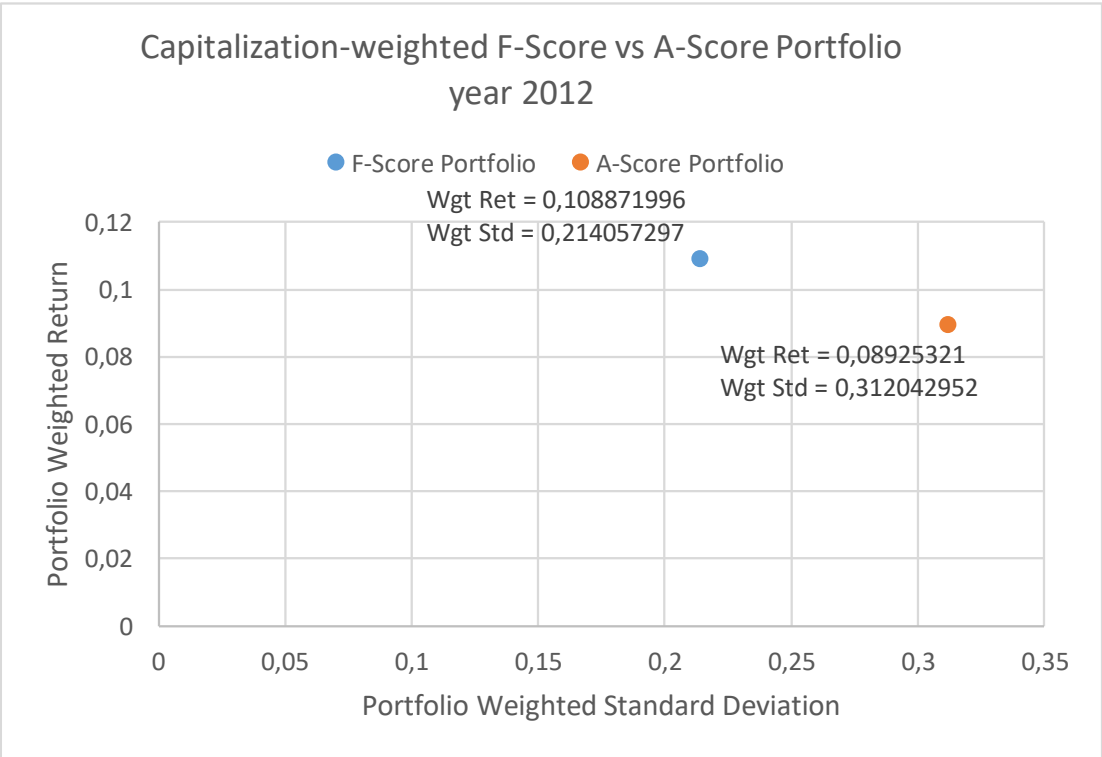
The comparison metrics of a capitalization-weighted F-Score Portfolio in 2011 and a capitalization-weighted A-Score Portfolio in 2011 are presented in Figure 4.19. The A-Score Portfolio exhibits a negative weighted return of -0.03 and a weighted standard deviation of 0.19. The F-Score Portfolio delivers a negative weighted return of -0.16 and a standard deviation of 0.13. In conclusion, the performance metrics in 2011 suggest that the A-Score Portfolio outperforms the F-Score Portfolio. It offers higher return and a higher risk compared to the F-Score Portfolio.

Figure 4.19: Capitalization-weighted F-Score versus A-Score Portfolio in year 2011



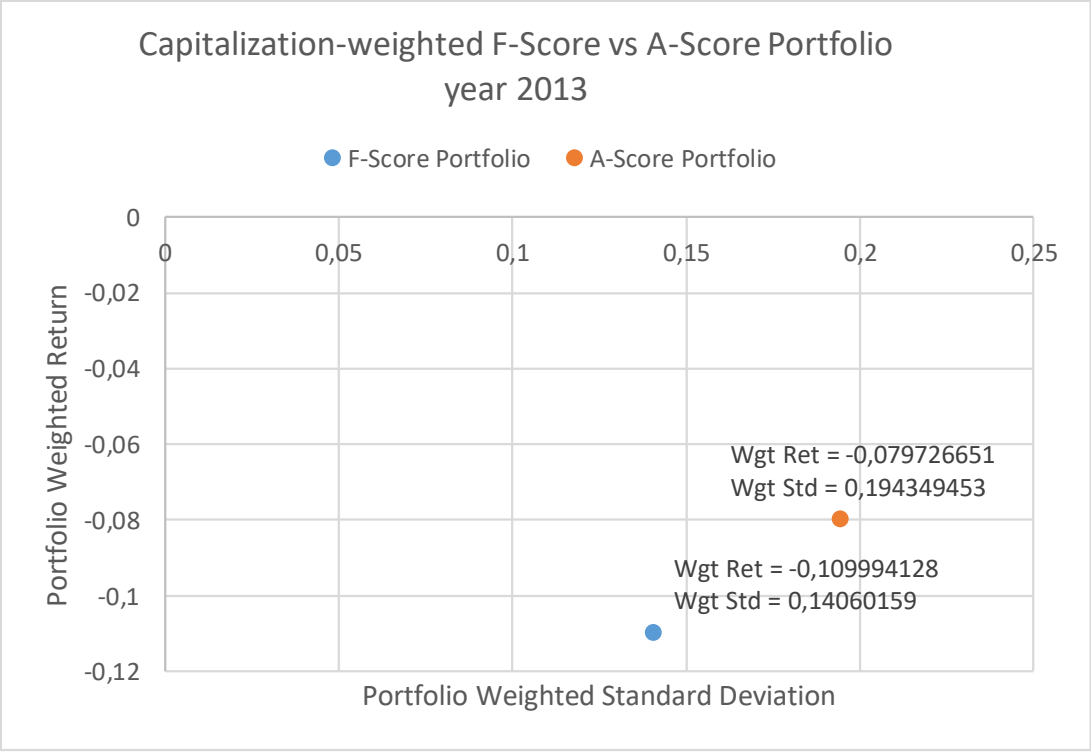
A capitalization-weighted F-Score in 2012 is compared to a corresponding capitalization-weighted A-Score Portfolio. Figure 4.20 presents the performance metrics for each capitalization-weighted portfolio. The A-Score Portfolio delivers a weighted return of 0.09 and a standard deviation of 0.31. The F-Score Portfolio exhibits a weighted return of 0.11 and a standard deviation of 0.21. The outcome for 2012 suggests that the F-Score Portfolio outperforms the A-Score Portfolio by offering higher return and a lower standard deviation. The A-Score Portfolio delivers inferior performance during this period.

Figure 4.20: Capitalization-weighted F-Score versus A-Score Portfolio in year 2012



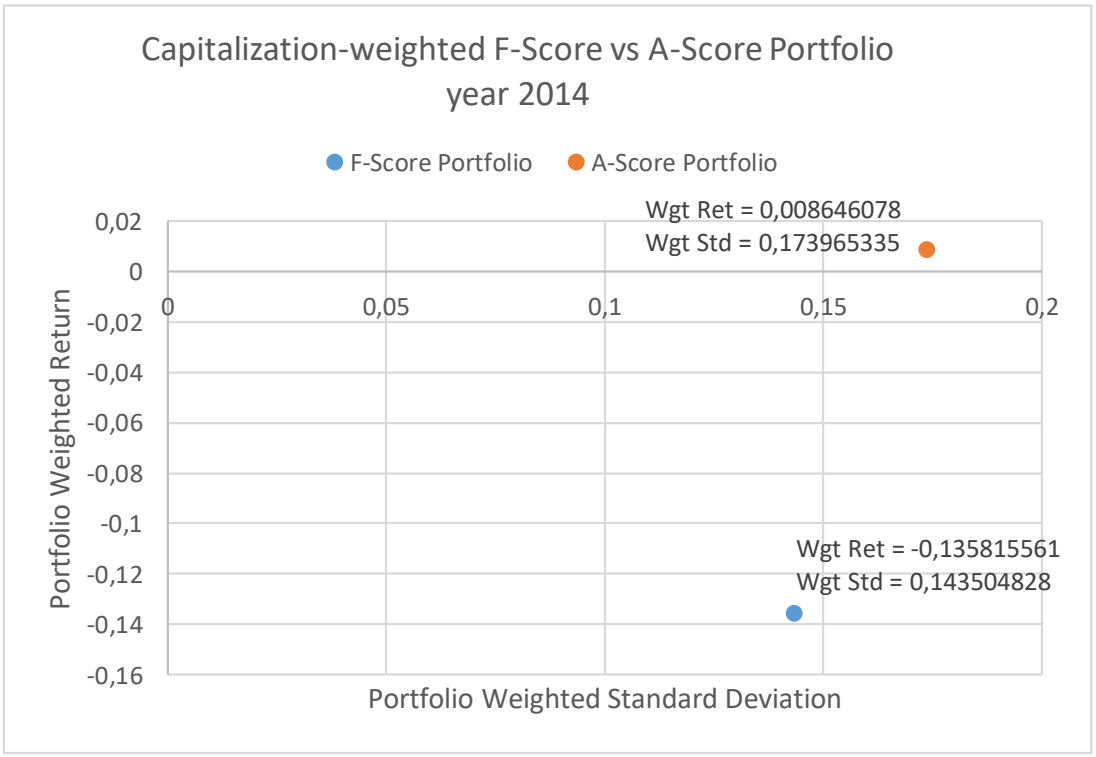
The empirical results of a capitalization-weighted F-Score Portfolio in 2013 and a capitalization-weighted A-Score Portfolio in 2013 are presented in Figure 4.21. The A-Score Portfolio exhibits a negative weighted return of -0.08 and a weighted standard deviation of 0.20. The F-Score Portfolio delivers a negative weighted return of -0.11 and a weighted standard deviation of 0.14. In year 2013, the A-Score Portfolio outperforms the F-Score Portfolio by offering slightly higher return at the cost of higher risk.

Figure 4.21: Capitalization-weighted F-Score versus A-Score Portfolio in year 2013



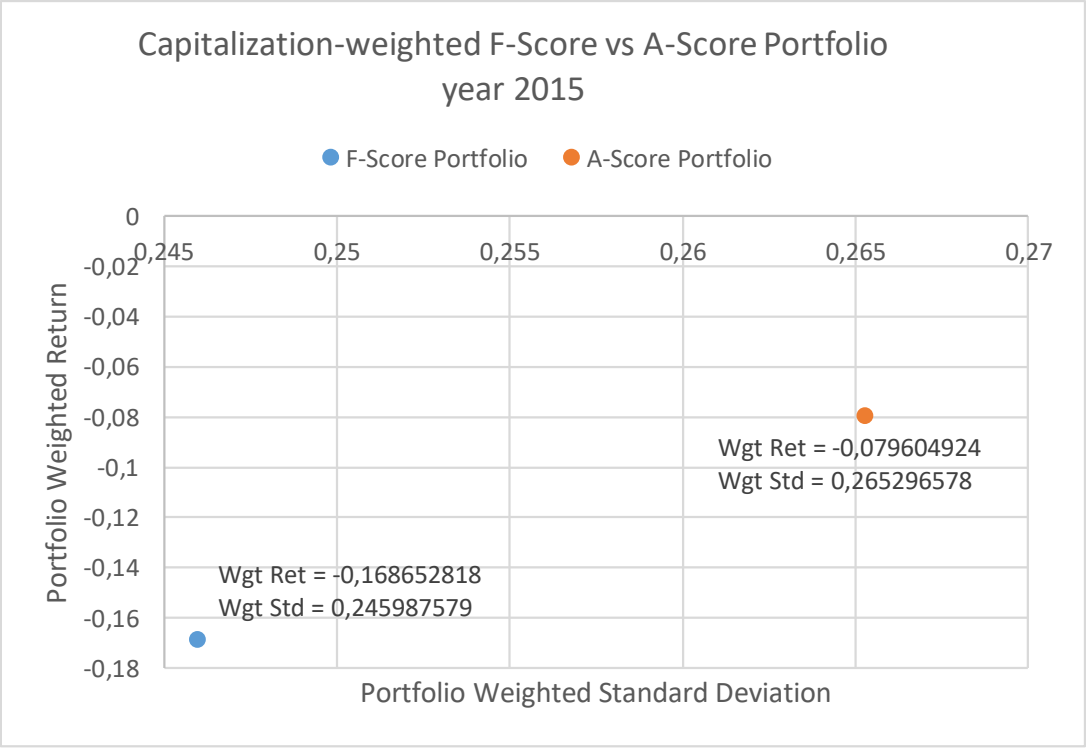
A capitalization-weighted F-Score Portfolio in 2014 is compared to a corresponding capitalization-weighted A-Score Portfolio. Figure 4.22 presents the performance metrics for each capitalization-weighted portfolio in 2014. The A-Score Portfolio offers a weighted return of 0.008 and a weighted standard deviation of 0.17. The F-Score Portfolio delivers a negative weighted return of -0.14 and a standard deviation of 0.14. In year 2014, the F-Score Portfolio offers a negative return compared to a positive return for the A-Score Portfolio. The difference in terms of return is offset by a higher risk.

Figure 4.22: Capitalization-weighted F-Score versus A-Score Portfolio in year 2014



The last pair of comparison consists of a capitalization-weighted F-Score Portfolio in 2015 and a capitalization-weighted A-Score Portfolio in 2015. Figure 4.23 shows the weighted return and the weighted standard deviation for each portfolio in 2015. The A-Score Portfolio exhibits a negative weighted return of -0.08 and a weighted standard deviation of 0.27. The F-Score Portfolio delivers a negative weighted return of -0.17 and weighted standard deviation of 0.25. The A-Score Portfolio offers a still negative, but substantially higher return in comparison to the F-Score Portfolio in 2015. In terms of risk, both portfolios suggest similar standard deviation values.

Figure 4.23: Capitalization-weighted F-Score versus A-Score Portfolio in year 2015



The summarized list of performance metrics for the capitalization-weighted F-Score and A-Score Portfolios can be seen in Table 4.2. The capitalization-weighted F-Score Portfolios deliver negative return in 8 of 11 observable years, whereas the capitalization-weighted A-Score Portfolios suggest negative return in 6 of 11 cases. In summary, the capitalization-weighted A-Score Portfolio beats the capitalization-weighted F-Score Portfolio in the majority of observable years by offering higher return at the cost of higher or similar risk. An exception in that interpretation represent the results in the outburst of the financial crisis in 2007 and 2008. This reverse outcome is confirmed also in year 2012. In the majority of years, the A-

Score Portfolio will be favored by a risk-seeking investor due to its higher return and risk. Consistently, in those years the F-Score Portfolio will be preferred by a risk-averse investor due to the inferior offered risk. In three observable pairs the F-score Portfolio will be favored by a risk-seeking investor and the A-Score Portfolio by risk-averse investor.

Table 4.2: Central Performance Metrics for Capitalization-weighted F-Score and A-Score Portfolios

	Capitalization-weighted Portfolios			
	F-Score Portfolio		A-Score Portfolio	
Year	Portfolio Weighted Return	Portfolio Weighted Std. Dev.	Portfolio Weighted Return	Portfolio Weighted Std. Dev.
2005	-0,216023788	0,198197216	-0,198771715	0,207683936
2006	-0,137240186	0,166587606	0,018499877	0,257542908
2007	-0,112975307	0,123763844	-0,143134490	0,144559070
2008	-0,187721401	0,186803073	-0,210070074	0,135528207
2009	0,169657350	0,299807966	0,216648147	0,509908319
2010	0,228779748	0,513953090	0,280149430	0,495323151
2011	-0,161789000	0,132739291	-0,032618232	0,197938710
2012	0,108871996	0,214057297	0,089253210	0,312042952
2013	-0,109994128	0,140601590	-0,079726651	0,194349453
2014	-0,135815561	0,143504828	0,008646078	0,173965335
2015	-0,168652818	0,245987579	-0,079604924	0,265296578

4.2.2. Comparison based on overall performance

Further valuable source of information comes from the comparison process based on overall performance of the capitalization-weighted F-Score Portfolios and the capitalization-weighted A-Score Portfolios. Similar to the equally weighted portfolios, we analyze the aggregated overall performance for the capitalization-weighted F-Score Portfolios between 2005 and 2015 and the capitalization-weighted A-Score Portfolios between 2005 and 2015, respectively. The empirical comparison process is based on a T-test.

Figure 4.24 summarizes the results of the conducted test. The F-Score Portfolios are labeled by 1 and the A-Score Portfolios by 0. We observe hypotheses analogous to our scenario with the equally weighted portfolio. The *null hypothesis* assumes that the difference between the mean performance of the 11 observable capitalization-weighted A-Score Portfolios and the mean performance of the 11 observable capitalization-weighted F-Score Portfolios is equal to 0. The *alternative hypothesis* assumes that the difference between the mean performance of the 11 observable capitalization-weighted A-Score Portfolios and the mean performance of the 11 observable capitalization-weighted F-Score Portfolios is not equal to 0. The numbers of the one-sided T-test present a P-value of 0.1254, which is higher than the threshold value of 0.05. Due to that outcome, we fail to reject the null hypothesis and do not find statistical difference between the means of the capitalization-weighted A-Score and F-Score Portfolios. Repeatedly the statistical test suggests no under- or overpeformance of any of the two types of capitalization-weighted portfolios. The two-sided tests fail to reject the null hypothesis, as well.

Figure 4.24: T-test for overall performance comparison between

capitalization-weighted F-Score vs A-Score Portfolios

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	11	.0086606	.0623199	.2066918	-.1301969	.1475181
1	11	-.1067931	.0364068	.1207479	-.1879126	-.0256736
combined	22	-.0490663	.0374029	.1754353	-.1268499	.0287174
diff		.1154537	.072175		-.0351008	.2660081

diff = mean(0) - mean(1) t = 1.5996
Ho: diff = 0 degrees of freedom = 20

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9373 Pr(|T| > |t|) = 0.1254 Pr(T > t) = 0.0627

5. Investment Strategy of the A-Score Method

This chapter summarizes the key steps of the investment strategy of the A-Score Method.

An investor, who is willing to implement the investment strategy of the A-Score Method, should select a sample of companies and collect their Book-to-Market Ratios for each fiscal year of interest. In order to concentrate on the value investment stocks, the investor should select the 20 % companies with highest Book-to-Market Ratios per year. This percentage reflects the highest quintile of Book-to-Market Ratios after sorting the Book-to-Market Ratios in the sample into quintiles. This strategy is based on Piotroski (2000).[214] The next step outlines the collection of ratios, which exhibit the highest explanatory power in predicting these stocks' returns. According to the A-Score Method they include the book-to-market ratio, net income before extraordinary items, accruals, historical change in long-term debt, book value, capex, historical change in short-term debt, and change in asset turnover ratio. Based on these variables, an investor predicts the returns of the selected companies. According to the A-Score Method an investor should select the 15 companies with the highest predicted returns per year and form a portfolio per year based on the abovementioned variables. The selected number of companies per portfolio allows for selecting companies with the highest predicted returns, while simultaneously achieving sufficient diversification effects. In general, it is highly dependent on the overall number of companies in the concrete sample and should be adapted accordingly. This master thesis suggests a buy and hold investment strategy per portfolio and a one year holding period.

[214] See Piotroski (2000), p. 11

6. Conclusion

The comprehensive analyses presented in this master thesis lead to valuable conclusions on portfolio management topics. They align several important aspects, which we explore in this research.

The intermediary steps suggest precise fundamental variables that assert statistical significance in explaining the stocks' returns based on our sample data. The empirical results suggest that the book-to-market ratio, net income before extraordinary items, accruals, historical change in long-term debt, book value, capex, historical change in short-term debt, and change in asset turnover ratio exhibit high explanatory power in explaining the stocks' returns.

The core topic of interest in this master thesis focuses on the comparison process between the F-Score Portfolios and A-Score Portfolios. Our results in the *equal weight scenario* prove that the A-Score Portfolios outperform the corresponding F-Score Portfolios in most of the observed years. The portfolios, which are formed and hold in the outburst of the financial crisis, represent an exception. They deliver results in favor of the F-Score Portfolios. The aggregated overall performance per type of portfolio does not allow for conclusion in favor of the F-Score or the A-Score method for portfolio construction. Similarly, the *capitalization weight scenario* suggests superior performance of the A-Score Portfolios over the F-Score Portfolios based on a yearly comparison. The period in the outburst of the financial crisis favors repeatedly the F-Score Portfolios. The performance on aggregated level per type of portfolio eliminates the possibility of concluding superiority of one of the two approaches for portfolio formation. Hence, the results, which are based on equal weight portfolios and on capitalization weight portfolios, lead to identical conclusions.

This master thesis provides a different approach for portfolio formation as a central point. The investment strategy behind the *A-Score Approach* suggests selecting the top 20 % companies with the highest Book-to-Market Ratios in a sample. It requires predicting the returns of those companies based on the book-to-market ratio, net income before extraordinary items, accruals, historical change in long-term debt, book value, capex, historical change in short-term debt, change in asset turnover ratio and selecting the 15 companies with the highest predicted returns. The number of selected companies should be adapted based on the concrete sample size with the aim of allowing for sufficient number of companies, while simultaneously achieving diversification effects. The final set of companies is used as a base to form a portfolio. The A-Score Method is tested on an index based sample, which concentrates on the

European market. In terms of future findings, further interesting conclusions might be derived in the process of testing this approach on a broader sample of companies or on other regions. In addition, valuable results might be extracted by selecting some of the other 3 regression models, which are mentioned in this master thesis.

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Appendix A: Abstract

This master thesis examines the real determinants of value investment returns on a financial statement and a portfolio analysis level. Two types of portfolio construction strategies are applied to a sample of high Book-to-Market STOXX Europe 600 companies in the period 2004-2015. Hence, we construct 11 equally weighted F-Score Portfolios, 11 equally weighted A-Score Portfolios, 11 capitalization-weighted F-Score Portfolios and 11 capitalization-weighted A-Score Portfolios in the period 2005-2015. Each portfolio suggests one year holding period and corresponds to a specific year in the stated range of years. The F-Score Portfolios are based on Piotroski's (2000) F-Score approach for investment strategies. The A-Score Portfolios are based on an A-Score approach for portfolio construction, which we develop in this research. They are built upon fundamental variables, which exhibit significance in explaining the stocks' returns in our sample. In a complex regression modeling process, which includes VIF Tests, Forward Selection and Backward Elimination methods, we select these variables to be the book-to-market ratio, net income before extraordinary items, accruals, historical change in long-term debt, book value, capex, historical change in short-term debt and change in asset turnover ratio. We consider different regression models with control for company, time or industry fixed effects. As a final choice we use the company fixed effects regression model to predict the returns of the selected companies. The main goal is to compare the performance of the F-Score Portfolios to the A-Score Portfolios by selecting 15 companies with the highest F-Score signals and 15 companies with the highest predicted returns. The comparison process is based on yearly and on overall performance of the different types of portfolios. We calculate portfolio return and standard deviation metrics on the grounds of which we conclude that the A-Score Portfolios outperform the F-Score Portfolios in the majority of years. The portfolios, which are formed and hold in the outburst of the financial crisis, present results in favor of the F-Score approach. The aggregated overall performance per type of portfolio does not allow for conclusion in favor of the F-Score or the A-Score method for portfolio construction. The results, which are based on equal weight portfolios and on capitalization weight portfolios, control for weight based differences. They lead to identical conclusions. An investor, who is willing to implement the investment strategy behind the A-Score Approach, should select the top 20 % companies with the highest Book-to-Market Ratios in a sample. The next steps suggest predicting the returns of those companies based on the book-to-market ratio, net income before extraordinary items, accruals, historical change in long-term debt, book value, capex, historical change in short-term debt, change in asset

turnover ratio and selecting the 15 companies with the highest predicted returns. The number of selected companies should be adapted based on the concrete sample size with the aim of allowing for sufficient number of companies, while simultaneously achieving diversification effects. The final set of companies with the highest predicted returns is used as a base to form a portfolio.

Appendix B: Abstract (German/Deutsch)

Diese Masterarbeit untersucht die realen Determinanten der Value-Investment-Renditen auf Bilanz- und Portfolio-Analyse-Ebene. Zwei Typen von Portfolio-Konstruktionsstrategien werden auf eine Stichprobe von STOXX Europe 600-Unternehmen im Zeitraum zwischen 2004 und 2015 angewendet. Daher konstruieren wir 11 gleichgewichtete F-Score Portfolios, 11 gleichgewichtete A-Score Portfolios, 11 kapitalisierungsgewichtete F -Score Portfolios und 11 kapitalisierungsgewichtete A-Score Portfolios im Zeitraum zwischen 2005 und 2015. Jedes Portfolio schlägt eine Kauf- und Haltedauer von einem Jahr vor und entspricht einem bestimmten Jahr im angegebenen Zeitraum. Die F-Score Portfolios basieren auf F-Score-Ansatz vom Piotroski (2000) für Anlagestrategien. Die A-Score Portfolios basieren auf einem A-Score Ansatz für den Portfoliokonstruktion, den wir in dieser Forschung entwickeln. Sie basieren auf fundamentalen Variablen, die die Aktienrenditen in unserer Stichprobe mit statistischer Signifikanz erklären. In einem komplexen Regressionsmodellierungsprozess, der die Methoden VIF Tests, Forward Selection und Backward Elimination beinhaltet, wählen wir die Variablen Buch-Kurswert-Verhältnis, das Ergebnis der gewöhnlichen Geschäftstätigkeit, die Rechnungsabgrenzung, die historische Veränderung der langfristigen Schulden, den Buchwert, die Investitionsausgaben, die historische Veränderung der kurzfristigen Schulden und die historische Veränderung der Kapitalumschlagsquote aus. Wir betrachten verschiedene Regressionsmodelle mit Kontrolle für Unternehmens-, Zeit- oder Industrie-Fixeffekte. Als endgültige Wahl verwenden wir das Regressionsmodell mit Kontrolle für Unternehmens-Fixeffekte, um die Renditen der ausgewählten Unternehmen vorherzusagen. Das Hauptziel ist, die Wertentwicklung der F-Score Portfolios und der A-Score Portfolios durch Auswahl von 15 Unternehmen mit den höchsten F-Score-Signalen und 15 Unternehmen mit den höchsten prognostizierten Renditen zu vergleichen. Der Vergleichsprozess basiert auf der Jahres- und Gesamt-Leistung der verschiedenen Portfolios. Wir berechnen die Portfoliorenditen und die Standardabweichungswerte. Aufgrund dieser Werte schließen wir, dass die A-Score Portfolios die F-Score-Portfolios in den meisten Jahren übertreffen. Die Portfolios, die im Ausbruch der Finanzkrise gebildet und gehalten werden, zeigen Ergebnisse zugunsten des F-Score-Ansatzes. Die aggregierte Gesamtleistung je Portfoliostyp lässt keine Schlussfolgerung für den F-Score oder die A-Score Methode in Bezug auf Portfoliokonstruktion zu. Die Ergebnisse, die auf gleichgewichtete oder kapitalisierungsgewichtete Portfolios beruhen, schätzen eventuelle gewichtsbezogene Differenzen. Im Endeffekt, führen sie zu identischen Schlussfolgerungen. Ein Investor, der bereit ist, die Anlagestrategie hinter dem A-Score-Ansatz umzusetzen, soll

die Top 20% der Unternehmen mit den höchsten Buch-Kurswert-Verhältnissen in einer Stichprobe auswählen. Die nächsten Schritte deuten darauf hin, dass die Renditen dieser Unternehmen auf der Grundlage des Buch-Kurswert-Verhältnises, des Ergebnises der gewöhnlichen Geschäftstätigkeit, der Rechnungsabgrenzung, der historischen Veränderung der langfristigen Schulden, des Buchwertes, der Investitionsausgaben, der historischen Veränderung der kurzfristigen Schulden, der historischen Veränderung der Kapitalumschlagsquote prognostiziert werden und die 15 Unternehmen mit den höchsten prognostizierten Renditen ausgewählt werden. Die Anzahl der ausgewählten Unternehmen sollte auf der Grundlage der Stichprobengröße angepasst werden, um eine ausreichende Anzahl von Unternehmen zu ermöglichen und gleichzeitig Diversifikationseffekte zu erzielen. Die endgültige Stichprobe von Unternehmen mit den höchsten prognostizierten Renditen wird als Basis für die Bildung eines Portfolios verwendet.

Appendix C: List of Variables and Variables' Sources

Variable	Description	Source and Symbol
ACCRUALm	Net Income before extraordinary Items / Total Assets – Cash Flow from Operations / Total Assets (See NIL, CFO, TA, ROAm and CFOm)	
a_score_portf_mean	Mean Return for the Equally Weighted A-Score Portfolio per year = the sum of market adjusted returns for the 15 companies per A-Score Portfolio per year / 15 (See m_adj_return)	
a_score_portf_std	Standard Deviation of the mean return for the Equally Weighted A-Score Portfolio per year = (market adjusted return per company and per year – mean return for the equally weighted A-Score Portfolio per year) / 15 (See a_score_portf_mean)	
BM	**Book-to-Market Ratio** = 1/Market-to-Book Ratio (See MB)	
BS_CASH_NEAR_CASH_ITEM	**Cash & Cash Equivalents** Also available as Historical field INDUSTRIALS Cash & Near Cash Items: Cash in vaults and deposits in banks. Includes ST investments with maturities of less than 90 days. May include marketable securities and short-term investments with maturities of more than 90 days if not disclosed separately. Excludes restricted cash (Restricted cash is included in Other Current Assets). China: May include restricted cash if not disclosed separately. Greece: Does not include demand and time deposits. Since they are interest-bearing, they are classified as short-term investments. Japan: May include restricted cash. Korea: May include restricted cash if not disclosed separately. Mexico: Includes cash and marketable securities. Turkey:	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_CASH_NEAR_CASH_ITEM

	May include restricted cash. Post-dated checks are included in Accounts Receivable. BANKS Cash & Near Cash: Includes cash in vaults and non-interest earning deposits in banks. Includes receivables from the central bank and postal accounts. Includes cash items in the process of collection and unposted debits. Interest bearing deposits in other banks are included in interbank assets. Includes statutory deposits with the central bank. Japan: Excludes collateral. Semi-annual and consolidated reports include deposits to central bank and other institutions. Netherlands: Includes cash, checks and short-term investments. South Korea: Includes foreign exchange currency. Includes restricted cash. FINANCIALS Cash & Near Cash Items: Cash in vaults and deposits in banks. Includes short-term investments with maturities less than 90 days. Excludes restricted cash. Korea: May include restricted cash. INSURANCES Cash & Near Cash Items: Excludes restricted cash which is included in other assets if separable. Cannot be negative. If negative Cash is disclosed, the amount is subtracted from other current assets. Australia: Includes deposits at call and bank accepted bills of exchange. Korea: May include restricted cash. UTILITIES Cash & Equivalents: Cash in vaults and deposits in banks. Includes short-term investments with maturities less than 90 days.	

	Excludes restricted cash (it is included in restricted bond proceeds). REITS Cash & Near Cash Items: Cash, cash equivalents and marketable securities with maturities of 90 days or less. Excludes restricted/escrowed cash that is included in restricted assets. Japan: May include marketable securities and short term investments with maturities more than ninety days to one years if not disclosed separately. MUNICIPAL G.O. Cash in vaults and deposits in banks. Includes short term investments with maturities of less than 90 days. Excludes restricted cash.	
BS_LT_BORROW	**Long-term Debt** Also available as Historical field All interest-bearing financial obligations that are not due within a year. Includes convertible, redeemable, retractable debentures, bonds, loans, mortgage debts, sinking funds, and long-term bank overdrafts. Excludes short-term portion of long term debt, pension obligations, deferred tax liabilities and preferred equity. Includes subordinated capital notes. Includes long term hire purchase and finance lease obligations. Includes long term bills of exchange and banker's acceptances. May include shares issued by subsidiaries if the group has an obligation to transfer economic benefits in connection with these shares. Includes mandatory redeemable preferred and trust preferred securities in accordance with FASB 150 effective June 2003. Includes other debt which is interest bearing. Net with unamortized premium or discount on debt. May include fair value adjustments of embedded derivatives. For Real Estate Investment Trusts (REITs), this field is used either for secured debt or long-term borrowing. Secured debt refers to mortgage and other secured debt collateralized by property or assets of the company. Includes all secured borrowings regardless of length of term. Available for all formats.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_LT_BORROW
BS_SH_OUT	**Shares Outstanding** Also available as Historical field	BLOOMBERG PROFESSIONAL®

	All the shares of a corporation that have been authorized, issued, purchased, and held by investors as of period end date. Net of treasury shares which are shares held by the corporation itself if the number is disclosed. Excludes shares to be issued. For a company with multiple shares, all classes of shares both listed and unlisted with common stock characteristic are converted to common stock equivalents of Fundamental Ticker (DX895, EQY_FUND_TICKER). Please refer to Multiple Share Information (DY667, MULTIPLE_SHARE_INFO) for current multiple share information. China & Taiwan: Historical shares outstanding do not reflect any increase in shares as a result of rights issues. Philippines: Includes number of subscribed shares.	Bloomberg Symbol: BS_SH_OUT
BS_ST_BORROW	**Debt in Current Liabilities (Short-term Debt)** Also available as Historical field Includes bank overdrafts, short-term debts and borrowings, repurchase agreements (repos) and reverse repos, short-term portion of long-term borrowings, current obligations under capital (finance)leases, current portion of hire purchase creditors, trust receipts, bills payable, bills of exchange, banker's acceptances, interest bearing loans, and short term mandatory redeemable preferred stock. Net with unamortized premium or discount on debt and may include fair value adjustments of embedded derivatives. For banks and financials, includes call money, bills discounted, federal funds purchased, and due to other banks or financial institutions. For Real Estate Investment Trusts (REITs), includes all unsecured borrowings regardless of length of term. This field is used either for unsecured debt or short term borrowing. Unsecured debt refers to mortgage and other secured debt which is not collateralized by property or assets of the company. Available for all formats.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_ST_BORROW
BV	**Book Value of Total Common Equity** Also available as Historical field The amount that all common shareholders have invested in a company. Calculated as: Share Capital & APIC + Retained Earnings and Other Equity	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: TOT_COMMON_EQY

	Where: Share Capital & APIC is BS064, BS_SH_CAP_AND_APIC Retained Earnings and Other Equity is BS065, BS_RETAIN_EARN Figure is reported in millions. The Scaling Format Override (DY339, SCALING_FORMAT) can be used to change the display units for the field.	
BV_TA	Book Value of Total Common Equity / Total Assets (See BV and TA)	
CA	**Current Assets** Also available as Historical field INDUSTRIALS Current Assets Reported: The total of all Current Assets as reported. This is the summation of Cash & Cash Equivalents, Marketable Securities & Other Short-term Investments, Accounts & Notes Receivable, Inventories, and Other Current Assets. Includes accrued income. UTILITIES Current Assets Reported: Includes cash, marketable securities, restricted bond proceeds, net receivables and unbilled revenue, fossil fuel inventory, materials + supplies and gas in storage, prepayments and other current assets. MUNICIPAL G.O. The total of all current assets as reported excluding restricted assets. Includes cash & cash equivalents, short term investments, accounts receivable, notes receivable, government receivables, inventories, and other current assets.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_CUR_ASSET_REPORT
CA_TA	Current Assets / Total Assets (See CA and TA)	
CL_TA	Current Liabilities / Total Assets (See CL and TA)	
CAPEX	**Capex** Also available as Historical field Amount the company spent on purchases of tangible fixed assets. May include intangible assets when not disclosed separately. The value is always negative. Figure is reported in millions. The Scaling Format Override (DY339, SCALING_FORMAT) can be used to change the display units for the field. INDUSTRIALS, BANKS, FINANCIALS, INSURANCE, UTILITIES, & MUNICIPAL REVENUE	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: CAPITAL_EXPEND

	Returns Capital Expenditure CF017, CF_CAP_EXPEND_PRPTY_ADD for companies reported indirect cash flow statement method and CF052, CF_CAP_EXPEND_INC_FIX_ASSET for companies reported source and uses cash flow statement. REITS Calculated as: Capital Expenditure + Property Improvements Where: Capital Expenditure is CF017, CF_CAP_EXPEND_PRPTY_ADD for companies reported indirect cash flow statement method and CF052, CF_CAP_EXPEND_INC_FIX_ASSET for companies reported source and uses cash flow statement. Property Improvements is CF021, CF_PRPTY_IMPRV ARD_CAPITAL_EXPEND_FINL_INVEST Also available as Historical field This is the Capital Expenditures and Financial Investing figure as reported by the company. The account title may be standardized and slightly different from the original account title in the company's financial statement.	
CAPEX_TA	Capex / Total Assets (See CAPEX and TA)	
cap_weight_a_score	Capitalization Weight for a company in an A-Score Portfolio per year = Historical Market Capitalization per company and year / Total Historical Market Capitalization of an A-Score Portfolio (See HMCAP and MCP_a_score_p)	
cap_weighted_a_score_comp_return	Capitalization-weighted companies' returns in an A-Score Portfolio per year = capitalization weight of a company in the A-Score Portfolio per year * market adjusted return of the same company per year (See HMCAP, MCP_a_score_p, cap_weight_a_score, and m_adj_return)	
cap_weighted_a_score_portf_ret	Weighted Return for the whole capitalization-weighted A-Score Portfolio per year = Sum of the capitalization-weighted companies' returns in an A-Score Portfolio per year (See HMCAP, MCP_a_score_p, cap_weight_a_score, m_adj_return, and cap_weighted_a_score_comp_return)	
cap_weighted_a_score_portf_std	Weighted Standard Deviation for the whole capitalization-weighted A-Score Portfolio per year = sqrt (variance for the whole capitalization-weighted A-Score Portfolio per year) (See HMCAP, MCP_a_score_p, cap_weight_a_score, cap_weighted_a_score_comp_return,	

	cap_weight_a_score_portf_ret, m_adj_return, dev_cap_weight_mean_a_score, sq_dev_cap_weight_mean_a_score, w_sq_dev_cap_weight_mean_a_score, and cap_weighed_a_score_portf_var)	
cap_weighted_a_score_ portf_var	Variance for the whole capitalization-weighted A-Score Portfolio per year = sum of the capitalization-weighted square deviation of the market adjusted return of company from the capitalization-weighted return for a whole A-Score Portfolio per year (See HMCAP, MCP_a_score_p, cap_weight_a_score, cap_weighted_a_score_comp_return, cap_weight_a_score_portf_ret, m_adj_return, dev_cap_weight_mean_a_score, sq_dev_cap_weight_mean_a_score, and w_sq_dev_cap_weight_mean_a_score)	
cap_weight_fscore	Capitalization Weight for a company in a F-Score Portfolio per year = Historical Market Capitalization per company and year / Total Historical Market Capitalization of a F-Score Portfolio (See HMCAP and MCP_f_sc_p)	
cap_weighted_f_score_ comp_return	Capitalization-weighted companies' returns in a F-Score Portfolio per year = capitalization weight of a company in the F-Score Portfolio per year * market adjusted return of the same company per year (See HMCAP, MCP_f_sc_p, cap_weight_fscore, and m_adj_return)	
cap_weighted_f_score_ portf_ret	Weighted Return for the whole capitalization-weighted F-Score Portfolio per year = Sum of the capitalization weighted companies' returns in a F-Score Portfolio per year (See HMCAP, MCP_f_sc_p, cap_weight_fscore, m_adj_return, and cap_weighted_f_score_comp_return)	
cap_weighted_f_score_ portf_std	Weighted Standard Deviation for the whole capitalization weighted F-Score Portfolio per year = sqrt (variance for the whole capitalization-weighted F-Score Portfolio per year) (See HMCAP, MCP_f_sc_p, cap_weight_fscore, cap_weighted_f_score_comp_return, cap_weight_f_score_portf_ret, m_adj_return, dev_cap_weight_mean_f_score, sq_dev_cap_weight_mean_f_score, w_sq_dev_cap_weight_mean_f_score, and cap_weighed_f_score_portf_var)	
cap_weighted_f_score_ portf_var	Variance for the whole capitalization-weighted F-Score Portfolio per year = sum of the capitalization-weighted square deviation of the market adjusted return of company from the capitalization-weighted return for a whole f-Score Portfolio per year (See HMCAP, MCP_f_sc_p, cap_weight_f_score, cap_weighted_f_score_comp_return, cap_weight_f_score_portf_ret, m_adj_return, dev_cap_weight_mean_f_score,	

	sq_dev_cap_weight_mean_f_score, and w_sq_dev_cap_weight_mean_f_score)	
CASH_TA	Cash & Cash Equivalents / Total Assets (See BS_CASH_NEAR_CASH_ITEM, and TA)	
CF_DEPR_AMORT	**Depreciation and Amortization** Also available as Historical field INDUSTRIALS Depreciation & Amortization: Includes all depreciation and amortization expenses included as a part of Cost of Goods Sold and Selling, General and Administrative Expenses (Operating Expenses). May be negative if company amortizes negative goodwill. Includes amortization of deferred stock compensation. Excludes amortization of debt discount. Media Companies: Excludes amortization of Programming Rights/Sublicensing Rights/Content Library. Finland: Includes depreciation expenses in excess of that allowed by the tax code. Japan: For consolidated statements, includes amortization of long-term prepaid expenses and amortization of deferred assets. Malaysia: May include write-off or write-down of intangible assets when disclosed together with regular amortization. BANKS Depreciation & Amortization: Includes depreciation and amortization expenses. May be negative if company amortizes negative goodwill. Includes amortization of deferred stock compensation. Excludes amortization of debt discount. Japan: Includes the amount of loans directly written off net of recoveries. FINANCIALS Depreciation & Amortization: Includes depreciation and amortization expenses. May be negative if company amortizes negative goodwill.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: CF_DEPR_AMORT

	Includes amortization of deferred stock compensation. For investment management companies only, includes amortization of deferred sales commissions. Excludes amortization of debt discount. INSURANCES Depreciation and Amortization Includes depreciation and amortization of property and equipment, amortization of goodwill and change in the provision for loan losses. May be negative if company amortizes negative goodwill. Includes amortization of deferred stock compensation and amortization of deferred policy acquisition costs. Excludes amortization of debt discount. UTILITIES Depreciation & Amortization: Includes depreciation and amortization expenses included as a part of Cost of Goods Sold and Selling, General and Administrative Expenses (Operating Expenses). May be negative if company amortizes negative goodwill. Includes amortization of deferred stock compensation. Excludes amortization of debt discount. REITS Depreciation & Amortization: Depreciation and amortization expenses taken on tangible and intangible assets.	
CFO	**Cash Flow from Operations** Also available as Historical field Total amount of cash a company generates from its operation. The effect of Changes in Non-cash Working Capital on Cash from Operations can be either positive or negative. Decrease in current assets or increase in current liabilities, increases Cash from Operations; while an increase in current assets or decrease in current liabilities, decreases Cash from Operations. Generally calculated as: Net Income + Depreciation & Amortization + Other Noncash Adjustments + Changes in Non-cash Working Capital Where: Net Income is CF010, CF_NET_INC Depreciation & Amortization is CF011, CF_DEPR_AMORT Other Non-cash Adjustments is CF012, CF_OTHER_NON_CASH_ADJUST Changes in Non-cash Working Capital is CF013, CF_CHNG_NON_CASH_WORK_CAP	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: CF_CASH_FROM_OPER

	INDUSTRIALS Cash from Operations: Total cash from operating activities. Sum of Net Income, Depreciation and Amortization, Other Non-Cash Adjustments, and Changes in Non-cash Working Capital. BANKS Cash from Operations: Sum of Net Income, Depreciation & Amortization and Provision for Loan Losses, Other non-cash adjustments, and Changes in non-cash working capital Japan: Due to reconstruction of the Japanese Cash Flow Statement, there are differences between Cash Flows from Operating, Investing, and Financing Activities, and the reported data. FINANCIALS Cash from Operations: Sum of Net Income, Provision for doubtful debts, Depreciation and Amortization, Other non-cash Adjustments, and Changes in non-cash working capital. INSURANCES Cash from Operations: Sum of Net Income, Depreciation & Amortization, Other non-cash adjustments, and Changes in non-cash working capital. UTILITIES Cash from Operations: Sum of Net Income, Depreciation & Amortization, Other Non-Cash Adjustments, and Changes in Non-Cash Working Capital. REITS Cash from Operations: The sum of net income (loss), depreciation & amortization, provision for doubtful accounts, other non-cash items and changes in operating assets and liabilities.	
CFOm	Cash Flow from Operations / Total Assets (See CFO and TA)	
CH_CA_TA	Historical change in the firm's Current Assets / Total Assets between the current and prior year (See CA, TA and CA_TA)	

CH_CASH_TA	Historical change in the firm's Cash & Cash Equivalents / Total Assets between the current and prior year (See BS_CASH_NEAR_CASH_ITEM, TA, and CASH_TA)	
CH_CL_TA	Historical change in the firm's Current Liabilities / Total Assets between the current and prior year (See CL, TA and CL_TA)	
CH_DEBT_CL_TA	Historical change in the firm's Debt in Current Liabilities (Short-Term Debt) / Total Assets between the current and prior year (See BS_ST_BORROW, TA, and DEBT_CL_TA)	
CH_ITPM_TA	Historical change in the firm's Income Tax Payable / Total Assets between the current and prior year (See IncomeTaxesPayableDATASTR, ITPM, TA and ITPM_TA)	
CH_LEVERm	Historical change in the firm's Long-term Debt/Total Assets between the current and prior year (See BS_LT_BORROW, TA, and LT_DEBT_TO_TOT_ASSET)	
CH_LIQUIDm	Historical change in the firm's Current Ratio between the current and prior year (See CUR_RATIO)	
CH_MARGINm	Historical change in the firm's Gross Margin Ratio between the current and prior year (See TS, Costs_goods_sold, and GMR)	
CH_ROAm	Historical change in the firm's Net Income before Extraordinary Items / Total Assets between the current and prior year (See NIL, TA, and ROAm)	
CH_SH_OUTm	Historical change in the firm's Shares Outstanding between the current and prior year (See BS_SH_OUT)	
CH_TURNm	Historical change in the firm's Asset Turnover Ratio between the current and prior year (See TS, TA, and TURN)	
CL	**Current Liabilities** Also available as Historical field INDUSTRIALS Current Liabilities: The summation of Accounts Payable, Short-term Borrowings, and Other Short-term Liabilities. UTILITIES Current Liabilities: The sum of Short-term borrowings, Accounts Payable, Accruals, and Other Current Liabilities.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_CUR_LIAB

	MUNICIPAL G.O. The summation of accounts payable, current portion of debt, accruals and other current liabilities.	
Company	Company Name (STOXX Europe 600 Index's Components)	BLOOMBERG PROFESSIONAL®
Costs_goods_sold	Costs of Goods Sold / 1000 (this procedure converts the value from thousands to millions) (See Costs_goods_soldDATASTR)	
Costs_goods_soldDATASTR	**Costs of Goods Sold** Expense Data, Annual & Interim Item; Field 01051 Industrials, Other Financial Companies: For manufacturing companies, cost of goods sold represents specific or direct manufacturing cost of material and labor entering in the production of finished goods. Excise taxes and windfall profits taxes are not included. Most non-U.S. corporations do not disclose cost of goods sold. For merchandise companies, cost of goods sold represents the purchase price of items sold, as well as indirect overhead such as freight, inspecting, and warehouse costs. If a breakdown of total operating cost of non-manufacturing companies is not available, then it is treated as cost of goods sold. For Utilities and Service Organizations, if there is no clear breakdown between cost of goods sold and Selling, General and Administrative Expenses, the total amount is updated to Cost of Goods Sold and noted that Selling General and Administrative Expenses are included. Service Organizations may refer to this as Cost of Services. It includes but is not restricted to: Exploration expenses for extractive companies. Dry hole costs and impairment of unproved properties, when they cannot be included in depreciation. Employee benefits and other labor expenses such as salaries, pension expense, profit-sharing expense, insurance, etc. (If a company does not buy or make goods to sell, this expense is included in selling, general and administrative expense.) (field 01084) Engineering expense, if the company engages in engineering operations Cost of department lease income Cost of franchise sales Cost of rent & royalty income included in revenues For non-U.S. corporations, materials expense (field 18195), changes in inventory (field 18196), capitalized costs (field 18197) and that portion of salaries and benefits expense which are direct production costs It excludes: Depreciation and amortization of intangibles charged to cost of goods sold. (If this amount is not available,	Thomson Reuters Datastream Symbol: WC01051

	then the total amount of depreciation and amortization is deducted) Directors' fees and remuneration Idle plant expense Moving expense Purchase discounts Value-added taxes General and service taxes For restaurants and fast food companies, other operating expenses like franchise, direct personnel and restaurant operating costs Excise taxes Windfall profit taxes Figure is downloaded in thousands.	
CUR_RATIO	**Current Ratio** Also available as Historical field INDUSTRIALS, UTILITIES, & MUNICIPAL REVENUE Ratio to indicate the company's ability to pay back its short-term liabilities with its short-term assets. Unit: Actual. Calculated as: Current Assets / Current Liabilities Where: Current Assets is BS015, BS_CUR_ASSET_REPORT Current Liabilities is BS050, BS_CUR_LIAB Portfolio: Ratio of Current Assets (BS015, BS_CUR_ASSET_REPORT) to Current Liabilities (BS050, BS_CUR_LIAB). Derived from Current Ratio (RR053, CUR_RATIO). Totals are computed as sum of securities contribution. Contributions for each measure is computed as the number of shares in portfolio * security-level measure / outstanding shares (IS060).	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: CUR_RATIO
DA_TA	Depreciation and Amortization / Total Assets (See CF_DEPR_AMORT, and TA)	
DEBT_CL_TA	Debt in Current Liabilities (Short-term Debt) / Total Assets (See BS_ST_BORROW, and TA)	
dev_cap_weight_mean_a_score	Deviation of the market adjusted return per company included in an A-Score Portfolio per year from the capitalization-weighted return for the whole A-Score Portfolio per year = market adjusted return of a company per year - weighted return for the whole capitalization-weighted A-Score Portfolio per year (See HMCAP, MCP_a_score_p, cap_weight_a_score, cap_weight_a_score_comp_return, and cap_weight_a_score_portf_return)	

dev_cap_weight_mean_f_score	Deviation of the market adjusted return per company included in a F-Score Portfolio per year from the capitalization-weighted return for the whole F-Score Portfolio per year = market adjusted return of a company per year - weighted return for the whole capitalization-weighted F-Score Portfolio per year (See HM, MCP_f_sc_p, cap_weight_fscore, cap_weight_f_score_comp_return, and cap_weight_f_score_portf_return)	
di1	Dummy Variable for Industry = Automobiles & Parts (controls for industry fixed effects)	
di10	Dummy Variable for Industry = Personal & Household Goods (controls for industry fixed effects)	
di11	Dummy Variable for Industry = Real Estate (controls for industry fixed effects)	
di12	Dummy Variable for Industry = Retail (controls for industry fixed effects)	
di13	Dummy Variable for Industry = Technology (controls for industry fixed effects)	
di14	Dummy Variable for Industry = Telecommunications (controls for industry fixed effects)	
di15	Dummy Variable for Industry = Travel & Leisure (controls for industry fixed effects)	
di16	Dummy Variable for Industry = Utilities (controls for industry fixed effects)	
di2	Dummy Variable for Industry = Basic Resources (controls for fixed income effects)	
di3	Dummy Variable for Industry = Chemicals (controls for industry fixed effects)	
di4	Dummy Variable for Industry = Construction & Materials (controls for industry fixed effects)	
di5	Dummy Variable for Industry = Food & Beverage (controls for industry fixed effects)	
di6	Dummy Variable for Industry = Health Care (controls for industry fixed effects)	
di7	Dummy Variable for Industry = Industrial Goods & Services (controls for industry fixed effects)	
di8	Dummy Variable for Industry = Media (controls for industry fixed effects)	
di9	Dummy Variable for Industry = Oil & Gas (controls for industry fixed effects)	
DPS	**Dividends per Share** Also available as Historical field Returns the same value as IS151, IS_DIV_PER_SHR, in actual. For companies in North America and Japan, this field includes the sum of regular cash and special cash dividends per share. For all other regions, this field is based only on the regular cash dividends per share and excludes memorial and special cash dividends. This field acknowledges periodic dividends for US companies on the ex-date. However outside of the	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: EQY_DPS

	US, this is the dividend attributable to the period, which may include either proposed or paid dividends. This field excludes return of capital, except for Switzerland and Taiwan. Returns the latest reported annual dividend per share. Override fields Equity Fundamental Year (DS324, EQY_FUND_YEAR) and Fundamental Period (DS323, FUND_PER) can be used to retrieve interim data. For companies where the dividend frequency and the reporting frequency don't match, this field may not be available for interim periods. For dividend history including interim dividends, also see Dividend Per Share 12 Month Net (DV022, EQY_DVD_SH_12M_NET) and Dividend Per Share 12 Month Gross (DV023, DVD_SH_12M). This field is populated with dividend per share for Fundamental Ticker (DX895, EQY_FUND_TICKER) for multiple shares companies with different dividends from each class. Please refer to Dividend Per Share Ind Annual - Gross (DV039, EQY_IND_DPS_ANNUAL_GROSS) to view the dividend per share for other classes of multiple-share companies.	
EBIT	**EBIT** Also available as Historical field Earnings before interest expenses and income taxes. Figure is reported in million. The Scaling Format Override (DY339, SCALING_FORMAT) can be used to change the display units for the field. INDUSTRIALS, UTILITIES, REITS, & MUNICIPAL REVENUE This field is synonymous with Operating Income (Losses) (IS033, IS_OPER_INC) FINANCIALS Calculated as: Operating Income + Interest Expense Where: Operating Income (Losses) is IS033, IS_OPER_INC Interest Expense is IS022, IS_INT_EXPENSES REITS Calculated as: Operating Income + Interest Expense Where: Operating Income (Losses) is IS033, IS_OPER_INC Interest Expense is IS034, IS_INTEREST_EXPENSE	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: EBIT
EBITDA_Adj	EBITDA / 1000 (this procedure converts the value from thousands to millions)	

	(See EBITDA_DATASTR)	
EBITDA_DATASTR	**EBITDA** Supplementary (Income) Data, Annual & Interim Item; Field 18198 All Industries: EARNINGS BEFORE INTEREST, TAXES, DEPRECIATION & AMORTIZATION (EBITDA) represent the earnings of a company before interest expense, income taxes and depreciation. It is calculated by taking the pre-tax income and adding back interest expense on debt and depreciation, depletion and amortization and subtracting interest capitalized. Figure is downloaded in thousands.	Thomson Reuters Datastream Symbol: WC18198
EBITDA_HEV	EBITDA / Historical Market Capitalization (See EBITDA_Adj, EBITDA_DATASTR, and HEV)	
EQ_OFFER	New Issued Shares=1 (0) if the historical change in firm's Shares Outstanding between current and prior year > (<) 0 (See BS_SH_OUT and CH_SH_OUT)	
EY	**Earnings Yield** = EBIT / Enterprise Value (See EBIT and HEV)	
F_ACCRUAL	**F-Score Signal for Accrual** F_ACCRUAL = 1 (0) if Cash Flow from Operations / Total Assets > (otherwise) Net Income before extraordinary items / Total Assets (See CFO, NIL, TA, CFOm, and ROAm)	
F_CFO	**F-Score Signal for Cash Flow from Operations** F_CFO = 1 (0) if Cash Flow from Operations / Total Assets > (otherwise) 0 (See CFO, TA and CFOm)	
F_CH_LEVER	**F-Score Signal for Change in Long-term Debt** F_CH_LEVER = 1 (0) if the historical change in firm's Long-term Debt / Total Assets between current and prior year < (>) 0 (See BS_LT_BORROW, TA, LT_DEBT_TO_TO_ASSET, and CH_LEVERm)	
F_CH_LIQUID	**F-Score Signal for Change in Current Ratio** F_CH_LIQUID =1 (0) if the historical change in firm's Current Ratio between current and prior year > (<) 0 (See CUR_RATIO and CH_LIQUIDm)	
F_CH_MARGIN	**F-Score Signal for Change in Gross Margin Ratio** F_CH_MARGIN = 1 (0) if the historical change in firm's Gross Margin Ratio between current and prior year > (<) 0	

	(See TS, Costs_goods_sold, GMR, and CH_MARGINm)	
F_CH_ROA	**F-Score Signal for Change in Net Income before Extraordinary Items** F_CH_ROA = 1 (0) if the historical change in firm's Net Income before Extraordinary Item / Total Assets between current and prior year > (otherwise) 0 (See NIL, TA, ROAm, and CH_ROAm)	
F_CH_TURN	**F-Score Signal for Change in Asset Turnover Ratio** F_CH_TURN = 1 (0) if the historical change in firm's Asset Turnover Ratio between current and prior year > (<) 0 (See TS, TA, TURN, and CH_TURNm)	
F_EQ_OFFER	**F-Score Signal for Change in New Issued Shares** F_EQ_OFFER = 1 (0) if the historical change in firm's Shares Outstanding between current and prior year < (otherwise) 0 (See BS_SH_OUT, CH_SH_OUT, and EQ_OFFER)	
F_ROA	**F-Score Signal for Net Income before Extraordinary Items** F_ROA = 1 (0) if Net Income before Extraordinary Items / Total Assets > (<) 0 (See NIL, TA, and ROAm)	
F_SCORE	**F-Score** = F-Score Signal for Net Income before Extraordinary Items + F-Score Signal for Cash Flow from Operations + F-Score Signal for Change in Net Income before Extraordinary Items + F-Score Signal for Accrual + F-Score Signal for Change in Long-term Debt + F-Score Signal for Change in Current Ratio + F-Score Signal for Change in New Issued Shares + F-Score Signal for Change in Gross Margin Ratio + F-Score Signal for Change in Asset Turnover Ratio (See F_ROA, F_CFO, F_CH_ROA, F_ACCRUAL, F_CH_LEVER, F_CH_LIQUID, F_EQ_OFFER, F_CH_MARGIN, F_CH_TURN)	
f_score_portf_mean	Mean Return for the Equally Weighted F-Score Portfolio per year = the sum of market adjusted returns for the 15 companies per F-Score Portfolio per year / 15 (See m_adj_return)	
f_score_portf_std	Standard Deviation of the mean return for the Equally Weighted F-Scpre Portfolio per year = (market adjusted return per company and per year – mean return for the equally weighted F-Score Portfolio per year) / 15 (See f_score_portf_mean)	
gg	Capitalization-weighted Market Return (based on STOXX Europe 600) = sum of the weighted market	

	returns per company and year of the STOXX Europe 600 Index (See HMCAP, MCPindex, weight_market and w_return_index)	
GMR	**Gross Margin Ratio** = (Total Sales – Costs of Goods Sold) / Total Sales (See TS and Costs_goods_sold)	
GROSS_PROFIT_ASSETS	**Gross Profit to Total Assets Ratio** = (Total Sales – Costs of Goods Sold) / Total Assets (See TS, Costs_goods_sold anf TA)	
HEV	**Historical Enterprise Value** Also available as Historical field INDUSTRIALS, FINANCIALS, INSURANCE, UTILITIES, & REITS Measure of a company's theoretical takeover price. Calculated as: Market Capitalization + EV Components Where: Historical Market Capitalization is RR250, HISTORICAL_MARKET_CAP EV Components is RR968, CUR_EV_COMPONENT Market Capitalization calculation excludes Number of Treasury Shares (BS091, BS_NUM_OF_TSY_SH). For limited partnerships, enterprise value is the value of the limited partner, and does not include any value assigned to the general partner. The field returns the value in the fundamental Currency Override (DS215, EQY_FUND_CRNCY) For current enterprise value, in the fundamental currency, use Current Enterprise Value (RR905, CURR_ENTP_VAL). For current enterprise value in another currency, use Currency Adjusted Current Enterprise Value (RR937, CRNCY_ADJ_CURR_EV). Figure is reported in million. The Scaling Format Override (DY339, SCALING_FORMAT) can be used to change the display units for the field.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: ENTERPRISE_VALUE
HMCAP	**Historical Market Capitalization** (per company) Also available as Historical field Total market value of all of a company's outstanding shares at period-end date stated in the company's fundamental currency (DS215, EQY_FUND_CRNCY). The period-end date is the	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: HISTORICAL_MARKET_CAP

	most recent for which full fundamental data has been collected. Calculated as: Shares Outstanding * Last Closing Price Where: Shares Outstanding is BS081, BS_SH_OUT Last Closing Price is PR005, PX_LAST Shares Outstanding excludes treasury shares (BS091, BS_NUM_OF_TSY_SH) For multiple share companies, market cap is the sum of market capitalization of all classes of common stock at period end date. For current market cap, please refer to RR902, CUR_MKT_CAP Figure is reported in million. The Scaling Format Override (DY339, SCALING_FORMAT) can be used to change the display units for the field.	
IncomeTaxesPayableDATASTR	**Income Taxes Payable** Liability Data, Annual & Interim Item; Field 03063 Industrials, Insurance: INCOME TAXES PAYABLE represents an accrued tax liability which is due within the normal operating cycle of the company. Data for this field is generally not available prior to 1989. It excludes: Taxes other than income Ad Valorem taxes Value Added taxes General and Services taxes Excise taxes Windfall profit taxes Figure downloaded in thousands.	Thomson Reuters Datastream Symbol: WC03063
Industry	STOXX Europe 600 Index's 19 Supersectors according to the ICB industry classification	STOXX INDEX METHODOLOGY GUIDE
ISIN	International Securities Identification Number	BLOOMBERG PROFESSIONAL®
ITPM	Income Tax Payable / 1000 (this procedure converts the value from thousands to millions) (See IncomeTaxesPayableDATASTR)	
ITPM_TA	Income Tax Payable / Total Assets (See IncomeTaxesPayableDATASTR, ITPM, TA, and ITPM_TA)	
LCGS	Log (Costs of Goods Sold) (See Costs_goods_sold_soldDATASTR, and Costs_goods_sold)	

LHMCAP	Log (Historical Market Capitalization) (See HMCAP)	
LT_DEBT_TO_TOT_ ASSET	Long-term Debt / Total Assets (See BS_LT_BORROW, and TA)	
LTS	Log (Total Sales) (See TS)	
m_adj_return	**Market Adjusted Return** = one year Buy and Hold Return per company and year – Capitalization-weighted Market Return per year (See HMCAP, MCPindex, weight_market, w_return_index, Return, and gg)	
MB	**Market-to-Book Ratio** Available as Historical field INDUSTRIALS, BANKS, FINANCIALS, INSURANCE, UTILITIES, & REITS Measure of the relative value of a company compared to its market value. Unit: Actual. Calculated as: Market Capitalization / Book Value Where: Market Capitalization is RR902 (CUR_MKT_CAP) for current or daily ratio Market Capitalization is RR250 (HISTORICAL_MARKET_CAP) for historical fundamental period ratio Book Value is RR010, TOT_COMMON_EQY	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: MARKET_CAPITALIZ ATION_TO_BV
MCP_a_score_p	Total Historical Market Capitalization for A-Score Portfolio per year (See HMCAP)	
MCP_f_sc_p	Total Historical Market Capitalization for F-Score Portfolio per year (See HMCAP)	
MCPindex	Sum of the market capitalization of each company in the STOXX Europe 600 Index per year (See HMCAP)	
Midprice	**Midprice** = (Ask Price + Bid Price) / 2 (See PX_ASK and PX_BID)	
NAFA	**Net Assets from Acquisitions** Cash Flow Data, Annual & Interim Item; Field 04355 All Industries: NET ASSETS FROM ACQUISITIONS represent assets acquired through pooling of interests or mergers. It does not include capital expenditures of acquired companies. Data for this field is generally not available prior to 1989.	Thomson Reuters Datastream Symbol: WC04355

	It includes but is not restricted to: Net assets of acquired companies Additions to fixed assets from acquisitions Working capital of companies acquired (if shown as both a source and a use, both numbers are netted against each other) Excess of cost of acquired companies Discount on acquisitions Figure downloaded in thousands.	
NAFAM	Net Assets from Acquisitions / 1000 (this procedure converts the value from thousands to millions) See NAFA	
NAFAM_TA	Net Assets from Acquisitions / Total Assets (See NAFA, NAFAM, and TA)	
NIL	**Net Income (Loss) before Extraordinary Items** Also available as Historical field INDUSTRIALS Income (Loss) before Extraordinary Items: Net Income excluding the effects of discontinued operations, accounting standard changes, and natural disasters. This field displays income (loss) before XO items and minority interests. BANKS Income (Loss) before Extraordinary Items: Net Income excluding the effects of discontinued operations, accounting standard changes, and natural disasters. This field displays income (loss) before XO items and minority interests. FINANCIALS Income(Loss) before Extraordinary Items: Income (Loss) before Extraordinary Items excludes the effects of discontinued operations, accounting standard changes, and natural disasters. This field displays income (loss) before XO items and minority interests. Korea: May include effects of extraordinary items. INSURANCES Inc(Loss) bef Extraord Items: Income (Loss) before Extraordinary Items excludes the effects of discontinued operations, accounting standard changes, and natural disasters. This field displays income (loss) before XO items and minority interests. Korea: May include effects of extraordinary items. UTILITIES	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: IS_INC_BEF_XO_ITEM

	Net Income excluding the effects of discontinued operations, accounting standard changes, and natural disasters. This field displays income (loss) before XO items and minority interests. REITS Income (loss) before Extraordinary Items excludes the effects of discontinued operations, accounting standards changes, and natural disasters. This field displays income (loss) before XO items and minority interests.	
NWC	**Net Working Capital** = Current Assets – Current Liabilities (See CA and CL)	
NWC_LTD	Net Working Capital – Long-term Debt (See CA, CL, NWC, and BS_LT_BORROW)	
NWC_LTD_TA	(Net Working Capital – Long-term Debt) / Total Assets (See CA, CL, NWC, NWC_LTDA, and TA)	
pm_adj_return	Estimated return per company per year from the final regression in this research	
PPE	**Property, Plant and Equipment** Also available as Historical field INDUSTRIALS Net Fixed Assets (or Property, Plant and Equipment): Gross fixed Assets less amounts of Accumulated Depreciation. Those assets of a permanent nature required for the normal conduct of a business, and which will not normally be converted into cash during the ensuring fiscal period. May include investment properties if disclosed under net fixed assets by the company. May include intangible fixed assets such as easements and land rights. BANKS Net Fixed Assets: Net of accumulated depreciation. Operating fixed assets only. Includes assets held under operating leases when the bank is the lessor. Depreciation for the assets is included in other operating expenses. FINANCIALS Net Fixed Assets: Includes fixed assets net of accumulated depreciation. Includes assets acquired under operating leases. INSURANCE Net Fixed Assets: Net of accumulated depreciation. Operating fixed assets only. Includes equipment leased out under operating leases.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_NET_FIX_ASSET

	UTILITIES Net Fixed Assets: Includes utility and non-utility fixed assets net of accumulated depreciation. Includes operating fixed assets only. REITS Net Real Estate Properties: Real estate property, net of accumulated depreciation plus real estate held for resale.	
PX_ASK	**Ask Price** Also available as Historical field Lowest price a dealer will accept to sell a security. Fixed Income: This will return the last available ask price. Equities: If the market is closed, this will return the last ask from the last day the market was open. If the market is open, and there is not an ask in the market, this will return 'N.A.' Economic Statistics: Provides the current release of statistic.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: PX_ASK
PX_BID	**Bid Price** Also available as Historical field Highest price an investor will accept to pay for a security. Fixed Income: This will return the last available bid price. Loans: The price at which an investor offers to pay to purchase all or part of a loan. Equities: If the market is closed, this will return the last bid from the last day the market was open. If the market is open, and there is not a bid in the market, this will return 'N.A.'	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: PX_BID
qBM	Quintiles for the Book-to-Market Ratio Observations	
RD	**Research & Development** Supplementary (Expense) Data, Annual & Interim Item; Field 01201 Industrials: RESEARCH AND DEVELOPMENT EXPENSE represents all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities. These costs can be categorized as: 1. Basic research 2. Applied research	Thomson Reuters Datastream Symbol: WC01201

	3. Development costs of new products It includes but is not restricted to: Software Expense Design and Development Expense It excludes: Customer or government sponsored research amortization For oil, gas, coal, drilling and mining companies, purchase of mineral rights Engineering Expense Contributions by government, customers, partnerships or other corporations to the company's research and development expense Figure is downloaded in thousands.	
RDM	Research & Development / 1000 (this procedure converts the value from thousands to millions) (See RD)	
RDM_TA	Research & Development / Total Assets (See RD, RDM, and TA)	
Return	**one year Buy and Hold Return** = ((Midprice in current year + Dividends per Share in current year) / Midprice in prior year) – 1 (See PX_ASK, PX_BID, Midprice, and DPS)	
ROAm	Net Income before Extraordinary Items / Total Assets (See NIL and TA)	
ROE	**Return on Equity** Also available as Historical field Measure of a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested, in percentage. Calculated as: (T12 Net Income Available for Common Shareholders / Average Total Common Equity) * 100 Where: T12 Net Income Available for Common Shareholders is T0089, TRAIL_12M_NET_INC_AVAI_COM_SHARE Average Total Common Equity is the average of the beginning balance and ending balance of RR010, TOT_COMMON_EQY If either the beginning or ending total common equity is negative, Return on Equity will not be calculated. Please reference Return on Common Equity Adjusted (F1169, RETURN_ON_COMMON_EQUITY_ADJUSTED) for the adjusted value that excludes the impact of abnormal items.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: RETURN_COM_EQY
ROIC	**Return on Invested Capital** = EBIT / Tangible Capital	

	(See EBIT and Tangible_Capital)	
Sloan_Accruals	**Sloan's Accruals** = (historical change in firm's Current Assets / Total Assets between current and prior year – historical change in firm's Cash & Cash Equivalents / Total Assets between current and prior year) - (historical change in firm's Current Liabilities / Total Assets between current and prior year – historical change in firm's Debt in Current Liabilities / Total Assets between current and prior year – historical change in firm's Income Tax Payable / Total Assets between current and prior year) - Depreciation and Amortization / Total Assets (See CH_CA_TA, CH_CASH_TA, CH_CL_TA, CH_DEBT_CL_TA, CH_ITPM_TA, and DA_TA)	
stdROE	Standard deviation for Return on Equity (See ROE)	
sq_dev_cap_weight_mean_a_score	Squared Deviation of the market adjusted return per company and per year included in an A-Score Portfolio per year from the capitalization-weighted return for the whole A-Score Portfolio per year = (Deviation of the market adjusted return per company and year included in an A-Score Portfolio from the capitalization-weighted return for the whole A-Score Portfolio per year) ^2 (See HMCAP, MCP_a_score_p, cap_weight_a_score, cap_weighted_a_score_comp_return, cap_weight_a_score_portf_ret, m_adj_return, and dev_cap_weight_mean_a_score)	
sq_dev_cap_weight_mean_f_score	Squared Deviation of the market adjusted return per company and per year included in a F-Score Portfolio per year from the capitalization-weighted return for the whole F-Score Portfolio per year = (Deviation of the market adjusted return per company and year included in an F-Score Portfolio from the capitalization-weighted return for the whole F-Score Portfolio per year) ^2 (See HMCAP, MCP_f_sc_p, cap_weight_fscore, cap_weighted_f_score_comp_return, cap_weight_f_score_portf_ret, m_adj_return, and dev_cap_weight_mean_f_score)	
TA	**Total Assets** Also available as Historical field INDUSTRIALS Total Assets: The total of all short and long-term assets as reported on the Balance Sheet. BANKS Total Assets: This is the sum of Cash & bank balances, Fed funds sold & resale agreements, Investments for Trade and Sale, Net loans, Investments held to maturity, Net fixed assets, Other assets, Customers' Acceptances and Liabilities. Canada:	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: BS_TOT_ASSET

	This is the sum of Cash & Bank Balances, Short Term Investments, Interbank Assets, Securities Purchased with Resale Agreements, Net loans, Investments Held to Maturity, Net fixed assets, Other assets, Customers' Acceptances and Liabilities. FINANCIALS Total Assets: Total assets is equal to the sum of Cash & near cash items, Short-term investments & securities inventory, Net receivables, Total Long-Term Investments, Net fixed assets, and Other assets. INSURANCES Total Assets: Total assets is the sum of Cash & Near Cash Items, Net Receivables, Total Investments, Net Fixed Assets, Deferred Policy Acquisition Costs, and Other Assets UTILITIES Total Assets: This account will generally equal Total Assets in the annual report, except when Utility plant is net of deferred income taxes. Deferred income taxes is presented on the credit or liability side of the balance sheet. This item is balancing both the debit (assets) and credit (liabilities and shareholders' equity) sides. REITS Total Assets: Total Assets is the sum of Net Real Estate Investments, Cash and Equivalents, Other Investments, Receivables, Other Assets and Restricted Assets. MUNICIPAL ISSUERS: For general obligation (G.O.) issuers (general fund), this is the total of all short-term, restricted, capital and long-term assets as reported on the statement of net assets. For all other issuers, this is the total of all short-term, restricted, unrestricted, capital and long-term assets as reported on the balance sheet. Figure is reported in millions.	
Tangible_Capital	**Tangible Capital** = Property, Plant & Equipment + Net Working Capital (See PPE and NWC)	
TS	**Total Sales (Revenue)** Also available as Historical field INDUSTRIALS Sales/Revenue/Turnover: Total of operating revenues less various adjustments to Gross Sales.	BLOOMBERG PROFESSIONAL® Bloomberg Symbol: SALES_REV_TURN

	Adjustments: Returns, discounts, allowances, excise taxes, insurance charges, sales taxes, and value added taxes (VAT). Includes revenues from financial subsidiaries in industrial companies if the consolidation includes those subsidiaries throughout the report. Excludes inter-company revenue. Excludes revenues from discontinued operations. Includes subsidies from federal or local government in certain industries (i.e. transportation or utilities). Canada: May include royalty income and exclude royalty payments. France: Reporting formats are diverse: Cost summary method (en liste) Debit/credit format (en compte) The debit/credit format lists all of the company's expenses and losses on the debit side and all its income and gains on the credit side, with no clear separation between operating and non-operating activities. Consolidation may be line-by-line, proportional, or by the equity method. When the equity method is used, equity earnings from associates are included under Non-Operating Gains and Losses. Germany: Net of taxes when available. Some companies include value-added tax (VAT) and other taxes. Indonesia: May include turnover from associated companies. Ireland: Excludes turnover from joint ventures and/or associates. Pre-FRS 3: Includes turnover from continuing and discontinued operations and turnover from acquisitions. Post-FRS 3: Includes turnover from continuing operations and acquisitions. Excludes turnover from discontinued operations. Net profits from discontinued operations appear in Extraordinary Losses (Gains). Japan: Please see IS297 for Total Operating Revenue (Japan) reported in the summary of company earnings report (Kessan Tanshin). Luxembourg: Reporting formats are diverse: Cost summary method (en liste) Debit/credit format (en compte) The debit/credit format lists all of the company's expenses and losses on the debit side and all its income and gains on the credit side, with no clear	

	separation between operating and non-operating activities. Consolidation may be line-by-line, proportional or by the equity method. When the equity method is used, equity earnings from associates are included under Non-Operating Gains and Losses. South Africa: Excludes turnover from discontinued operations, if disclosed. Net profits from discontinued operations are placed in 'Extraordinary losses (gains) pre-tax. Turnover and Operating Profit from Discontinued Operations are displayed separately as a reference item. United Kingdom: Excludes turnover from joint ventures and/or associates. Pre-FRS 3: Includes turnover from continuing and discontinued operations and turnover from acquisitions. Post-FRS 3: Includes turnover from continuing operations and acquisitions. Excludes turnover from discontinued operations. Net profits from discontinued operations appear in Extraordinary Losses (Gains). Turnover and operating profit from discontinued operations are displayed separately as reference items. U.S.: May include royalty income. BANKS Sales/Revenue/Turnover: Gross revenue from any operating activity. Total revenue is defined as the sum of total interest income, investment income, trading profit (loss), commissions and fees earned and other operating income. Excludes revenue from discontinued operations. Revenue may be negative due to large trading account losses. Japan: Please see IS297 for Total Operating Revenue (Japan) reported in the summary of company earnings report (Kessan Tanshin). FINANCIALS Sales/Revenue/Turnover: Total of interest income, trading account profits (losses), investment income, commissions and fees earned, and other operating income (losses). Excludes revenue from discontinued operations. Revenue may be negative due to large trading account losses. Japan:	

	Please see IS297 for Total Operating Revenue (Japan) reported in the summary of company earnings report (Kessan Tanshin). INSURANCES Sales/Revenue/Turnover All revenues from any operating activities. The sum of net premiums earned, realized investment gain (loss), investment income, real estate operations, and other income. Excludes revenue from discontinued operations. UTILITIES Total Revenue: Includes revenues from electric, gas, water and other operating revenue. All revenues from any operating activity (principal activities). Gross revenues less adjustments. Excludes internal or inter-company revenues, except for privately held companies (utility subsidiaries). Excludes revenue from discontinued operations. REITS Sales/Revenue/Turnover: Revenues from real estate operating activities. Total of rental income, real estate sales (for Real Estate Operating companies), management and advisory fees, mortgage and note income and other operating income. Excludes equity in income from unconsolidated entities. Excludes gain/(loss) on sale of rental properties. MUNICIPAL G.O. Total of Operating Revenues. Includes revenues from charges for services, operating grants, capital grants, income taxes, property taxes, sales and use taxes, motor vehicle taxes, other taxes, unrestricted investment earnings and other miscellaneous revenues. Please reference IS010, (SALES_REV_TURN) for the unadjusted figure. Please reference Revenue Adjusted (IS800, IS_ADJ_SALES_REVENUE_TURNOVER) for the adjusted value that excludes the impact of abnormal items.	
TURN	**Asset Turnover Ratio** = Total Sales / Total Assets (See TS and TA)	
weight_market	Weight of each company in the STOXX Europe 600 Index = Market Capitalization per company and year / total market capitalization of the whole STOXX Europe 600 Index (See HMCAP and MCPindex)	
w_return_index	Capitalization-weighted market return per company in the STOXX Europe 600 Index = one year buy and hold return per company and per year from the	

	STOXX Europe 600 Index*weight of each company in the STOXX Europe 600 Index per year (See HMCAP, MCPindex, weight_market, and Return)	
w_sq_dev_cap_weight_ mean_a_score	Capitalization-weighted squared deviation per company and year in the A-Score Portfolio per year = capitalization weight per company and year in an A-Score Portfolio per year * squared deviation per company and year in the A-Score Portfolio per year (See HMCAP, MCP_a_score_p, cap_weight_a_score, cap_weighted_a_score_comp_return, cap_weight_a_score_portf_ret, m_adj_return, dev_cap_weight_mean_a_score, and sq_dev_cap_weight_mean_a_score)	
w_sq_dev_cap_weight_ mean_f_score	Capitalization-weighted squared deviation per company and year in the F-Score Portfolio per year = capitalization weight per company and year in a F-Score Portfolio per year * squared deviation per company and year in the F-Score Portfolio per year (See HMCAP, MCP_f_sc_p, cap_weight_f_score, cap_weighted_f_score_comp_return, cap_weight_a_score_portf_ret, m_adj_return, dev_cap_weight_mean_f_score, and sq_dev_cap_weight_mean_f_score)	
year	Year	

Appendix D: Additional Tables

Table 1: Final Sample with Top 20 % Book-to-Market Companies without Financial Intermediaries per Industry and Year

Industry	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Automobiles & Parts	7	9	8	6	8	6	4	7	7	5	5	4	76
Basic Resources	4	3	3	4	7	5	6	5	7	8	7	10	69
Chemicals	1	1	4	4	5	2	2	4	0	3	2	3	31
Construction & Materials	2	3	2	3	3	3	7	8	6	7	8	6	58
Food & Beverage	2	3	3	2	2	2	0	2	0	1	1	1	19
Health Care	1	1	0	1	1	1	2	1	0	0	0	0	8
Industrial Goods & Services	13	11	15	18	22	21	13	11	10	5	9	8	156
Media	0	3	4	4	0	2	3	2	2	1	2	2	25
Oil & Gas	0	0	1	1	1	2	4	5	7	8	13	13	55
Personal & Household Goods	7	6	5	6	7	7	7	7	6	5	4	0	67
Real Estate	18	19	19	21	16	18	20	16	17	25	22	23	234
Retail	3	6	5	4	4	4	2	1	6	5	5	4	49
Technology	3	4	4	4	5	3	1	2	3	2	2	2	35
Telecommunications	3	4	4	3	2	3	4	3	4	4	4	5	43
Travel & Leisure	5	6	4	4	4	7	6	6	4	4	0	2	52
Utilities	7	1	2	1	0	2	8	9	11	9	10	11	71
Total	76	80	83	86	87	88	89	89	90	92	94	94	1,048

Table 2: Descriptive statistics for one year Buy and Hold Return according to F-Score measure

F_SCORE	Mean	10 %	25 %	Median	75 %	90 %	N
2	-.2164387	-.6617473	-.6553057	-.4063783	.3204175	.3407358	11
3	-.0344982	-.5957854	-.4296815	-.1153822	.3379684	.4492149	42
4	-.0359984	-.6477291	-.356916	-.0482528	.1912072	.4807397	130
5	-.0037832	-.5732262	-.3053701	-.0242596	.1966698	.5086705	195
6	.0613462	-.4301839	-.1643667	.0626039	.2251656	.4905752	164
7	.1164985	-.2878791	-.1103707	.0717962	.2304232	.5862491	106
8	.1191556	-.2402652	-.1045035	.0515663	.3148306	.5872879	42
9	.2943927	-.0644873	.0882481	.3246419	.5133655	.6301091	9
Total	.0297803	-.511805	-.225306	.0159835	.2276595	.5219648	699

Table 3: Descriptive statistics for Market Adjusted Return according to F-Score measure

F_SCORE	Mean	10 %	25 %	Median	75 %	90 %	N
2	-.2601939	-.6568925	-.535481	-.1859049	-.0472376	.0301918	11
3	-.1780282	-.5961266	-.4248266	-.2288683	.092288	.173721	42
4	-.1817225	-.5829489	-.4143643	-.2511675	-.0231708	.1937918	130
5	-.1343063	-.5021977	-.3677112	-.191874	-.0073703	.2361755	195
6	-.0924724	-.4163691	-.275319	-.1512025	.0540643	.2925037	164
7	-.0836011	-.4149244	-.3083402	-.1279134	.0197087	.3372774	106
8	-.0513311	-.3757316	-.2502269	-.0878528	.1528774	.3123143	42
9	.1056561	-.2894516	-.0919356	.1626888	.3514123	.3992688	9
Total	-.1221533	-.4832056	-.3397333	-.1758446	.0277964	.2844223	699

Table 4: Correlation Matrix between potential independent variables in the regression model

	m_adj_return	BM	ROAm	CFOm	CH_ROAm	ACCRUALm	CH_LEVERm	CH_LIQUIDm	CH_SH_OUTm	CH_MARGINm	CH_TURNm	EY	NWC_LTD_TA	ROE	stdROE	ROIC	Sloan_Accruals	GROSS_PROFIT_ASSETS	LHMCAP	CUR_RATIO	BV_TA	LCGS	GMR	TURN	CH_DEBT_CL_TA	CH_CASH_TA	DA_TA	EBITDA_HEV	CAPEX_TA	NAFAM_TA	RDM_TA
m_adj_return	1.0000																														
BM	-0.2377	1.0000																													
ROAm	0.2627	-0.2432	1.0000																												
CFOm	-0.0097	-0.0643	0.0231	1.0000																											
CH_ROAm	0.3173	-0.1327	0.6057	-0.0591	1.0000																										
ACCRUALm	0.2173	-0.1576	0.7945	-0.5888	0.5232	1.0000																									
CH_LEVERm	-0.2195	0.1397	-0.1667	0.0286	-0.2103	-0.1505	1.0000																								
CH_LIQUIDm	0.0264	-0.0044	0.1179	0.1287	-0.0531	0.0001	0.0913	1.0000																							
CH_SH_OUTm	0.0370	0.0008	-0.0303	-0.0432	-0.0071	0.0008	-0.0250	0.0005	1.0000																						
CH_MARGINm	-0.0780	0.3946	-0.0093	0.0162	0.0777	-0.0171	0.0392	-0.0329	0.0095	1.0000																					
CH_TURNm	-0.0726	0.0045	-0.0113	0.0227	0.0052	-0.0224	-0.0918	-0.1151	-0.1479	-0.0791	1.0000																				
EY	0.0948	-0.0325	0.5280	0.1657	0.2394	0.3263	-0.0394	0.1347	-0.0248	0.0660	0.0448	1.0000																			
NWC_LTD_TA	0.0352	0.0263	0.0086	0.0349	0.0072	-0.0145	-0.0816	-0.0178	0.0054	-0.0164	0.0591	-0.0289	1.0000																		
ROE	0.2342	-0.2788	0.7588	0.0012	0.4582	0.6068	-0.2025	0.1453	-0.0421	0.0241	-0.0907	0.4074	0.0144	1.0000																	
stdROE	-0.0197	0.1117	-0.0964	-0.1790	0.0203	0.0307	0.0235	-0.0275	-0.0150	-0.0154	-0.0506	-0.1227	-0.0389	-0.0653	1.0000																
ROIC	-0.0520	-0.0724	0.0816	0.0783	-0.0309	0.0185	-0.0239	-0.0576	-0.0689	-0.0411	0.0196	0.1323	-0.0058	0.0854	-0.0132	1.0000															
Sloan_Accruals	0.1236	-0.2695	0.2477	-0.4034	0.0261	0.4701	-0.0848	0.2004	0.0167	-0.4047	-0.0329	0.1322	0.1322	0.2655	0.0141	0.0456	1.0000														
GROSS_PROFIT_ASSETS	-0.0997	-0.0162	-0.0399	0.4480	-0.0230	-0.3020	0.0222	-0.0449	-0.0429	0.0439	0.1920	0.1003	0.1321	-0.0532	-0.1897	0.0644	-0.1576	1.0000													
LHMCAP	0.0371	-0.2668	0.1354	0.1213	-0.0107	0.0358	-0.0680	0.1274	-0.0009	-0.1071	-0.0727	0.0988	-0.1506	0.1565	-0.0853	0.0151	0.0818	-0.0433	1.0000												
CUR_RATIO	0.0525	0.0517	-0.0508	-0.1214	-0.0038	0.0490	-0.0414	0.1828	0.0288	-0.0195	0.0098	-0.0933	0.7475	0.0073	0.0676	-0.0604	0.1723	-0.0878	-0.2552	1.0000											
BV_TA	0.0918	-0.0873	0.1870	0.0505	0.0801	0.1205	-0.1185	0.0312	-0.0657	-0.0178	0.0565	-0.0155	0.5200	0.1528	0.0374	0.0065	0.0188	-0.0308	-0.1046	0.6171	1.0000										
LCGS	-0.1283	0.0274	-0.1007	0.2843	-0.0980	-0.2525	0.0488	0.0178	0.0286	0.0004	-0.0552	0.0755	0.0249	-0.0797	-0.1119	0.0361	0.0078	0.2441	0.6114	-0.4249	-0.4569	1.0000									
GMR	0.0893	-0.0857	0.1358	-0.1159	0.0668	0.1792	-0.0484	0.0086	-0.0497	0.0095	0.1090	0.0160	-0.3218	0.1047	-0.0407	0.0211	-0.0903	0.0171	-0.0606	-0.0791	0.2647	-0.6833	1.0000								
TURN	-0.1375	0.1020	-0.0894	0.3050	-0.0459	-0.2575	0.0741	-0.0416	0.0439	0.2380	0.0793	0.0942	0.2210	-0.1063	-0.1008	0.0146	-0.1523	0.5042	-0.0902	-0.1653	-0.2443	0.5554	-0.6309	1.0000							
CH_DEBT_CL_TA	-0.0384	-0.0967	-0.0286	-0.0480	-0.0910	0.0043	-0.5169	-0.2160	-0.0246	-0.1181	-0.0152	-0.0199	0.0301	0.0560	-0.0726	0.0777	0.2400	-0.0304	0.0484	-0.0101	0.0064	-0.0016	0.0085	-0.0520	1.0000						
CH_CASH_TA	0.0069	0.0427	-0.1843	0.0372	-0.0115	-0.1705	-0.0095	0.0906	-0.0369	0.0110	0.0221	-0.1539	0.0825	-0.1102	0.0108	-0.0045	-0.2329	0.0028	-0.0627	0.1685	0.0413	-0.0194	-0.0296	0.0069	0.0122	1.0000					
DA_TA	-0.1274	-0.0083	-0.2604	0.5706	-0.1184	-0.5804	0.0838	-0.0433	-0.0283	-0.0146	0.0767	-0.1603	-0.0312	-0.2257	-0.0480	-0.0478	-0.5384	0.4780	0.0964	-0.2047	-0.1361	0.3826	-0.2001	0.3680	-0.0323	0.0487	1.0000				
EBITDA_HEV	0.0656	-0.0599	0.4887	0.2101	0.2991	0.2673	-0.0206	0.0866	-0.0223	0.0854	0.1130	0.5715	-0.0110	0.3693	-0.0936	0.0539	-0.0843	0.1812	0.1409	-0.1532	-0.1125	0.2184	-0.0990	0.1952	-0.1048	-0.1075	0.0982	1.0000			
CAPEX_TA	0.0884	0.0676	-0.0284	-0.1970	0.0020	0.0967	-0.0314	0.0377	0.0016	0.0324	0.0679	-0.0455	0.2296	-0.0781	-0.0462	0.0281	0.2003	-0.0305	-0.0667	0.2634	0.0981	-0.0178	-0.0698	-0.0072	-0.0482	0.0789	-0.1682	-0.0717	1.0000		
NAFAM_TA	-0.0274	0.0037	0.0397	0.0378	-0.0081	0.0109	0.0500	-0.1250	0.0174	-0.0146	-0.1144	0.0085	-0.0482	0.0625	-0.0440	0.0170	-0.1437	-0.0163	0.0049	-0.0469	0.0409	-0.0571	0.0282	-0.0608	0.0310	-0.1678	0.0256	0.0072	-0.0506	1.0000	
RDM_TA	-0.0859	0.0060	-0.2585	-0.0271	0.0265	-0.1879	0.0414	0.1164	0.0039	-0.0305	0.1378	-0.2813	0.4812	-0.1626	0.1312	-0.0640	-0.1864	0.2919	-0.2467	0.5162	0.3362	-0.3520	0.0920	0.0259	-0.0179	0.1734	0.2241	-0.1045	0.0205	-0.0214	1.0000

Table 5: VIF Test with all potential independent variables

Variable	VIF	1/VIF
LCGS	61.35	0.016300
LHMCAP	60.22	0.016605
GMR	12.81	0.078061
ROAm	7.90	0.126585
BV_TA	7.47	0.133948
TURN	5.48	0.182523
GROSS_PROFIT_ASSETS	5.08	0.196913
BM	4.86	0.205590
NWC_LTD_TA	4.76	0.210248
CUR_RATIO	4.33	0.230871
ACCRUALm	3.80	0.262820
CH_LIQUIDm	3.48	0.286969
CH_MARGINm	3.44	0.290716
Sloan_Accruals	3.00	0.333705
RDM_TA	2.72	0.367506
CH_DEBT_CL_TA	2.60	0.384849
DA_TA	2.60	0.385143
ROE	2.48	0.403408
EY	2.34	0.427738
CH_ROAm	2.22	0.450273
CH_LEVERm	1.91	0.523851
CH_CASH_TA	1.82	0.550926
EBITDA_HEV	1.67	0.598583
stdROE	1.65	0.605254
CAPEX_TA	1.47	0.682349
CH_TURNm	1.42	0.704440
NAFAM_TA	1.32	0.756671
CH_SH_OUTm	1.23	0.809976
ROIC	1.18	0.845745
Mean VIF	7.47	

Table 6: VIF Test after LCGS, LHMCAP, and GMR are omitted

Variable	VIF	1/VIF
ROAm	7.43	0.134624
CUR_RATIO	3.77	0.265257
ACCRUALm	3.74	0.267311
NWC_LTD_TA	3.68	0.271375
CH_LIQUIDm	3.20	0.312596
Sloan_Accruals	2.77	0.360711
BV_TA	2.59	0.386420
RDM_TA	2.58	0.387571
CH_DEBT_CL_TA	2.48	0.402682
DA_TA	2.46	0.406012
EY	2.30	0.435428
ROE	2.24	0.446988
CH_ROAm	2.20	0.454472
GROSS_PROFIT_ASSETS	2.19	0.456012
CH_MARGINm	2.04	0.489299
CH_LEVERm	1.85	0.539747
CH_CASH_TA	1.77	0.566164
EBITDA_HEV	1.65	0.604913
TURN	1.55	0.644041
stdROE	1.49	0.669873
CH_TURNm	1.38	0.725874
CAPEX_TA	1.35	0.738461
NAFAM_TA	1.29	0.774155
BM	1.24	0.809621
CH_SH_OUTm	1.20	0.830029
ROIC	1.17	0.857342
Mean VIF	2.37	

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Table 7: Descriptive Statistics for the final set of independent variables

Variable	Obs	Mean	Std. Dev.	Min	Max
BM	1048	1.151692	.8249499	.5450186	14.26534
ROAm	1048	.0236798	.0660012	-.5700638	.3082588
ACCRUALm	1048	-.033062	.0816319	-.6668373	.3246701
CH_LEVERm	966	-.0511765	7.109032	-57.4964	56.6149
BV_TA	1048	.4205242	.1648422	.068819	.9813944
CAPEX_TA	1043	-.0450991	.0398096	-.4495614	0
CH_DEBT_CL_TA	959	-.0039016	.0676712	-1.225006	.4628902
CH_TURNm	968	-.0083325	.1379029	-1.388268	1.751004

Table 8: Capitalization Weight's percentage per company and year in F-Score Portfolios

Year	Capitalization Weight's percentage per company in a F-Score Portfolio															Total
2005	0,0118772	0,0157394	0,0086851	0,0065455	0,0110664	0,0049642	0,1653714	0,3950281	0,0021338	0,0100179	0,0160796	0,0408177	0,0126773	0,2935461	0,0054503	1
2006	0,0117669	0,0062603	0,0047293	0,0103827	0,0079558	0,1190201	0,2446629	0,0083439	0,0282328	0,0509755	0,1951456	0,0039076	0,0552538	0,1241706	0,1291922	1
2007	0,0175669	0,0076123	0,0316871	0,0044698	0,0080159	0,0081661	0,1556930	0,3651806	0,0022790	0,0107941	0,0045348	0,0464058	0,0030739	0,1687021	0,1658188	1
2008	0,1591538	0,0926121	0,0280520	0,0025660	0,0335896	0,0168715	0,0183946	0,0232126	0,0307951	0,0420865	0,0105558	0,3908038	0,0325099	0,0060312	0,1127656	1
2009	0,1153842	0,0085463	0,0187150	0,0206928	0,0020195	0,0173501	0,0034465	0,0091061	0,0266301	0,0209467	0,2560482	0,1137560	0,0032466	0,0112587	0,3728532	1
2010	0,0629035	0,0229021	0,0113576	0,0341393	0,0457254	0,0083481	0,0318626	0,0085772	0,0205484	0,0173788	0,2824277	0,0595268	0,0101286	0,3334751	0,0506985	1
2011	0,0543363	0,0238558	0,0057006	0,0383329	0,0097761	0,0094805	0,0153373	0,0939121	0,0199438	0,0437079	0,0093089	0,2571296	0,0091030	0,0672628	0,3428125	1
2012	0,0429706	0,0132517	0,0038394	0,0204908	0,0064299	0,0182794	0,0158390	0,0046311	0,0413818	0,0066115	0,2124356	0,0330479	0,3723296	0,0909955	0,1174663	1
2013	0,0625985	0,0174004	0,0073140	0,0227723	0,0537237	0,0087333	0,0187995	0,0978201	0,0155882	0,0561104	0,0570330	0,0094174	0,0094690	0,5238622	0,0393579	1
2014	0,0438937	0,0165950	0,0081821	0,0336255	0,0105105	0,0225656	0,1181756	0,0200027	0,0700962	0,0270934	0,0125238	0,0675519	0,0085075	0,0119351	0,5287413	1
2015	0,0799809	0,0249315	0,0187463	0,0551353	0,0977406	0,0183102	0,0472037	0,2629924	0,0348499	0,0384395	0,0823879	0,0180202	0,1332758	0,0675152	0,0204706	1

Table 9: Capitalization Weight's percentage per company and year in A-Score Portfolios

Year	Capitalization Weight's percentage per company in a A-Score Portfolio															Total
2005	0,0142062	0,0407706	0,0371658	0,0144086	0,0057829	0,0676688	0,0259302	0,1461049	0,0092141	0,3490055	0,0474050	0,0089893	0,0193144	0,0338241	0,1802097	1
2006	0,0100899	0,0120928	0,0438182	0,2228455	0,0031107	0,2221738	0,0688369	0,0731300	0,0098543	0,0464476	0,0121995	0,1482789	0,0449185	0,0362607	0,0459428	1
2007	0,0446819	0,1175357	0,0386278	0,0098702	0,0027388	0,0962242	0,2743072	0,0124235	0,0558382	0,1615704	0,0142352	0,0792097	0,0557681	0,0129718	0,0239973	1
2008	0,0272786	0,0068713	0,0048980	0,0637031	0,5114896	0,0256697	0,0182020	0,0210862	0,0832831	0,0090064	0,0664542	0,0122826	0,1237824	0,0085725	0,0174203	1
2009	0,0102442	0,2744446	0,3502806	0,0321254	0,0100938	0,0115430	0,0071450	0,0023241	0,0497610	0,0652084	0,0189922	0,0823595	0,0177307	0,0107280	0,0570194	1
2010	0,0128435	0,0475231	0,0342935	0,0280398	0,0102508	0,0069115	0,0151396	0,2070693	0,0142261	0,0114640	0,0111853	0,0402584	0,4993459	0,0061698	0,0552795	1
2011	0,1075208	0,0277874	0,0206291	0,0113228	0,0803339	0,4094309	0,0119857	0,0138167	0,1116905	0,0111179	0,0183178	0,0650626	0,0238194	0,0735749	0,0135897	1
2012	0,0072444	0,0355359	0,0458143	0,0115660	0,0262259	0,1066234	0,0299956	0,0099778	0,0387236	0,4362750	0,0077139	0,0077470	0,0766814	0,0141970	0,1456787	1
2013	0,0136917	0,0145683	0,0976998	0,0104621	0,1952287	0,0383738	0,0282615	0,0251018	0,0067623	0,1182043	0,3761672	0,0126036	0,0067994	0,0214048	0,0346707	1
2014	0,0310998	0,0368733	0,0315414	0,1441607	0,0412572	0,0193536	0,0230523	0,0446015	0,0519422	0,0297017	0,1791649	0,0602692	0,0100657	0,0393678	0,2575487	1
2015	0,0203603	0,0917742	0,0165926	0,0996128	0,0284448	0,0148415	0,1431322	0,2782208	0,0657031	0,0514359	0,0363751	0,0417556	0,0382613	0,0187648	0,0547250	1

Table 10: Descriptive Statistics of Capitalization Weights for F-Score Portfolios

Year	Obs	Mean	Median	Std. Dev.	Min	Max
2005	15	.0666667	.0118772	.1212352	.0021338	.3950281
2006	15	.0666667	.0282328	.0776689	.0039076	.2446629
2007	15	.0666667	.0107941	.1037557	.002279	.3651806
2008	15	.0666667	.0307951	.0998899	.002566	.3908038
2009	15	.0666667	.018715	.1091212	.0020195	.3728532
2010	15	.0666667	.0318626	.1000965	.0083481	.3334751
2011	15	.0666667	.0238558	.0993676	.0057006	.3428125
2012	15	.0666667	.0204908	.1018132	.0038394	.3723296
2013	15	.0666667	.0227723	.1292325	.007314	.5238622
2014	15	.0666667	.0225656	.1314393	.0081821	.5287413
2015	15	.0666667	.0472037	.0641256	.0180202	.2629924
Total	165	.0666667	.0227723	.101939	.0020195	.5287413

Table 11: Descriptive Statistics of Capitalization Weights for A-Score Portfolios

Year	Obs	Mean	Median	Std. Dev.	Min	Max
2005	15	.0666667	.0338241	.093208	.0057829	.3490055
2006	15	.0666667	.0449185	.0729247	.0031107	.2228455
2007	15	.0666667	.0446819	.0731697	.0027388	.2743072
2008	15	.0666667	.0210862	.1277683	.004898	.5114896
2009	15	.0666667	.0189922	.103624	.0023241	.3502806
2010	15	.0666667	.0151396	.1296971	.0061698	.4993459
2011	15	.0666667	.0238194	.1014094	.0111179	.4094309
2012	15	.0666667	.0299956	.1099337	.0072444	.436275
2013	15	.0666667	.0251018	.1006367	.0067623	.3761672
2014	15	.0666667	.0393678	.0703714	.0100657	.2575487
2015	15	.0666667	.0417556	.068729	.0148415	.2782208
Total	165	.0666667	.0321254	.0948628	.0023241	.5114896

Appendix E: Additional Figures

Figure 1: Algorithm for Forward Selection

```
                     begin with empty model
p = 0.0000 <  0.1000  adding   BM
p = 0.0018 <  0.1000  adding   CH_ROAm
p = 0.0344 <  0.1000  adding   CH_TURNm
p = 0.0376 <  0.1000  adding   CAPEX_TA
p = 0.0603 <  0.1000  adding   CH_LEVERm
p = 0.0022 <  0.1000  adding   CH_DEBT_CL_TA
p = 0.0851 <  0.1000  adding   ACCRUALm
p = 0.0038 <  0.1000  adding   ROAm
p = 0.0217 <  0.1000  adding   BV_TA
p = 0.0341 <  0.1000  adding   ROIC
```

Source	SS	df	MS		
Model	9.72209118	10	.972209118	Number of obs	= 359
Residual	36.5426825	348	.105007708	F(10, 348)	= 9.26
				Prob > F	= 0.0000
				R-squared	= 0.2101
				Adj R-squared	= 0.1874
Total	46.2647737	358	.129231211	Root MSE	= .32405

m_adj_return	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
BM	-.1414681	.02969	-4.76	0.000	-.1998625	-.0830736
CH_ROAm	.4837739	.3589872	1.35	0.179	-.2222836	1.189831
CH_TURNm	-.3958382	.1304243	-3.04	0.003	-.6523572	-.1393191
CAPEX_TA	2.411299	.6825312	3.53	0.000	1.068894	3.753704
CH_LEVERm	-.0115894	.0035052	-3.31	0.001	-.0184835	-.0046953
CH_DEBT_CL_TA	-1.096304	.3926402	-2.79	0.006	-1.86855	-.3240571
ACCRUALm	-1.936552	.4633688	-4.18	0.000	-2.847908	-1.025197
ROAm	2.411851	.6228889	3.87	0.000	1.18675	3.636951
BV_TA	-.2772941	.1193414	-2.32	0.021	-.5120153	-.0425729
ROIC	-.0494846	.0232644	-2.13	0.034	-.0952411	-.003728
_cons	.1178569	.0668344	1.76	0.079	-.0135934	.2493071

Figure 2: Algorithm for Backward Elimination

```
                     begin with full model
p = 0.8660 >= 0.1000  removing NAFAM_TA
p = 0.8282 >= 0.1000  removing CH_SH_OUTm
p = 0.7799 >= 0.1000  removing ROE
p = 0.6868 >= 0.1000  removing NWC_LTD_TA
p = 0.7523 >= 0.1000  removing TURN
p = 0.7341 >= 0.1000  removing RDM_TA
p = 0.6112 >= 0.1000  removing CUR_RATIO
p = 0.3263 >= 0.1000  removing stdROE
p = 0.2820 >= 0.1000  removing EBITDA_HEV
p = 0.2329 >= 0.1000  removing DA_TA
p = 0.2882 >= 0.1000  removing Sloan_Accruals
p = 0.2681 >= 0.1000  removing GROSS_PROFIT_ASSETS
p = 0.2576 >= 0.1000  removing CH_CASH_TA
p = 0.2869 >= 0.1000  removing CH_LIQUIDm
p = 0.3284 >= 0.1000  removing CH_MARGINm
p = 0.1995 >= 0.1000  removing CH_ROAm
p = 0.1068 >= 0.1000  removing EY
```

Source	SS	df	MS		
Model	9.5313923	9	1.05904359	Number of obs	= 359
Residual	36.7333814	349	.105253242	F(9, 349)	= 10.06
				Prob > F	= 0.0000
				R-squared	= 0.2060
				Adj R-squared	= 0.1855
Total	46.2647737	358	.129231211	Root MSE	= .32443

m_adj_return	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
BM	-.1418045	.0297236	-4.77	0.000	-.2002645	-.0833445
ROAm	2.819417	.545175	5.17	0.000	1.747176	3.891659
BV_TA	-.2821755	.1194258	-2.36	0.019	-.5170603	-.0472907
ACCRUALm	-1.972128	.4631567	-4.26	0.000	-2.883058	-1.061199
CH_LEVERm	-.0117288	.0035078	-3.34	0.001	-.0186279	-.0048298
CH_DEBT_CL_TA	-1.137921	.3918812	-2.90	0.004	-1.908667	-.367175
ROIC	-.0518176	.023227	-2.23	0.026	-.0975001	-.006135
CAPEX_TA	2.527994	.6778067	3.73	0.000	1.194895	3.861094
CH_TURNm	-.373883	.1295539	-2.89	0.004	-.6286877	-.1190784
_cons	.1134198	.0668313	1.70	0.091	-.0180229	.2448626

Figure 3: Algorithm for Basic Multiple Linear Regression Model

```
. reg m_adj_return BM ROAm ACCRUALm ROIC CH_LEVERm BV_TA CAPEX_TA CH_DEBT_CL_TA CH_TURNm, robust

Linear regression                                     Number of obs =     851
                                                      F(  9,   841) =   13.46
                                                      Prob > F      =  0.0000
                                                      R-squared     =  0.1773
                                                      Root MSE      =  .32721
```

m_adj_return	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BM	-.0746024	.0200011	-3.73	0.000	-.1138602	-.0353445
ROAm	.8907679	.4214976	2.11	0.035	.0634572	1.718079
ACCRUALm	.0515673	.3018582	0.17	0.864	-.5409166	.6440512
ROIC	-.021909	.0136547	-1.60	0.109	-.0487103	.0048923
CH_LEVERm	-.0145199	.0033353	-4.35	0.000	-.0210664	-.0079734
BV_TA	.0314221	.0713819	0.44	0.660	-.1086856	.1715297
CAPEX_TA	.9613518	.3753116	2.56	0.011	.2246944	1.698009
CH_DEBT_CL_TA	-1.262715	.4029717	-3.13	0.002	-2.053663	-.4717666
CH_TURNm	-.2933459	.08476	-3.46	0.001	-.4597118	-.12698
_cons	-.0105731	.0480956	-0.22	0.826	-.1049746	.0838285

Figure 4: Algorithm for Multiple Linear Regression Model Simulation for Industry Fixed Effects

```
. reg m_adj_return BM ROAm ACCRUALm ROIC CH_LEVERm BV_TA CAPEX_TA CH_DEBT_CL_TA CH_TURNm di1 di2 di3 di4 di5 di6 di7 di8 di9 di10
>  di10 di11 di12 di13 di14 di15 di16, robust
note: di5 omitted because of collinearity
note: di10 omitted because of collinearity

Linear regression                               Number of obs =     851
                                                F( 24,   826) =    8.64
                                                Prob > F      =  0.0000
                                                R-squared     =  0.2121
                                                Root MSE      =  .32311
```

m_adj_return	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BM	-.0835771	.0194406	-4.30	0.000	-.1217359	-.0454184
ROAm	1.262874	.4425129	2.85	0.004	.3942922	2.131457
ACCRUALm	-.3391281	.3439533	-0.99	0.324	-1.014254	.3359973
ROIC	-.0170483	.0140358	-1.21	0.225	-.0445984	.0105019
CH_LEVERm	-.0138498	.0034025	-4.07	0.000	-.0205283	-.0071713
BV_TA	-.0798734	.0913576	-0.87	0.382	-.2591938	.099447
CAPEX_TA	.9185549	.378569	2.43	0.015	.1754844	1.661625
CH_DEBT_CL_TA	-1.259458	.4007875	-3.14	0.002	-2.04614	-.4727762
CH_TURNm	-.2896774	.0837262	-3.46	0.001	-.4540186	-.1253363
di1	.013222	.1193065	0.11	0.912	-.2209575	.2474015
di2	-.063451	.1196929	-0.53	0.596	-.2983891	.1714871
di3	-.0637647	.1250612	-0.51	0.610	-.3092398	.1817104
di4	-.0573433	.1177501	-0.49	0.626	-.2884679	.1737813
di5	0	(omitted)				
di6	-.217166	.152659	-1.42	0.155	-.5168112	.0824792
di7	-.0427629	.1166607	-0.37	0.714	-.2717492	.1862233
di8	-.2040114	.1176059	-1.73	0.083	-.4348531	.0268302
di9	-.1529692	.1149498	-1.33	0.184	-.3785972	.0726588
di10	.0903279	.1344339	0.67	0.502	-.1735443	.3542001
di10	0	(omitted)				
di11	.0388823	.1155662	0.34	0.737	-.1879556	.2657202
di12	-.1142213	.1154716	-0.99	0.323	-.3408736	.112431
di13	-.0475906	.1190741	-0.40	0.690	-.2813141	.1861329
di14	-.0717185	.1213703	-0.59	0.555	-.3099491	.166512
di15	-.0208834	.1305644	-0.16	0.873	-.2771605	.2353936
di16	-.136166	.1179305	-1.15	0.249	-.3676447	.0953127
_cons	.0609204	.1264215	0.48	0.630	-.1872248	.3090655

Figure 5: Algorithm for Multiple Linear Regression Model with Company Fixed Effects

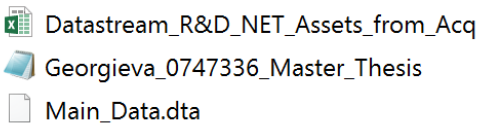
```
. xtreg m_adj_return BM ROAm ACCRUALm ROIC CH_LEVERm BV_TA CAPEX_TA CH_DEBT_CL_TA CH_TURNm, fe robust

Fixed-effects (within) regression               Number of obs      =       851
Group variable: id                              Number of groups   =       204

R-sq:  within  = 0.2423                         Obs per group: min =         1
       between = 0.0287                                        avg =       4.2
       overall = 0.1278                                        max =        11

                                                F(9,203)           =     14.77
corr(u_i, Xb)  = -0.3120                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 204 clusters in id)
------------------------------------------------------------------------------
             |               Robust
 m_adj_return|      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          BM |  -.1248942   .0358969    -3.48   0.001    -.1956728   -.0541156
        ROAm |   1.515544   .5734015     2.64   0.009     .3849575    2.64613
    ACCRUALm |  -.6945036   .5654572    -1.23   0.221    -1.809426    .4204191
        ROIC |  -.0234601   .0114536    -2.05   0.042    -.0460434   -.0008767
   CH_LEVERm |  -.0154542   .0036964    -4.18   0.000    -.0227425   -.0081659
       BV_TA |  -.5179538   .3352701    -1.54   0.124    -1.179012    .1431047
    CAPEX_TA |   1.877998   .9016134     2.08   0.039     .1002696    3.655726
CH_DEBT_CL_TA|  -1.510858   .3726639    -4.05   0.000    -2.245646   -.7760695
    CH_TURNm |  -.3504357   .1386463    -2.53   0.012    -.6238073   -.0770641
       _cons |   .2757387   .1541478     1.79   0.075    -.0281975    .5796749
-------------+----------------------------------------------------------------
     sigma_u |  .23128395
     sigma_e |  .31763779
         rho |  .34648384   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Figure 6: Algorithm for Multiple Linear Regression Model with Time Fixed Effects

```
. xtreg m_adj_return BM ROAm ACCRUALm ROIC CH_LEVERm BV_TA CAPEX_TA CH_DEBT_CL_TA CH_TURNm, fe robust

Fixed-effects (within) regression               Number of obs      =       851
Group variable: year                            Number of groups   =        11

R-sq:  within  = 0.1645                         Obs per group: min =        58
       between = 0.3052                                        avg =      77.4
       overall = 0.1739                                        max =        90

                                                F(9,10)            =     12.70
corr(u_i, Xb)  = -0.0249                        Prob > F           =    0.0002

                                    (Std. Err. adjusted for 11 clusters in year)
------------------------------------------------------------------------------
             |               Robust
 m_adj_return|      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          BM |  -.0671206   .0243273    -2.76   0.020    -.1213253   -.0129159
        ROAm |   1.027883   .3838857     2.68   0.023     .1725326    1.883234
    ACCRUALm |    .171633   .3018517     0.57   0.582    -.5009346    .8442005
        ROIC |  -.0223542   .0102732    -2.18   0.055    -.0452443    .0005359
   CH_LEVERm |  -.0128629   .0041649    -3.09   0.011    -.0221429    -.003583
       BV_TA |   .0401696   .0962358     0.42   0.685     -.174257    .2545963
    CAPEX_TA |    .777128   .4819732     1.61   0.138    -.2967753    1.851031
CH_DEBT_CL_TA|  -1.185238   .4669111    -2.54   0.029    -2.225581   -.1448955
    CH_TURNm |  -.2234345    .142453    -1.57   0.148    -.5408395    .0939706
       _cons |  -.0284425   .0572932    -0.50   0.630    -.1560996    .0992147
-------------+----------------------------------------------------------------
     sigma_u |  .08317927
     sigma_e |    .320177
         rho |  .06322451   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix F: Attached Data Files

This master thesis includes also several attached files, which we use in STATA. The main Bloomberg data is integrated in the STATA Do file “Main_Data”. In addition, we use the Excel File “Datastream_R&D_NET_Assets_from_Acq” to include additional financials from Datastream. The “Georgieva_0747336_Master_Thesis” is the main file, which controls the algorithms in STATA.



Appendix G: Curriculum Vitae

Anna Georgieva
BSc

WORK EXPERIENCE

01.05.2017 – Vienna, Austria
Bearing Point GmbH **Functional Analyst Financial Services – Management & Technology Consulting**

01.01.2017 – 30.04.2017 Vienna, Austria
Bearing Point GmbH **Intern Financial Services - Management & Technology Consulting**
Intensive Work with Abacus GMP at the Customer's Premises and in the Test Environment
Data Quality Analysis and Data Delivery for FinRep Solo, Smart Cubes Reporting Types
Analysis of regulatory frameworks (e.g. Basel III) and Reports (e.g. VERA, FinRep)
Technical Analysis based on Abacus Wiki and OeNB Wiki
Internal Support with respect to new Abacus GMP Releases
Management Presentations and Project Management Topics
Organization of Internal Meetings
http://www.bearingpoint.com/de-at/

01.02.2015 – 31.07.2015 Vienna, Austria
Erste Group Bank AG **Intern Corporate Financial Analyst – Group Large Corporates (> EUR 500mn)**
Corporate Financial Analysis based on Annual and Interim Reports
Preparation of Credit Applications, Annual Reviews and Presentations
Researching of Corporate Information and Assistance in Administrative Work
Focus on: energy, construction, insurance and machine building industries
http://www.erstegroup.com/en/Corporates/Large-Corporates

01.07.2012 – 31.08.2012 Varna, Bulgaria
Société Générale Expressbank **Intern in Front Office – Retail Banking**
Customers' consultation under the supervision of a Bank Loan Agent
Administrative work
http://www.sgeb.bg/en/homepage.html

EDUCATION AND TRAININGS

01.10.2013 – Vienna, Austria
University of Vienna **Business Administration – Master of Science**
Specialization: Corporate Finance, Financial Markets, Strategic Management
Practical courses: Venture Capital, Performance Analysis

01.10.2008 – 30.06.2013 Vienna, Austria
University of Vienna **International Business Administration – Bachelor of Science**
Specialization: International Financial Management, Risk and Insurance,
Business History, Business communication in Russian

15.09.2002 – 30.06.2007 Varna, Bulgaria
5th gymnasium for foreign languages „Joan Ekzarch" **High school leaving diploma**
Main subjects: German, Bulgarian, Mathematics