University of Cape Town

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IS THERE A GROSS PROFITABILITY PREMIUM ON THE JOHANNESBURG STOCK EXCHANGE?

Research dissertation presented for the approval of the University of Cape Town Senate in partial fulfilment of the requirements for the degree of Masters of Commerce specialising in Financial Management

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ABSTRACT

This study tests whether a gross-profit-to-assets premium exists on the Johannesburg Stock Exchange (JSE) by constructing portfolios over a 16-year time period from 2002 to 2018. The use of gross-profit-to-assets as a stock selection tool has been found to be a viable investment strategy in some developed markets. However, this concept has not been tested on the JSE, which is a sophisticated stock exchange within a developing economy. This approach may also be a viable strategy for South African investors and, thus, is worth investigating. In addition, there exists the possibility of improving value strategies by adding a gross-profit-to-assets quality strategy overlay to hedge against the "value trap" to which the former method is susceptible.

This study, therefore, compares value investing to quality investing strategies in terms of their returns by constructing both long and long-short portfolios using four metrics namely: gross-profit-to-asset ratios, book-to-price ratios, earnings-to-price ratios, and a double sort of gross-profit-to-assets ratios and book-to-price ratios. In addition, excess and abnormal returns are calculated, and portfolios are once again compared to each other. When excess returns are calculated, each separately constructed portfolio is compared to the market index, and then to the risk-free rate. Lastly, the individual portfolios are compared to expected returns, calculated using the Capital Asset Pricing and the Fama and French Five Factor (2015) asset pricing models.

The study finds that long only portfolios constructed using gross-profit-to-assets outperformed both book-to-price and earnings-to-price metrics. Further, it is found that adding gross-profit-to-assets to a value strategy, using the book-to-price ratio, is an improvement on a simple value strategy – probably because it avoids the "value trap" problem. While the long only portfolios show positive results, the long-short portfolios are not as successful. For long-short portfolios, gross-profit-to-assets and the double-sort are still superior to book-to-price and earnings-to-price, but when compared to the market index, the portfolios all underperform.

Regressions of the excess returns of both the long and long-short portfolios against the five factors of Fama and French's Five Factor Model (2015) show that the intercepts (alphas) of the various portfolio excess returns are not statistically significant and, in the case of the long portfolios, are weakly negative. Within the assumptions of this model, these findings, therefore, fail to confirm that the various factor-based investment strategies statistically outperform the market on a risk-adjusted basis.

DECLARATION

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ACKNOWLEDGEMENTS

This academic venture has not been an easy journey and I ended up taking the 'scenic route'. My thesis had to be put on hold when my daughter was born. Those colleagues who have been with me on this journey know that most of my anticipated research time was consumed by learning about a very rare condition that my daughter is faced with. I, therefore, had to undergo a mindset change to get myself back into a finance research mode. As I was forced to juggle many things at once, the only way I was able to achieve this refocusing on my studies was through the support of my husband, Ryann Dean, and my supervisor, Associate Professor Francois Toerien.

Thank you Ryann for working with me as a team to give me the guidance and support to remain focused within tough times. Thank you, Francois, for the incredible patience, support and guidance you have provided throughout this journey. I have learnt so much from you, Francois, and appreciate all the efforts that you have put into helping me achieve this goal.

To Emily Dean, my daughter, whose strength has made both me and the world very proud – this thesis is dedicated to you. You allow me to continue to be the strongest person I can be, and I will continue trying to be the best I can be for you. You have given me a completely different view on life and have made me a better person as a result. Thank you for pushing me beyond what I thought I was capable of achieving.

ACRONYMS AND ABBREVIATIONS

ALSI	All Share Index
APT	Arbitrage-Pricing Theory
BTM	Book-to-market
BTP	Book-to-price
CAGR	Cumulative annual growth rate
CAPM	Capital Asset Pricing Model
DDM	Dividend Discount Model
EMH	Efficient market hypothesis
ETP	Earnings-to-price
GPA	Gross-profit-to-assets
JSE	Johannesburg Stock Exchange
MPT	Modern Portfolio Theory
UMD	Momentum Factor
P/B	Price-to-book
P/E	Price-to-earnings

CHAPTER 1: INTRODUCTION

Many equity investment strategies have been developed and studied, with the common objective of finding new methods of wealth creation. When faced with having to make investment decisions, individual investors have different investment requirements, such as liquidity preferences, risk appetites and specific return objectives. Investment strategies allow investors to quantify and create an investment process for selecting stocks based on the investor's risk-profit objective. A strategy quantifies the approach through applying rules, guidelines, behaviours or procedures, in an attempt to achieve an appropriate result. Thus, investment strategies can help investors to either maximize their returns on the market or find ways to hedge their risk accordingly to allow for a suitable return. The aim is to achieve a return that is above the risk adjusted return[1], referred to as a premium.

Implementing investment strategies to gain market premiums implies that market anomalies exist. Market anomalies refer to patterns or distortions which indicate some predictability in market returns and, hence, contradict the Efficient Market Hypothesis, which states that all relevant and available information is fully reflected in the asset price. These market anomalies, therefore, indicate that either markets are not fully efficient (*i.e.* do not quickly/efficiently incorporate new information into asset prices), or that there are asset pricing risk factors other than the well-known market factor (beta) of the Capital Asset Pricing Model (CAPM) that are correlated with equity returns. Risk factors are those market indicators that help estimate the price of a share or stock being traded and constitute an inherent market risk. These factors are built into extended factor models used to predict and control risk. Fama and French (1992) extended the CAPM model to include two further risk factors − size and value − because they found that value[2] and small-capitalization stocks[3] outperformed markets on a frequent basis.

[1] This can be applied to shares, portfolios or funds and is the average return required by an investor after taking into account the relevant risk associated with earning that return.
[2] Value stocks are stocks that have a low price-to-book ratio relative to stocks that have a high price-to-book ratio, whilst the so-called size effect is linked to the size (measures as the market capitalization) of stocks.
[3] Value stocks are stocks that have a low price-to-book ratio relative to stocks that have a high price-to-book ratio, whilst the so-called size effect is linked to the size (measured as the market capitalization) of stocks.

Fama and French (2015) subsequently extended their three factors model into a five-factor model to include two additional risk factors, namely profitability and investment[4].

The existence of risk factors and market anomalies implies that equity markets in fact may not be efficient and, hence, that the potential exists for finding ways to obtain excess returns on stocks by following specific investment approaches (or strategies) that aim to exploit these anomalies. Equity investment strategies, often also referred to as investment styles, that are found in the currently available academic literature include traditional investment styles such as value investing and growth[5] investing, as well as quality investing, indexing[6], momentum trading[7], income investing[8], small cap investing[9] and socially responsible investing[10]. The two investing strategies or styles that are relevant to this study are value investing (based on a value premium), and quality investing (based on a profitability premium).

Value investing has been widely implemented as an investment strategy since its formalization by Graham and Dodd in 1934. This strategy follows the approach of investing in undervalued shares, with the latter being identified based on specific value indicators, such as the book-to-price ratio (net asset value/share price) and earnings-to-price ratio (earnings per share/share price). Specifically, higher value relative to price shares, as indicated by low book- or earnings-to price ratios, are preferred.

However, the effectiveness of value investing has been questioned in recent years. It has been argued that value investing delivers superior performance as a result of the higher risk that comes

[4] The profitability factor takes cognizance of the finding that companies that report higher future earnings outperform those that do not, while the investment factor takes account of internal investment and returns, and the finding that low-investment firms tend to outperform high-investment firms.
[5] Growth investing is a strategy that aims to invest in companies that generate above average growth, regardless of whether the share price is expensive in terms of metrics, such as book-to-price or earnings-to-price.
[6] Index investing is a passive investment strategy that aims to generate returns in line with a specific index. This practice can be achieved through purchasing exchange-traded funds (ETF) that closely track an underlying index.
[7] Momentum investing is a strategy that aims at selecting stocks, futures or market ETFs that have upward trending prices.
[8] Income investing is a strategy that aims to invest in a portfolio of assets that will ensure a constant stream of cash/income.
[9] Small cap investing is a strategy that aims to invest in small cap stocks because investors believe that small cap firms have more scope for growth and, thus, are more agile.
[10] Social responsibility investing is a strategy that aims to not only consider financial return, but also to ensure that investments are made in companies that have a positive social/environmental impact.

with investing in cheaper stocks (Reggiani & Penman, 2018). Thus, investors can find themselves in what is referred to as a “value trap”, where a cheap stock is cheap for a specific reason, and subsequently continues to drop in price. This practice can sometimes be related to industries which are in structural decline, or companies that have very poor prospects. Reggiani and Penman (2018) argue that when buying ‘’value’’ firms with low price multiples, the anticipated investment in future potential earnings growth may not materialize and, therefore, the buyer is taking on an additional risk. Thus, these investment experts argue that while there may be alpha in screening for cheap stocks by selecting high earnings-to-price and book-to-price, buying the ‘’value’’ may be attached to risky earnings growth.

Although value investing remains a very popular approach to equity investing, a related investment strategy, known as quality investing, is increasingly being adopted by many portfolio managers. Quality investing relies on the identification of, and investment in, quality stocks involving companies that have strong and sustainable business models, high margins, clear competitive advantages, and/or relatively low business risks. Investing in quality businesses avoids the “value trap” and can in this sense be an improvement on the previously described value investing approach.

One of the key metrics defining quality businesses is their profitability. Measures used to assess this factor, as well as whether the shares of these companies deliver a so called ‘profitability premium’, include their dividends, cash flows, net income, gross-profit and, more recently, operating profit. If these attributes are superior for specific companies, it is likely indicative of so-called “quality.” Thus, finding ways to capture premiums, such as the profitability premium, is consistent with the quality investment style. More importantly, it is of great interest to investment professionals to know whether investment strategies involving profitability-based premiums will outperform strategies using more established risk-premiums, such as the price-to-earnings factor used by value investors, and price momentum factors. Dice et al (2017) compared the performance of a number of asset pricing models, such as the Capital Asset Pricing Model (CAPM), the Fama-French (1993) Three-Factor Model, the Carhart (1997) Four-Factor Model and the Pastor-Stambaugh (2003) Model. The testing was done on data from the New York Stock Exchange covering the period January 1967 to December 2014- a total of 576 months. From this

study, evidence was found that suggested that fundamentals such as investment and profitability were the drivers behind a broad cross section of expected returns. Measures, such as return on equity to measure profitable companies, have proved to be persistently profitable over the longer term (Dice, et al., 2017). The profitability persistence is not always captured in the market pricing of the stock, and this allows for investors to capture a premium for the persistence factor known as a profitability premium.

Profitability strategies are growth strategies and so Novy-Marx (2013) argues that the addition of elements of a growth strategy may provide a hedging tool for value investing. This practice also helps to avoid the value trap, because investing in a company that may have risky earnings prospects can be hedged against by incorporating elements of a growth strategy in the form of high earnings growth metrics. Growth strategies invest in stocks that exhibit above average growth, even if these stocks appear to be expensive. However, Novy-Marx (2013) argues that growth and value strategies complement each other, and that they share a common philosophy, despite being highly disparate in characteristics and covariances. Novy-Marx's argument is that traditional value strategies sell expensive assets to finance inexpensive assets, and profitability-based strategies sell unproductive assets to acquire productive assets, which is another angle of value. These methods, therefore, are closely related, and it is meaningful to analyse profitability in the context of value. The measure of profitability that is of interest for this study is gross-profit (revenue minus cost of goods sold). Gross profitability alone would be considered a growth strategy. However, Novy-Marx (2013) transforms this strategy into a ratio of gross-profit-to-assets, and finds that gross-profits-to-assets has roughly the same predictive power as book-to-market in predicting the cross section of returns in the US market. Investing in companies with high profitability ratios reflects high profitability and, therefore, quality (Novy-Marx, 2013).

A large body of academic literature covers anomalies such as profitability factors in the US equity market. These studies include Novy-Marx's (2013) study on gross profitability, the works of Fama and French (2015) and Ball, Gerakos, Linnainmaa and Nikolaev (2015) that investigate operating profitability, and Hou, Xue and Zhang's (2015) profitability measures. However, although developing markets have sparked more interest over recent years, there are few studies on

profitability-based investment strategies in these markets and, hence, the present study will focus on South Africa as a developing country with a well-developed public equity market.

Finding value stocks on a small listed exchange such as the Johannesburg Stock Exchange (JSE) can be difficult, especially when applying Benjamin Graham's stock selection criteria. This problem arises because several of the metrics used in Graham's process reduce the sample size tremendously. Klerk and Maritz (1997) used Graham's selection criteria for the period 1977-1995 for the industrial shares on the JSE and the highest sample for a given set of criteria for a given year was 36 companies. Although value investing remains a popular investment strategy in South Africa, it remains at risk to value traps, and, therefore, it may be beneficial for investors to consider the approach of quality investing or, alternatively, a blend of value and quality investing. This study, therefore, introduces gross-profit-to-assets as a quality measure in the South African context, to establish whether this quality metric can be used as a share selection tool on the JSE. In addition to being the basis for a stand-alone strategy, this metric could be of relevance to investment managers who follow a value approach, as a complementary metric to reduce the risk of losses through value traps.

Specifically, this study seeks to establish whether gross-profit-to-assets is a stronger measure in predicting returns on the JSE than value metrics, such as book-to-market and earnings-to-price ratios.

1.1 Problem statement, research questions and hypotheses

Although value investing has been widely researched in the currently available academic literature and has been shown by many studies to outperform other forms of investing, it remains at risk of the "value trap". Thus, when selecting a value stock (a stock that is considered to be trading at a price below its intrinsic value, generally measured by fundamentals such as book value), there is scope to improve the selection criteria of stocks to include a measurement of gross-profit-to-assets to allow for a quality investing approach overlay. Gross-profit-to-assets is an indicator of the company's asset productivity, and a high gross profitability ratio would indicate that the company has a competitive advantage through higher profits. In order to do this, this study investigates whether Novy-Marx's (2013) gross-profit-to-assets metric, as the

basis of a quality strategy, outperforms two value investing ratios, namely the book-to-price and earnings-to-price ratios, on the JSE. In addition to this exploration, the study also addresses the question of whether the gross-profit-to-assets ratio can act as a hedging strategy, by combining it with the book-to-price ratio used in value investment strategies. In this study, the above strategies are considered within both long only, as well as long-short, portfolio contexts.

The research questions and related hypotheses statements for this study, therefore, are as follows:

Research question 1:

Do long-only portfolios constructed on, respectively, gross-profit-to-assets ratios, earnings-to-price ratios, and book-to-price ratios, for the JSE, earn returns that exceed that of the market.

Hypothesis 1 and its subcomponents, therefore, can be stated as follows:

a) $H1a_0$: gross-profits-to assets (long) <= market return
   $H1a_{alt}$: gross-profits-to assets (long) > market return
b) $H1b_0$: earnings-to-price (long) <= market return
   $H1b_{alt}$: earnings-to-price (long) > market return
c) $H1c_0$: book-to-price (long) <= market return
   $H1c_{alt}$: book-to-price (long) > market return

Research question 2:

In the context of long-only value strategies, do portfolios sorted on gross-profit-to-assets ratios earn returns that exceed that of portfolios separately sorted on a) the earnings-to-price ratio or b) the book-to-price?

The corresponding hypotheses are:

a) $H2a_0$: gross-profits-to assets (long) <= earnings-to-price ratio return
   $H2a_{alt}$: gross-profits-to assets (long) > earnings-to-price ratio return
b) $H2b_0$: gross-profits-to assets (long) <= book-to-price ratio return
   $H2b_{alt}$: gross-profits-to assets (long) > book-to-price ratio return

Research question 3:

Considering a combined long-only strategy, would adding a quality strategy overlay, based on the gross-profits-to-assets ratio, to a value strategy sorted on the book-to-price ratio, increase the performance of the portfolio?

The corresponding hypothesis is:

$H3_0$: book-to-price gross-profits-to assets (long) <= book-to-price (long)

$H3_{alt}$: book-to-price gross-profits-to assets (long) > book-to-price (long)

Research question 4:

In the context of long-short value strategies, do portfolios sorted on gross-profit-to-assets ratios earn returns that exceed that of portfolios separately sorted on a) the earnings-to-price ratio or b) the book-to-price ratio?

The corresponding hypotheses are:

a) $H4a_0$: gross-profits-to assets (long-short) <= earnings-to-price ratio return
   $H4a_{alt}$: gross-profits-to assets (long-short) > earnings-to-price ratio return
b) $H5a_0$: gross-profits-to assets (long-short) <= book-to-price ratio return
   $H5a_{alt}$: gross-profits-to assets (long-short) > book-to-price ratio return

Research question 5:

Considering a combined long-short strategy, would adding a quality strategy overlay, based on the gross-profits-to-assets ratio, to a value strategy sorted on the book-to-price ratio, increase the performance of the portfolio?

The corresponding hypothesis is:

$H5_0$: book-to-price gross-profits-to-assets (long-short) <= book-to-price (long-short)

$H5_{alt}$: book-to-price gross-profits-to-assets (long-short) > book-to-price (long-short)

1.2 Novelty and contribution

Value investing is a popular investment strategy that has met with varying levels of success in different markets, and over different time horizons within those markets. However, what this investment approach lacks, resulting in value investors sometimes being caught in a "value trap", is a measure of business quality to reduce the risk of "value trap" type investments. Profitability and returns are common quality indicators, but bottom-line (net) profit can be subject to adjustments, accounting discretion and non-comparability across regions. For this reason, gross profit is a better quality metric because it is less subject to distortions and, therefore, gives a cleaner representation of the core profitability of the business (Novy-Marx, 2013). A gross-profit-to-assets measure, therefore, is a good measure to judge business quality and, potentially, a useful addition to a value-based investment strategy. In addition, a possible profitability premium on the JSE would open the possibility of other profitable investment approaches not yet widely used.

Gross-profit-to-assets has been tested in a number of developed markets as the basis of investment strategies on its own, or in combination with value strategies, with mixed (but mostly positive) results. However, this approach has not yet been tested in the context of the South African market, which is an interesting case because it is a developing economy but has a well-developed stock exchange (the JSE). For South African and other investors interested in investing on the JSE the tests conducted in this study will be of great value in determining whether a quality overlay, in addition to the customary value investing approach, is a profitable way to invest in this market or not (and, in particular, whether it can help value investors to avoid the "value trap"). Thus, investors in South Africa will be able to improve both their long and long-short value investing strategies if the testing of gross-profits-to-assets as an investment filter proves to be useful on the JSE, in line with Novy-Marx's (2013) findings in the US market.

1.3 Thesis outline

The remainder of the study is structured as follows. Chapter 2 discusses the previous relevant market-related literature, followed by Chapter 3, which examines the sample data chosen for this study, as well as the sample and timeframe chosen. Chapter 4 describes the methodology

used in this study, and Chapter 5 discusses the results and findings of the research. Chapter 6 concludes by covering the key findings, as well as areas for future research flowing from this study.

CHAPTER 2: LITERATURE REVIEW

Chapter 1 discussed the potential benefits of an equity investment strategy that overlays quality metrics on top of the value investing philosophy. This chapter gives an overview of the theoretical framework and background for the Efficient Market Hypothesis (EMH), and asset pricing models such as the Arbitrage Pricing Theory (APT), the Capital Asset Pricing Model (CAPM), and the Fama and French Three Factor (1992) and Five Factor (2015) models. This framework is explored in conjunction with the market anomalies literature based on price-to-earnings, book-to-market, and gross-profit-to-assets ratios, which help indicate the applicability for actual investment strategies. Particular attention is given to the quality and value investing approaches, because these are closely linked to the focus of this study. Lastly, this chapter covers the South African findings that are relevant to this study.

2.1 Random Walk and the Efficient Market Hypothesis (EMH)

"Random walks" are paths that follow a random process and include a succession of random steps. In the context of equity prices, a random walk would mean that any changes in stock prices are independent of each other and have the same distribution. This behaviour means that past trends in stock price movements are not useful in predicting the future movement of those prices.

The ''efficient'' market was first defined by Fama (1965b), who concluded that stock market prices follow a random walk. In 1970, Fama defined an efficient market as a market in which prices always ''fully reflect'' available information and, hence, can be called ''efficient''. This explanation means that when stock price changes are random and cannot be predicted, the efficient market hypothesis holds, because all information relevant to the share (e.g. financial information related to the firm, or economic information which may affect the share price), is already fully reflected in its current price. Roberts (1967) categorized the efficient market hypothesis into three versions of strength namely: weak, semi-strong and strong. The nature of the information which is included in the share price will determine the strength of the efficiency. When a weak form of market efficiency exists, asset prices (in this case equities) only incorporate historical information, including all prior price information. This limitation means that any future

price change cannot be predicted by historical information, and moves in line with the random walk theory (Fama, 1970). The next form of the EMH is the semi-strong form, in which case the share price fully reflects all publicly available information, such as announcements or the release of company reports and earnings. This latter practice means that an investor would not be able to make excess returns above the market through the collection of public information, because this factor has already been priced into the share price (Fama, 1970). Lastly, if a strongly efficient market exists, the share price should reflect the historical information, public information and internal information, regarding the company. This comprehensive data could be an instance when investors, or even employees, may have access to internal information that has not yet been released to the public (Fama, 1970). It can also be argued that information used internally leads to insider trading if acted upon. This contention seems to imply that it is impossible to influence stock prices through insider information, because if it was, it would mean that insider traders could beat the market and the strong form of EMH (Fama, 1991). It must also be noted that insider trading is illegal in most countries.

2.2 Asset pricing models

As indicated in the previous section, the EMH argues that markets are efficient and that it is impossible for investors to outperform the market, because all share prices should already reflect any relevant information that would cause the share price to change (Fama, 1970). An asset pricing model, therefore, that adheres to this theory must be one that exists in equilibrium. This state of stability simply means that the prices of the assets, at all quantities of the asset supplied, are equal to the assets demanded at that price. To test the market efficiency theory, there needs to be the assumption that the equilibrium asset pricing model holds. An example of two previously mentioned models that link closely to EMH are the CAPM of Sharpe (1964), and the APT of Ross (1976). Both these models suggest that it should not be possible to earn abnormal returns on assets that have been priced in equilibrium.

2.2.1 The Capital Asset Pricing Model (CAPM)

The CAPM stemmed from work conducted independently by Treynor (1961, 1962), Sharpe (1964), Lintner (1965a) and Mossin (1966), which built on the previous work on diversification and Modern Portfolio Theory (MPT) of Markowitz (Markowitz, 1952).

The MPT stresses that risk is an inherent part of obtaining higher rewards when it comes to investing in markets or shares that have various levels of risk. The argument is that all investors are able to construct a portfolio that will allow them to optimize their risk-return trade-off, taking into account the level of market risk (Markowitz, 1952b). Much of the research and work undertaken around CAPM provides empirical evidence that investors are unable to earn returns in excess of the average risk-adjusted returns. The CAPM defines an asset's total risk as consisting of systematic and unsystematic risk. Systematic risk is the risk that cannot be diversified away - so-called market risk. Unsystematic risk is specific risk that relates to the actual share in question. Modern portfolio theory holds that this risk, which does not relate to general movements of the market, can be diversified away by increasing the number of shares held in an investor's portfolio (Markowitz, 1952). This argument means that it should be possible to explain a share's returns in terms of its systematic risk with respect to the market, which is measured through a coefficient called its "beta". The only way for investors to earn a higher return for investing in one stock rather than another is by requiring a higher return due to the increased systematic risk (beta). CAPM, therefore, helps to price in the risk of a stock and what return on investment an investor would require (Sharpe, 1964). CAPM assumes a strong market efficiency, which is important when applying the asset pricing model.

The CAPM describes the relationship between the expected return on an asset and the risk of investing in that asset through the following linear function:

$$E(r_i) = r_f + \frac{Cov\,(r_i, r_m)}{\sigma_m^2}\,[E(r_m) - r_f] \qquad (1)$$

or

$$E(r_i) = r_f + \beta_i[E(r_m) - r_f] \qquad (2)$$

where ERi is the expected return on the asset i, r_f is the risk-free rate, βi is the beta of asset i to the market portfolio m, $E(r_m)$ is the expected return on the market portfolio, and $E(r_m) - r_f$ represents the market risk premium.

Several early empirical studies supported the validity of CAPM (see for example Black, Jensen & Scholes, 1972; Fama & MacBeth, 1973; and Blume & Friend, 1974). While the CAPM still plays an important role in modern finance theory, more recent studies and empirical evidence found various anomalies inconsistent with the CAPM, thus casting serious doubts on its practical validity as an asset pricing model. Thus, many subsequent studies found that factors such as the price-to-earnings ratio (PER) and firm size (MV) may be better measures than beta as predictors of stock returns (see for example: Basu, 1977; Banz, 1981 and Fama & French, 1992). Models that incorporate these factors and others are generally based on the previously mentioned APT.

2.2.2 Arbitrage-Pricing Theory (APT)

As an alternative to the CAPM, Ross (1976) proposed the APT. Unlike CAPM, which assumes that markets are efficient, APT assumes that markets do sometimes misprice stock prices, but eventually corrects these errors, resulting in stock prices moving back to fair value. It is in a situation such as this that investors can use arbitrage to their advantage, based on their risk aversion, by taking up a position in the mispriced asset or market portfolio. Taking advantage of the mispricing allows the market to restore itself to the equilibrium prices. The APT model, however, is more complex than CAPM. Whereas CAPM only uses one factor to capture systematic risk (such as the Beta), APT uses a multi-factor pricing model incorporating macroeconomic or share-specific variables to capture systematic risk. Thus, the APT model explains the expected return on an asset through the relationship between two explanatory items: the macroeconomic or asset specific influences, and the asset's sensitivity to those influences. For any given asset, there are a very large number of asset specific influences that could be considered in the formula, and this choice depends upon the judgement of the analyst applying the theory. Influences may range from (but are not limited to) inflation, investor confidence, exchange rates, interest rates or market indices. While this freedom of choice allows the model to be more readily customized than the CAPM model, it brings with it the difficulty of deciding upon which factors might

influence the asset's price, as well as identifying all of these influences when there is a large breadth of factors.

The APT is represented by the following linear regression formula:

$$E(r_j) = r_f + \beta_1 RP_1 + \beta_2 RP_2 + \cdots + \beta_n RP_n \qquad (3)$$

where $E(r_j)$ is the expected return on asset j, r_f is the risk-free rate of return, β_n is the level of sensitivity of an asset's price with respect to a particular factor 'n', which is a macroeconomic variable that causes systematic risk and RP_n is the risk premium of this particular factor 'n'.

2.2.3 Factor model extensions

The CAPM only explains the cross-section of stock returns using one factor. Numerous studies have indicated the need for more than one factor in predicting asset pricing. This suggestion has led to further models being introduced, including the Fama-French Three Factor Model (Fama & French, 1993), the Carhart Four Factor Model (Carhart, 1997), and more recently, the Five Factor Model (Fama & French, 2015). The research conducted using these models has predominantly focused on the US market, largely due to reasons of liquidity and general data availability.

2.2.3.1 The Fama and French Three Factor Model

In 1992, Fama and French concluded that, in addition to the market factor, there were two additional factors, namely size and book-to-market equity, that explained cross-sectional equity returns (Fama & French, 1992). This claim implied that the CAPM does not hold on its own and opened up the possibility that other factors, such as size, leverage, earnings per share and book-to-market equity, could also be contributors to the prediction of cross-sectional returns. It was found that small-cap stocks outperformed markets on a regular basis and, therefore, an adjustment needed to be made to align the tendency for this outperformance (Fama & French, 1992).

Based on empirical evidence, the three factors that are used to explain asset returns in the subsequently developed Fama and French Three Factor Model (1993) are market risk, the outperformance of small-cap companies relative to large-cap companies (the size factor), and

the outperformance of high book-to-market companies compared to low book-to-market companies (the value factor). The Three Factor Model (Fama & French, 1993) makes use of time-series regressions to allow for a better predictability of cross-sectional returns compared to the CAPM. The model is represented by the following equation, where a portfolio's expected rate return is depicted:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \qquad (4)$$

$R_{it} - R_{ft}$ represents the expected rate of return, where R_{it} is the total return of the stock or portfolio, i at time t, and R_{ft} is the risk-free rate of return at time t. α_{it} and ϵ_{it} represent the interception of the regression and the error term respectively. $\beta_1, \beta_2, \beta_3$ refers to the factor coefficients and are represented by the slopes in the time series regression. $R_{Mt} - R_{ft}$ is the excess return on the market portfolio (index), SMB_t represents the excess return of a portfolio of small company stocks, less a portfolio of large company stocks (the "small minus big" factor, or size premium) and HML_t, the value premium, which is the return difference between stocks with a low book-to-market ratio and those with a high one (the "value factor").

Proponents of the EMH and, thus, believers in market efficiency, argue that the tendency of value stocks to outperform the market is due to the excess risk that a value and small cap firm stock has. The small firm or size effect was first identified by Banz (1981) and Keim (1983) who identified that small market capitalization firms showed stock performance superiority. This is because these stocks carry a higher business risk and a higher cost of capital. On the other hand, those who believe that markets are inefficient, argue that this outperformance is due to the market underestimating the value of these companies and, therefore, pricing them incorrectly - thus excess returns are earned in the long run as the value adjusts.

An interesting finding by Fama and French (1992) is that the market beta in fact has very little influence on the predictability of share returns, which is significant considering the fact that this beta is at the heart of the CAPM theory.

2.2.3.2 The Carhart Four Factor Model

Carhart (1997) extended Fama and French's Three Factor Model (1993 by adding an additional factor, namely momentum. Momentum refers to price momentum, which occurs when rising asset prices continue to rise, and falling asset prices continue to fall. The weighted average one-month return of the lowest performing firms are subtracted from the weighted average one-month return of the highest performing firms to obtain the momentum factor (Carhart, 1997)

The momentum factor (UMD) is added to the Three Factor Model (Fama & French, 1993) to produce the Carhart Four Factor Model, as shown below:

$$R_{it} - R_{ft} = \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t \qquad (5)$$

where UMD, of the "up minus down" factor, represents the monthly historical excess returns of the stocks (the "winners") that went up, minus the monthly excess returns of the stocks that lost value (the "losers").

Equation 5 shows that the expected monthly return for an asset in excess of the monthly t-bill rate is determined by regressing the excess returns of the asset (the alpha) and the factors listed on the right hand side of the equation, which attempt to control for risk factors. These market-wide risk factors listed above are as follows: from Fama and French (1993), the monthly return of the market value weighted index less the risk free rate (t-bill), the monthly premium of the book-to-market factor (HML), the monthly premium of the size factor(SMB), with the addition of the monthly premium on winners minus losers (UMD) (Carhart, 1997).

2.2.3.3 Fama and French's Five Factor model (2015)

In 2015, Fama and French extended the Three Factor Model (1993) to a Five Factor Model (2015) to include the market, size, value, profitability and investment patterns in average stock returns. This expansion was also based on Novy-Marx's (2013) findings that profitability has a strong relation to average return (Novy-Marx, 2013). The two new factors stemmed from the Dividend Discount Model (also known as the Gordon Growth Model devised by Professor Myron Gordon in 1962)

, as this model is based on the premise that the value of any stock today is dependent on future dividends. The two new factors developed from this were investment and profitability (Fama & French, 2015). The aim of the Five Factor Model is to explain average returns on portfolios formed to produce large spreads in size, book-market, profitability and investment.

The Fama and French Five Factor Model is represented by the following equation:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA + \epsilon_{it} \qquad (6)$$

where RMW_t represents robust returns of a diversified portfolio minus weak returns of a diversified portfolio at time t, CMA represents the conservative investment firm's returns minus aggressive investment firm's returns equal to low-high investment firms return at time t.

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2.3 Market anomalies and relevant ratios

Academic research has found many instances of return patterns and return predictability that are inconsistent with an efficient market. These are referred to as market anomalies, and directly contradicts the Efficient Market Hypothesis (EMH) (i.e. provides evidence of market inefficiencies).

Anomalies indicate that there may be risk factors other than beta that are not considered in the CAPM and that can strongly predict share returns, as well as provide opportunity for earning abnormal returns. Anomalies indicate that either markets are inefficient, or that there are inadequacies in underlying asset-pricing models (Schwert, 2003a). The empirical evidence on these anomalies indicate that there remain inconsistencies with asset pricing models such as the CAPM. While earlier literature supported the CAPM, more recent studies, such as those involving the Fama and French Three and Five Factor Models, capture some of these anomalies to improve the predictability of share returns.

Equity market anomalies are broad, because there are numerous possible arguments or reasons for why they exist, and as a result there is a broad range of literature that covers these areas. The first argument is that shares are mispriced, which brings into question the efficiency of markets. Another reason is attributed to behavioural finance, which explains the violation in terms of an

incorrect assumption in the EMH that investors are rational (Schwert, 2003b). Instead, it is suggested that non-rational investors cause pricing irregularities, as well as asset pricing inefficiencies. This relatively new theory suggests that there are elements of psychology, as well as emotion, that could influence investors' investment decisions, which result in behaviour that may be irrational or unpredictable. A further argument is that there are other variables which represent risk that are not captured by beta (Fama & French, 1992). Data-mining or sample selection bias can also result in upward bias, and can be regarded as anomalies (Kothari, Shanken & Sloan, 1995). Lastly, there is an argument that these variables and results may be time dependent and, therefore, only have predictive power for a short time period (Malkiel, 2003). Due to the limited scope of this study, the focus is on the anomalies considered to be value and profitability anomalies.

The anomalies that investment related research has identified as contributing to the value effect (i.e. to returns of portfolios sorted on value measurements) are the book-to-market (also referred to as the book-to-price) and the price-to-earnings ratio anomalies. These factors, plus profitability factors, which are linked to quality effects, will be discussed in the sections that follow, as both value and quality investing strategies are at the core of this study.

2.3.1 Price-to-earnings

The price-to-earnings (P/E) ratio is often referred to as the price-to-earnings multiple, as it indicates how much an investor is paying for the underlying earnings of the company. Academic research provides empirical evidence that the price-to-earnings ratio can be used as a predictor of future share returns. The first study indicating that the price-to-earnings ratio was an anomaly was by Nicholson (1960), but risk measures and risk adjusted performance for comparison portfolios was not considered at the time.

Basu (1977) found that the price-to-earnings ratio was in fact an anomaly (abnormal returns were generated as measured by the CAPM), and that equity securities with a low price-to-earnings ratio earned higher absolute and risk-adjusted rates of returns than those equity securities that had high price-to-earnings ratios. Reinganum's (1981) subsequent study, which found that portfolios sorted on earnings-to-price ratio exhibited average returns that were different to

CAPM predictions, supported the empirical findings that anomalies exist, which either means that CAPM is mis-specified or that markets are inefficient.

2.3.2 Book-to-market (BTM) ratio

The book-to-market ratio is also referred to as book-to-price ratio, or the inverse price-to-book ratio. The book-to-market ratio compares the book value per share to the price per share of the company. Theoretically, a high book-to-market ratio (which is the same as a low market-to-book ratio) indicates a cheap stock (Graham, 1973). Tests conducted on the US stock market found that there is a positive relationship between the book-to-market ratio and the subsequent stock returns. (Rosenberg et al., 1985). Using 1400 of the largest companies from the Compustat database covering mainly the NYSE plus the ASE and other regional exchanges and the NASDAQ, Rosenberg et al (1985) concluded that the success of the book-to-market ratio over the period 1980-1984 meant that there are market inefficiencies and potential for future profits to be made. As previously mentioned, based upon the results of some of the research findings, Fama and French (1992) concluded that there are other factors that predict the cross sectional returns of shares other than the market factor, and one of the factors they, consequently, introduced into their Three-Factor Model, as an improvement on the CAPM, was the book-to-market ratio.

2.3.3 Profitability factors

The reviewed academic literature provides evidence that profitable companies are often profitable over a long-term, and this perseverance gives the firm a premium that may not be captured by the market. This so-called ''profitability premium'' depends on the measure used to define profitability. Measures that are used in this regard include dividends (Fama & French, 2006), cash flows (Novy-Marx, 2013), bottom line net income (Ball et al., 2015), gross-profit (Novy-Marx, 2013) and operating profit (Ball et al., 2015). The resulting debate centres on which indicators of profitability are more effective in predicting the cross section of average returns.

Higher profitability may indicate that higher stock returns are expected in the near term. The Dividend Discount Model (DDM), also referred to as Gordon Growth Model (so-called because it was devised by Professor Myron Gordon in 1962) values a company's stock as the sum of the

present values of all its future dividend payments. The indication that a company can pay future dividends through increased profitability, therefore, is an indication of its stock's value. Profitability was thus included in the Fama and French Five Factor Model (2015). The profitability factor, abbreviated in the model as RMW (robust-minus-weak), is the difference between the average return of a stock portfolio with robust operating profitability, and the average return of a stock portfolio with weaker operating profitability.

Another measure of profitability used to determine a firm's value are discounted free cash flows. Financial economists and analysts are more inclined to use measures like these, because they are not distorted by accounting metrics, but rather equate to sustainable future cash flows generated by the firm. In practice, however, earnings are widely used as a productivity indicator, despite the many disadvantages of so doing. The argument for using earnings is that firms that have productive assets should yield higher returns than firms with unproductive assets. The variation between productive and unproductive firms means that investors will have different demands based on different productivity. Investors will demand high average returns for productive assets and demand lower returns for unproductive assets. Productivity, therefore, identifies the variation in required returns, which indicates the profitable firms generate higher average returns that unprofitable firms (Novy-Marx, 2013).

Earnings include non-universal accounting practices (for example US GAAP versus IFRS), and the inclusion of non-cash flow accounting line items, as well as once off-line items that do not recur. For this reason, Novy-Marx (2013) argues the importance of gross-profit-over-assets, rather than earnings-over-book equity, because gross-profit is a cleaner measure of earnings. If investment strategies were to look solely at profitability, these would be termed growth strategies. However, growth strategies can act as a hedge for value investing. It is more beneficial, therefore, to add profitability as a measure, on top of a value investing strategy, which can reduce that strategy's overall volatility.

Ball et al. (2015) argue that the deflator used in combination with a profitability measure plays an important role in its ability to predict cross-sectional share returns. Thus, they find that net income is as good a predictor of share returns as gross-profit, as long as consistent deflators are

used. Ball et al. (2015) Tconstruct an alternative measure of profitability, namely operating profitability (revenue less cost of goods sold and selling, general, and administrative expenses, excluding expenditure on research and development), a system which allows a better match of current expenses and current revenue. Their empirical finding, based on the ordinary common shares of all firms traded on the NYSE, the Amex and the Nasdaq, from the period July 1963 to December 2013, is that operating profit is a more powerful predictor of share returns than either gross-profit or net income.

In a subsequent study, Chen, Sun, Wei and Xie (2018) broadened the coverage of markets beyond the US, by studying 33 countries for the period 1990-2017, specifically investigating whether the profitability effect has predictive power on stock returns in both developing and developed markets. Six measures of profitability were used in their study, namely gross profitability as per Novy-Marx (2013)[11], operating profitability as per Fama and French (2015)[12], operating profitability as per Ball, et al. (2015)[13], two lagged gross profitability measures of Zhang (2017)[14], and the profitability measure (return on equity) of Hou, Xue, and Zhang (2015)[15]. Chen et al. (2018)'s study found that in the majority of cases the profitability effect was 40% greater in developed markets than in developing markets. The profitability effect was stronger in instances where more developed countries had more developed capital markets and less limitations to arbitrage. However, there was evidence that internationally, the profitability effect exists on a country-by-country basis. It was further found that lagging the gross profitabiltiy deflator did not matter in monthly sorts with quarterly earnings updates, but that it did in annual sorts, and that earnings (return on equity and return on assets) performed as a better measure than gross-profit in predicting the cross-section of average stock returns. In addition, a stronger profitability effect occurs when measuring profitability with quarterly updates than with annual updates.

[11] Revenue less cost of goods sold.
[12] Revenue less cost of goods sold, less selling, general and administrative expenses - interest expense) divided by book equity.
[13] Revenue less cost of goods sold and selling, general and administrative expenses, excluding expenditures on research and development.
[14] Using Novy Marx's (2013) gross-profit with a holding period of 1 month, 6 months and 12 months.
[15] Profitability is measured as ROE (Return on Equity), which is income before extraordinary items divided by one quarter-lagged book equity.

2.3.3.1 Gross-profit as a profitability factor

Gross profit is defined as revenue minus the cost of goods sold. In terms of accounting concepts, gross profit is the profit the company makes after deducting all costs directly associated with making the product or involved in rendering its services (or selling the product).

Novy-Marx (2013) argues that gross-profit is not affected by subsequent line items, which tend to move profit numbers further away from measures of true economic profitability as one goes further down the income statement (also known as the Statement of Comprehensive Income). In other words, even though one company may look more profitable than another on the basis of its bottom line, this view may be a misleading interpretation resulting from specific accounting line items. For example, the research and development line item, which may result in huge future benefits to a company, will, in the short term, give a false sense of lower sustainable earnings than competitors (Novy-Marx, 2013).

Novy-Marx (2013) further argues that when looking at predicting the cross-section of average returns, gross-profits-to-assets can be used as a tool for creating portfolios of long-short strategies, as well as for increasing the performance of value strategies. Thus, gross-profit over total assets was found to be a much stronger predictor of future earnings than earnings over book equity. Further to this, Novy-Marx (2013) concludes that gross-profit has the same power as book-to-market (a value measure) in predicting the cross section of returns (Novy-Marx, 2013). Novy-Marx (2013) found that unprofitable firms which had higher valuation ratios (*e.g.* a higher price-to-book ratio), had significantly lower returns than profitable companies. Firms that were profitable were seen to be growth firms, since they are able to grow faster than unprofitable firms. The ability of a firm to expand or grow in the future (including in terms of its earnings, free cash flow and dividend payouts) can also be emphasized as a selection tool through the use of gross-profit (Novy-Marx, 2013).

2.3.3.2 The gross profitability premium

The gross profitability premium is defined as the ability to generate alpha (the process of generating excess returns) through using gross profit-to-assets in predicting the cross section of

average share returns. Kisser (2014) argues that the profitability premium results from increased higher risk associated with higher operating leverage[16]. This outcome occurs because firms that have high gross profitability were found to have higher degrees of operating leverage capturing the risk theoretically associated with high fixed costs. Liu (2015), on the other hand, ascribes the gross profitability premium to behavioural bias by investors. Liu (2015) agrees that the profitability premium is consistent over time and that profitable firms have higher returns and less volatility than unprofitable firms. However, to a certain degree, the profitability premium is determined by the under- or overvaluation of investors, which results in a forecasting error. This situation occurs when an investor is unable to properly predict a firm's future cash flows based on its current profitability, especially due to younger firms having inconsistent positive cash flows and, therefore, higher probabilities of financial distress. Liu (2015) concludes that the expectation error shows that analysts are overoptimistic for low profitability firms in comparison to high profitability firms, and that this mistaken confidence explains the gross profitability premium phenomenon.

Chen et al. (2018) found the gross profitability premium to be pervasive in the 33 equity markets they tested. In addition to this, Lam et al. (2016) provided arguments for both behavioural and risk based explanations for the profitability premium. The gross profitability premium, according to Novy-Marx (2013), can be captured without exposing an investor to any additional risk.

Very little research on gross profit as a measure of a predictor of cross-sectional returns exists before the work of Novy-Marx (2013). The latter study focused on US NYSE and Amex listed firms over the time frame from July 1963 to December 2010, and found gross profit to be a strong predictor of cross-sectional returns on these two markets

A subsequent investigation by the same author, Novy-Marx (2013), covered nineteen additional developed countries[17] to expand the findings for international evidence, and discovered that there was a significant profitability spread and that the value spread was even larger than the

[16] The proportional share of fixed operating costs relative to variable operating costs

[17] The countries in the sample (outside of the US) were: Australia, Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Hong Kong, Italy, Japan, the Netherlands, New Zealand, Norway, Singapore, Spain, Sweden and Switzerland

profitability spread (Novy-Marx, 2013). In addition to Novy-Marx's findings, Black and Meyer-Brauns (2015) found similar evidence on profitability premiums in a study covering fifteen European markets over a 33-year period from 1982 to 2014. This study similarly concluded that profitability premiums could be used to predict market returns.

Similarly, evidence of a gross profitability premium as a key factor in explaining outperforming in emerging markets was found by Gordon and De Rossi (2013). These researchers created a long/short strategy using Novy Marx's gross profit-to-assets strategy but restricted it to the 125 largest stocks on the MSCI[18]. This study covered the period from January 1998 to September 2013 and its findings indicated that high profitability shares would have outperformed a portfolio of low-profitability shares by 9% per annum on average for this fifteen-year period, ignoring transaction costs. In this study, gross profitability (at a Sharpe ratio of 0.71) compared well to traditional alpha factors (value, momentum and size) in both absolute and risk-adjusted performance. This study also showed that using a more refined value factor with four separate value metrics still resulted in a Sharpe ratio at a comparable level to gross profitability. A further advantage of gross profitability as a return-predicting factor is its limited correlation with traditional investment styles, which means its use could act as a potential diversification tool within portfolio management (Gordon & De Rossi, 2013).

2.4 Investment styles

Individuals have different requirements (i.e. liquidity preferences or risk appetites) and objectives when it comes to making investment decisions. There are many investment strategies that can be followed in order to achieve these goals, each having its own specific stock selection criteria. Investment strategies can help investors to either maximize their returns on the market or find ways to hedge their risk accordingly and allow for a suitable return. These strategies are linked to different investment philosophies and are also known as "investment styles". A fundamental philosophical distinction underlying investing styles is whether the investor believes in the EMH and, hence, that it is not possible to beat the market because all information is

[18] The MSCI Emerging Markets Index consists of the following 21 emerging market country indices: Brazil, Chile, Colombia, the Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Peru, the Philippines, Poland, Russia, South Africa, Taiwan, Thailand and Turkey.

publicly available and reflected in the stock price, or rejects this idea. The former belief is associated with passive investing (simply replicating the market when investing), while the latter process will involve dynamic investing, which requires the active selection of stocks in an attempt to outperform the market. Different investment styles are distinguished by the basis on which investors actively select stocks. For example, value investing uses fundamental analysis (using economic and financial factors to measure a share's intrinsic value) as a strategy for identifying undervalued stocks. The two investing strategies that are relevant to this study and which will be discussed below, are value investing (based on a value premium) and quality investing (based on a profitability premium).

2.4.1 Value Investing

Graham and Dodd (1934) pioneered value investment strategies, which are based on criteria classified as either quantity or quality criteria. Some of the criteria used to classify shares as value stocks include strong financial conditions, earnings stability, dividend records, earnings per share growth, moderate price-to-earnings ratios and moderate price-to-book ratios (Novy-Marx, 2013). For example, a high book-to-market ratio means that the investor attains value through the high book assets to the amount spent on the share (i.e. market value) (Novy-Marx, 2013). Academic research has also shown that in the US, shares that have low price-to-book (high book-to-price) ratios outperform those shares that have high price-to-book (low book-to-price) ratios (Basu, 1977).

More recently, value investing has also been criticized by academics such as Damodaran (2012), who argues that while value investing can look impressive on paper, active value investing may not always provide the promised payoffs and, therefore, its benefits do not outweigh other investment strategies (Damodaran, 2012). Value investing seeks to buy assets or stocks that are undervalued, in contrast to growth investing, which seeks to invest in shares that have high growth prospects. Chan and Zang (1998) found that value stocks which were undervalued were the result of the firms being in in a state of distress or having reached maturity. Fama and French (1998) concluded that a risk factor for distressed companies can be included to capture the value premium. Chan and Lakonishok (2004) also emphasised that the higher return earned on value

stocks is not due to the additional risk taken, but rather to the fact that the stock is undervalued. They also confirmed that value stocks provide higher risk adjusted returns than stocks which have high price-to-book and price-to-earnings, which are referred to as “glamour stocks”.

Chan and Lakonishok’s (2004) investigation of value and growth investing in the US market from the 1990s to 2001 found that in the 1990s growth stocks significantly outperformed value stocks, but with updated data through 2001, value investing was found to outperform growth investing. Their metrics were extended to not only include the popular book-to-market ratio, but also cash flow-to-price, earnings-to-price and sales-to-price ratios. The value portfolio constructed on this basis outperformed the relevant markets tested, and results were favourable for both small-cap and large stocks (Chan & Lakonishok, 2004). Similarly, Elze (2010) found that on European stock exchanges (using the EuroStoxx Index as a proxy) enhanced value strategies, which included sorting portfolios using popular ratios, such as dividend yield (DY), price-to-book (P/B) and price-to-earnings (P/E), captured superior returns in comparison to stocks that were termed “glamour stocks”. In this context, value stocks were defined as those that had low price-to-book, price-to-earnings or price-to-cash flow ratios, and glamour stocks as those with high corresponding ratios.

2.4.2 Quality investing

Quality investing, which focusses on finding and investing only in excellent companies, with less of a focus on their actual value, gained more interest and momentum after the collapse of the tech bubble in 2001. In common with value investing, which focuses on ratios such as price-to-book, dividend yield and earnings ratio, quality investing also makes use of both quantitative and qualitative criteria that are seen as explaining a company’s success. Qualitative factors that are used include good management, good and sustainable profit margins, and strong competitive advantages (often called “a company’s economic moat”). The quantitative metrics, on the other hand, include financial risk ratios such as leverage (Debt/Equity) and interest coverage (EBITDA/Interest Expense), and ratios to measure a company’s earnings quality, such as return on invested capital (ROIC), return on equity (ROE), the size of its profit margins (including gross profitability), as well as the quality of its earnings. The quality of earnings is assessed by removing

any once-off or accounting items that may skew the performance of a company, in order to obtain a clearer picture of the company's true sales figures and cost line items.

Novy-Marx (2013) argues that quality and value investing are related. Thus, when buying an asset, whether a stock is high quality and is invested in without paying a premium, or whether a stock of average quality is bought at a discounted price, both have just has much value. Thus Novy-Marx (2013) argues that quality investing is a tool that can help extend the value strategy to generate even further returns, and that the true benefits accrue to those investors who look at both price and quality. This approach also avoids investors falling into value traps (where stocks are cheap for a reason), and instead allows them to invest in stocks that are truly undervalued. The focus, therefore, shifts from value strategies which buy assets at bargain prices, to quality strategies that buy stocks that are uncommonly productive (Novy-Marx, 2013). The theory proposes that firms that are seen to be cheap but that are profitable tend to outperform those firms that are either only profitable or only cheap and that, having a strategy that is able to use both price and quality, allows for steadier returns than strategies that only trade on one of these aspects. This advice is applicable to both long/short investors as well as long-only investors. (Novy-Marx, 2013). Overall the aim of this policy is to assist investors to invest in the cheapest high-quality companies, as identified by a combination of ratios such as the book-to-market ratio (value investing) and the gross profit ratio (quality investing).

Emde and Yildirim (2016) examined the performance of long and long-short portfolios sorted on the basis of gross profits-to assets, book-to-price and earnings-to-price ratios, respectively, on the Swedish Stock Exchange for the period 1994 to 2013. They also compared a combined portfolio double-sorted on the gross profits-to assets and book-to-price ratios, to test the findings of Novy Marx (2013) in a different context. The idea behind this approach was to include the principles of both value and quality investing in the study. The sample period of the study was further split into downturns (the years 2000 to 2003, 2007 to 2009 and 2010) so that the difference between a normal (i.e. non-downturn) and a downturn period could be assessed. The results showed that the gross profits-to assets ratio does work on the Stockholm Stock Exchange in both normal times and downturns. Both the long and the long-short portfolios based on the gross profits-to assets ratio outperform the overall market in normal and downturn times.

Further, the gross profits-to assets sorted portfolios outperformed earnings-to-price and book-to-price-based portfolios. Earnings-to-price performed well during downturn periods, while book-to-price-based portfolios did not perform well under any time period. Both earnings-to-price and book-to-price (value strategies) did not outperform the market. However, the results do not fully confirm those of Novy-Marx (2013), because the gross profits-to assets and book-to-price portfolios generated a high return and high standard deviation, while for the same portfolios, Novy-Marx (2013) found a higher return with the standard deviation remaining at the same level.

2.5 Empirical findings on equity market efficiency in South Africa

The following sections discuss relevant research in the South African context, given that this study's focus is on share selection on the JSE. It is important to consider whether the JSE is in fact efficient, and whether research in South Africa supports the findings of the anomalies and investment strategies literature in general.

2.5.1 CAPM, Fama and French Three Factor and Five Factor Model evidence

The theory behind the CAPM is that the market beta and asset returns are positively correlated. Van Rensburg (2003a) found a negative relationship between beta and asset returns on the South African market. A further study by (Strugnell, Gilbert and Kruger, 2015) updated this theory by correcting the sample for thin trading bias and still found that the negative relationship existed. A two factor APT model, which consisted of the Financial-Industrials Index and the Resources Index, was found to have a stronger explanatory power for share returns on the JSE than the CAPM Model (van Rensburg & Robertson, 2003).

While the Fama and French factor models (1992, 2015) have been extensively researched in the US market, it is also important to note that these factor models can have different effects in different countries. Griffin (2002) concluded that country specific (domestic) versions of the Three Factor Model provide better evidence of time-series variations in a portfolio, and for individual stock returns, than a world (global) factor model. Thus, domestic factor regressions yield lower average pricing errors than world models (Griffin, 2002).

Basiewicz and Auret (2010) tested the Fama and French Three Factor Model (1993) on the JSE and found that, due to the different nature of the JSE compared to the US stock market, the factor model used in the study mispriced certain types of assets. Specifically, the South African model failed to price small and value firms, whereas for the US model the returns on portfolios of small and growth firms were poorly predicted. It was further found that the direction of the mispricing was different for the two markets. Thus, whereas the US model generally over-predicted returns on small firms and under-predicted returns on large firms, the opposite was true of the South African model (Basiewicz & Auret, 2010).

2.5.2 Price-to-earnings

Two studies by van Rensburg and Robertson (2003a, 2003b) found that the price-to-earnings ratio can be used to predict share returns on the JSE. In the first study, twenty-four candidate style variables were tested, using a cross-sectional regression methodology. A two factor style based model, incorporating firm size and the price-to-earnings ratio, was found to be the best predictor of cross-sectional share returns (van Rensburg & Robertson, 2003a). This finding was in line with other academic research, suggesting that there are other variables (anomalies) that may better predict share returns than the CAPM beta. In their second study, van Rensburg and Robertson (2003b) applied Fama and Macbeth (1973) cross sectional regressions to the JSE, which allowed them to shortlist the price-to-earnings ratio as one of the six variables showing potential to predict share returns. When portfolios were sorted on size and price-to-earnings, evidence was again found in support of these two variables' suitability in modelling subsequent cross-sectional returns on the JSE (van Rensburg & Robertson, 2003b). This result was subsequently confirmed by Strugnell et al. (2011) in a study on JSE share returns, covering the period January 1994 to October 2007. In a related study, albeit on a sample of only fourteen South African firms, Enow and Brijlal (2016) found that dividends per share, earnings per share and the price-to-earnings ratio made up 57.8% of share price movements, and that earnings-per-share and the price-to-earnings ratio are significantly correlated to share returns.

2.5.3 The book-to-market ratio

Similar to Fama and French (1992) in the US, Auret and Sinclaire (2006) found that the book-to-market ratio also has strong explanatory power in predicting share returns on the JSE. In fact, they found that book-to-market had a much greater explanatory power than the size and price-to-earnings model of van Rensburg and Robertson (2003a), but that adding the book-to-market ratio to the size and price earnings model did not improve its predictive power (Auret & Sinclaire, 2006). Further support for the book-to-market ratio as a predictor of share returns on the JSE was subsequently documented by Hoffman (2012) in a study covering the period 1985 to 2010.

2.5.4 Value Investing in South Africa

Klerck and Maritz (1997) applied Graham's (1934) stock selection criteria to industrial shares on the JSE over the period 1977 to 1994, to test whether abnormal returns could be achieved through the value investment strategy. These researchers hoped to establish that if pockets of inefficiencies exist in the overall efficient market, investors who do not have the time or expertise for aggressive investment styles, could still earn abnormal returns by following Graham's strategy. Klerck and Maritz's (19970 study indeed found that investors who made use of this strategy to create their portfolios would have outperformed the Industrial Index over the test period (1977 to 1994). While occasionally there were results that were negative for certain periods and not all individual results were profitable, Graham's (1934) strategy did provide risk adjusted returns significantly above that which the asset pricing model suggested it should have done. However, this study only covers the period before 1994, and is restricted to industrial shares. Du Toit (2012) applied the methodology of The Brandes Institute (2009A), based on the work of Lakonishok, Shleifer and Vishny (1994) to calculated price/book-ratios for all stocks included in the ALSI for the period 1991 to 2011. Stocks were monthly ranked on a relative basis, monthly, in order to determine if the relative performance of value-versus-growth-stocks could be predicted in advance. The value portfolio was deemed to be the lowest 25% of P/B stocks and the growth portfolio the highest 25%. This performance was then tracked for the subsequent five years. The study found a significant relationship between the difference in the valuation multiple and the subsequent performance of the portfolios. The greater the valuation difference multiple,

the higher the subsequent outperformance of the value portfolio when compared to the growth portfolio.

2.6 Conclusion and research gap

This literature review covered the academic research which forms the context and basis for testing gross profit-to-assets as a measure of cross-sectional returns of shares on equity markets. While Chen et al. (2014) performed an in depth analysis on six profitability factors and concluded that earnings are a stronger predictor of returns than gross profit, it is of interest in this study to look at empirical evidence from a South African perspective, and to see whether gross profits-to-assets has a stronger predictive power than earnings-to-price and book-to-market in a South African context. In addition to this, Chen et al. (2014) applied the Carhart Four Factor Model in controlling for risk factors, while this study will apply Fama and French's Five Factor Model (2015) to control for risk factors, in line with Novy-Marx's (2013) study.

CHAPTER 3: DATA AND SAMPLING

The constituents of the JSE All Share Index (ALSI) were downloaded for every year end from 2002 to 2018 from Bloomberg. The ALSI is designed to reflect the movement of the South African equity market and, as of the end of 2019, includes approximately 150 JSE companies. The JSE ALSI is the largest index on the JSE in terms of size (the number of leading securities listed on the JSE) and value, as measured by market capitalization. The index represents 99% of the JSE's full market value (ignoring any restrictions, such as available free-float) for ordinary listed shares. Movements in this index are representative of the overall movement in the value of listed companies in South Africa and should give a good indication as to the SA economy. The JSE is the largest exchange on the African continent and is ranked 19th in the world by market capitalization (JSE, n.d).

The time period covered by the study is 16 years, namely the period 2002 to 2018. All data was obtained from Bloomberg and downloaded into Microsoft Excel. The start of the study period was determined by data availability, specifically with regards to the five asset pricing risk factors required for the JSE with regards to the Fama and French Five Factor Model (2015). This data, as provided by Legae Peresec (see https://www.legaeperesec.co.za/), is only available starting from 2003. The end of the study period was chosen to allow for the most recent audited financial results to date to be included.

Both current and delisted companies were included in the sample to avoid any survivorship bias that would arise if only currently listed companies were included. For this reason, the list of all companies acquired, delisted or which were bankrupt, was obtained from the JSE, including the effective date of each delisting. The data of both delisted and listed stocks was then downloaded as described below. In the case of real estate investment trusts (REITs) with more than one class of listed share (which is common for this asset class), one share class was removed on the basis that the financial data is the same because it is related to the same underlying company. Therefore, the class of share that showed gross profit as a line item was selected.

If data for a company for a respective year was missing or unavailable, that particular company year was excluded from the sample in order not to skew the results. These cases typically included companies which do not have gross profit disclosure in their financial statements, because this omission would mean that the required hypotheses could not be tested. Thus, the total number of companies in the ALSI each year exceeds that used in the sample. The main reason for this disparity is that not all companies disclose a gross profit metric, due to either the nature of their business model or chosen disclosure practices. The companies that do not disclose gross profit are primarily banks, real estate investment trusts, real estate developers, insurance companies, capital market companies, hotels and certain industrial and resource companies. There are a significant number of these companies in the ALSI, so any evaluation on gross profit will not include them, due to the lack of disclosure of the metric, or the irrelevance of the metric to the business model in question. A reconciliation was performed for the 2018 data and the break down is shown in Table 1 below. Other companies that were excluded from the sample were those that did not have an earnings-to-price ratio, due the company having negative earnings for the period under review.

Table 1: The number of companies that did not have gross profit for 2018

Sector	**Count**
Banks	5
Insurance	7
Capital markets	16
Real estate	33
Hotels	4
Industrial and resource	14
Other	7

The lowest number of stocks for a given year was 70 in 2004, and the highest number of stocks was 78 in 2008, as shown in Table 2 below:

Table 2: The number of companies per year for sample selected

Year	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Sample of companies per year	72	70	74	75	72	78	74	75	72	71	72	72	75	76	75	73

The data downloaded from Bloomberg for each company was the gross profit line item in the Statement of Comprehensive Income, total assets from the Statement of Financial Position, the price-to-book ratio, the price-earnings ratio, and monthly total returns for that company in Rands. Monthly data was also downloaded for the Short-Term Fixed-Interest Index (STeFI) 3-month return index as proxy for the risk-free rate, and for the total return of the JSE ALSI in Rands. Betas for the respective companies were downloaded for their financial year ends from Bloomberg. The five Fama-French (2015) factors for the JSE ALSI were downloaded into Excel from Legae Peresec's website (https://www.legaeperesec.co.za/).

The ratios downloaded for the price-to-book and price-to-earnings ratios were inverted to reflect book-to-price and earnings-to-price ratios (also referred to as earnings yield) to allow for better comparability with Novy-Marx's (2013) study. The absolute gross profit was divided by the total assets to reflect the gross profits-to assets ratio, which is the foundation for the portfolio construction being tested in this study. Both positive and negative gross profit figures were included, and any negative ratios dropped to the bottom of the list for ranking. All data downloaded from Bloomberg into Microsoft Excel was sorted within Microsoft Excel when required, and all calculations were conducted within this program. Data tables and calculations are saved within Microsoft Excel.

The next chapter discusses the necessary tools and procedures employed in this study in order to analyse the data discussed above. It outlines the process that was followed to construct and use the portfolios to answer the research questions set out in Chapter 1.

CHAPTER 4: METHODOLOGY

This methodology chapter comprises three sections, which broadly follow the structure of the research questions. Section 4.1 discusses how the various portfolios were constructed in order to be tested in line with the research questions set out in Chapter 1 of this study. Section 4.2 discusses the method used to calculate excess returns in order to answer research Question 1. The third section (4.3) discusses the use of the CAPM and the Five Factor Model (Fama & French, 2015) to calculate abnormal returns and to answer research Questions 2 to 5.

4.1 Portfolio construction

The methodology used in this study followed that of Novy-Marx (2013) and required the construction of portfolios as a first step, based on specific metrics associated with shares listed on the ALSI. Thus, four sets of portfolios were constructed by sorting on the following ratios: gross profits-to assets, book-to-price, earnings-to-price, and the combination of gross profits-to assets and book-to-price (the latter being a double-sort). These portfolios were created to mimic investment strategies that take long- or long-short positions in shares, based on specific selection criteria, as indicated below.

All companies that were included in the ALSI between 2002 and 2018 and which had gross profits listed were used as the primary data list for comparison across the four portfolios. For each year, the portfolios were constructed using the relevant ratios associated with the companies' respective year-ends, because it was for this point in time that the financial data was available on Bloomberg.

Once all the data for each year for each ratio was downloaded, companies were ranked from highest to lowest in terms of the respective ratios, based on data as at 31 December of each year. This strategy means that the ranking process was repeated for each calendar year of the sample period. For gross profits-to assets, book-to-price and earnings-to-price, a basic form of rating from highest to lowest was used to rank the companies, and for the fourth portfolio, the combination of gross profits-to assets and book-to-price and a double-sort was undertaken. To complete the double-sort, gross profits-to assets and book-to-price were individually sorted from

highest to lowest, in line with their separate portfolios, and their rankings in the two 'sorts', then added together. The sum of their rankings was then sorted from lowest to highest, with the lower rankings indicating a higher combined gross profits-to assets and book-to-price ratio.

Once the shares were sorted in ascending order for the respective ratio for each year, portfolios were created by taking the top 30% and bottom 30% from the list of companies by sorting specific metrics at that date, to construct the "high" and "low" portfolios, respectively. In addition, this information was also used to create high-low portfolios, comprised of buying the high portfolio and selling the low portfolio with respect to the relevant ratio. The stocks selected were equally weighted within each starting portfolio, implying that the returns earned by a portfolio is the average of the returns of the shares contained within it. Portfolios were rebalanced annually based on the available data at the end of every year (*i.e.* 31 December) and, therefore, the stocks held in each portfolio changed on an annual basis. The portfolio was equally weighted at the start of the period and the returns were averaged on the equally weighted basis for the entire annual period, until the portfolio was rebalanced again. The four portfolios were, thus, constructed and repeated every year for the period 2003 to 2018.

In summary, the portfolios were constructed as follows:

i. Gross profits-to assets

The portfolios constructed for gross profits-to-assets (GPA) ratios were as follows:

High (long):	The top 30% of shares were selected based on the highest gross profit-to-assets ratio from the sample data for the relevant period under review, to create a long-only portfolio.
High-low (long-short):	The top 30% and the bottom 30% of shares were selected based on the highest and lowest gross profit-to-assets ratios from the sample data for the relevant period under review, to create a long-short portfolio.

ii. Book-to-price

The portfolios constructed for book-to-price (BP) ratios were as follows:

High (long):	The top 30% of shares are selected based on the highest book-to-price ratio from the sample data for the relevant period under review to create a long-only portfolio.

High-low (long-short):	The top 30% and the bottom 30% of shares were selected based on the highest and lowest book-to-price ratios, respectively, from the sample data for the relevant period under review, to create a long-short portfolio.

iii. Earnings-to-price

The portfolios constructed for earnings-to-price (EP) ratios were as follows:

High (long):	The top 30% of shares are selected based on the highest earnings-to-price ratio from the sample data for the relevant period under review to create a long-only portfolio.
High-low (long-short):	The top 30% and the bottom 30% of shares are selected based on the highest and lowest earnings-to-price ratio from the sample data for the relevant period under review to create a long-short portfolio.

iv. Gross profits-to assets and book-to-price

The portfolios constructed for the combination gross profits-to-assets and book-to-price ratios were as follows:

High (long):	The top 30% of shares were selected based on the highest gross profit-to-assets and book-to-price ratio from the sample data for the relevant period under review to create a long-only portfolio.
High-low (long-short):	The top 30% and the bottom 30% of shares were selected based on the highest and lowest gross profit-to-assets and book-to-price ratio from the sample data for the relevant period under review, respectively, to create a long-short portfolio.

4.2 Excess return calculation

In order to answer the first research question set out in Chapter 1, which was whether the four respective ratios, sorted into portfolios both long and long-short, earn excess returns that exceed that of the market (JSE), excess returns needed to be calculated. This activity meant that eight portfolios were analysed for excess returns, namely portfolios based on the gross profits-to assets, book-to-price, earnings-to-price ratios, and the combination of the gross profits-to assets and book-to-price ratios, each for both long and long-short investment strategies.

In addition, monthly total actual portfolio returns were determined by averaging the actual monthly total returns for the shares in the portfolio at that point. As portfolios were rebalanced annually, the constituents of a given portfolio remained constant for twelve months at a time.

Should a share have delisted during the 12-month period, its returns were included up until the point it delisted. Although portfolios were rebalanced based on end-December data (because this was a convenient point at which all company year-ends would be included[19]), on the basis that actual financial results only become public approximately one quarter after financial year-end, and in order to allow for this to occur for companies with December financial year-ends, the methodology assumed actual portfolio construction only on 1 April of every year, based on the ratios as at the end of December. Therefore, in order to avoid look-ahead bias,[20] the monthly return data was lagged by three months to the actual ratio information and, therefore, was selected for the period April to March for each year. Thus, ratio sorting was based on the previous financial year-end for each company as at 31 December of every year, and the monthly returns data was based on the following year starting at 1 April. For each portfolio, a series of monthly excess returns were then calculated by finding the difference between the monthly average total returns of that portfolio, and the corresponding monthly total return of the ALSI. Positive variances thus indicated that the portfolio was able to earn excess returns compared to the ALSI, and negative variances indicated that the portfolio underperformed compared to the ALSI.

To better assess the results of the portfolios, the cumulative returns per month (based on a R1 invested at the beginning of April 2003) were also calculated using the monthly return data. This calculation was carried out for both the total monthly returns, as well as the monthly excess returns. The cumulative returns were then used to calculate the Cumulative Annual Growth Rates (CAGR)[21] for each year for the respective portfolios, as well as the CAGR for the entire period of 16 years under review (2003-2018).

4.3 Determination of abnormal returns

[19] South African companies typically have financial year-ends falling between 28/29 February and 31 December.
[20] Look-ahead bias occurs when information or data is used in a study that would have not been available or known at the time that the methodology assumed it was (*e.g.* if the study methodology assumes the creation of a portfolio at a date when the data used to construct the portfolio would not yet have been publically available). The analysis would lead to inaccurate results and result in a bias in the study.

[21] The formula for CAGR is $\left(\frac{Ending\ Value}{Starting\ Value}\right)^{\frac{1}{N}}$ - 1

The expected return of the portfolio is the average expected return that an investor would expect to earn and is calculated using asset pricing models. The expected return was then compared to the actual return of the portfolio in order to assess whether abnormal returns were earned for that portfolio for each year. For the purposes of this study, the CAPM asset pricing model was used to predict the returns of the portfolio. In addition to this, the Five Factor Model (Fama & French, 2015) was then used for further explanatory power for the expected return calculation. This approach allows for research questions 2 to 5 to be answered, namely to establish whether the portfolio sorted on the gross profits-to-assets ratio, outperforms portfolios sorted on earnings-to-price and book-to-price ratios, and whether a combined value-quality strategy based on the gross profits-to-assets ratios and book-to-price ratios outperforms a pure value book-to-price ratio value strategy.

4.3.1 CAPM

For this study, to predict expected portfolio returns the CAPM was used and compared to the actual portfolio returns, as previously calculated for the excess return component of the study (*i.e.* as the average monthly total returns of the shares in a given portfolio). The difference between the actual and expected returns are referred to as abnormal returns, or as Jensen's Alpha (Jensen, 1969). The abnormal return concept is important in this academic discourse, because evidence of abnormal returns supports the literature that has found factors other than those of CAPM to explain excess returns. The equation for Jensen's Alpha can be written as follows:

$$\alpha r_{t1} = r_{t1} - E\,(r_{t1}) \qquad (7)$$

Where αr_{t1} represents the abnormal return of the portfolio at time *t+1*, r_{t1} is the actual portfolio return at time *t+1*, and $E\,(r_{t1})$ is the expected portfolio return at time *t+1.* $E\,(r_{t1})$ is calculated using the CAPM and, therefore, the equation could be expanded as follows:

$$\alpha r_{t1} = r_{t1} - (r_f + \beta_i[E(r_m) - r_f]) \qquad (8)$$

The return of the STeFI 3-month money market index return was used as the monthly risk-free rate for the CAPM model. The risk-free rate should be that which theoretically has no risk of

financial loss for a given time period. The STeFI[22] is used as a benchmark rate for fixed interest or money market investments by many investors in South Africa and is based on the Sabor[23] and Jibar[24] interbank rates. As it is short term in nature, it should embed minimal, if any, duration risk.

Betas were downloaded for each share from Bloomberg. Betas are calculated on at least a semi-annual basis for the shares selected on Bloomberg, and the beta nearest to the relevant financial year-end was chosen for each applicable year. The beta for a portfolio is the weighted average of the individual betas of its constituents. The average of all share betas for each portfolio, therefore, was calculated and used in the CAPM formulas for the various portfolios.

The actual monthly equally weighted portfolio returns (r_{t1}) were determined by averaging the total share returns (thus including interest, capital gains, dividends and distributions realised) for the shares included in each specific portfolio.

For each month the expected total return for a specific portfolio was then subtracted from actual average total return of the shares in the portfolio, with a positive variance indicating that a positive abnormal return was earned for that given month, and a negative variance indicating that a negative abnormal return was earned for that given month.

In line with the excess return analysis, the cumulative returns were then used to calculate cumulative annual growth rates (CAGR)[25] for each year for the abnormal returns for the respective portfolios as well as the CAGR for the entire period under review (2003-2018) of 16 years.

4.3.2 The Five Factor Model

The Five Factor Model (Fama & French, 2015) was developed in an attempt to better explain the return behaviour of equities than occurs when the CAPM is used. This Five Factor Model was

[22] Short Term Fixed Interest
[23] South African Benchmark Overnight Rate
[24] Johannesburg Interbank Average Rate
[25] The formula for CAGR is $\left(\frac{Ending\ Value}{Starting\ Value}\right)^{\frac{1}{N}} - 1$, where *N* is the number of periods involved

incorporated into this study as an additional check, specifically to establish whether a statistically significant alpha is found for the various test strategies under the assumptions of this model.

A series of monthly excess returns were calculated by subtracting the monthly risk-free rate (STeFI 3-month return) from the actual average monthly returns of the shares in a portfolio for that month. The series of monthly excess returns were then regressed against the five factors of the Fama and French's Five Factor Model (2015), in order to determine to what extent this Five Factor Model can explain the patterns of excess returns and, more importantly, to compare the risk-adjusted returns (alphas) of the various strategies within this asset pricing framework.

The next chapter (Chapter 5) presents the findings for the methodology discussed above, as well the results in terms of the research questions outlined in Chapter 1 of this study.

CHAPTER 5: RESULTS AND ANALYSIS

The following chapter analyses and discusses the findings for the research questions in Chapter 1, starting with the demographic statistics relating to the sample data.

5.1 Descriptive statistics

Tables 3 to 5 (below) show the descriptive statistics for the study findings for the various portfolios. Table 3 shows the minimum, maximum and median of the total returns earned in a given year from the period 2003 to 2018. The total returns in this table were calculated using the CAGR formula for each year. Table 4 has a further breakdown of the monthly returns for the various portfolios, which shows more granular data.

On the long portfolio it can be noted that the gross profit-to-assets and the double sort gross profit-to-assets combined with book-to-price suffer from the smallest drawdown (lowest minimum figure) in a particular year - significantly lower than for the ALSI and the other portfolios. This result implies greater downside protection in these two portfolios, potentially due to the higher quality nature of the specific stocks held. The double-sort gross profit-to-assets and book-to-price also has the highest annual gain. Further, the gross profit-to-assets and the double-sort of gross profit-to-assets combined with book-to-price portfolios also have the highest mean and median returns.

For the long-short portfolios, the double-sort gross profit-to-assets and book-to-price strategy has the lowest annual drawdown, but gross profit-to-assets has the highest gain in a single year. Both portfolios also have the highest mean figures, but all are less than the ALSI.

Table 3: Total annual returns for the period 2003-2018 for long and long-short portfolios

LONG PORTFOLIOS - ANNUAL TOTAL RETURNS					
	GPA	**BP**	**EP**	**GPA + BP**	**ALSI**
Min	-15.2%	-26.3%	-22.5%	-10.3%	-28.5%
Max	79.2%	91.4%	83.8%	94.2%	57.7%
Mean	27.3%	26.5%	25.4%	29.9%	18.6%
Median	28.2%	20.6%	19.5%	27.9%	13.9%

LONG SHORT PORTFOLIOS - ANNUAL TOTAL RETURNS					
	GPA	**BP**	**EP**	**GPA + BP**	**ALSI**
Min	-27.1%	-22.8%	-23.7%	-19.9%	-28.5%
Max	50.5%	22.3%	30.9%	40.6%	57.7%
Mean	5.4%	1.7%	2.3%	12.0%	18.6%
Median	8.3%	2.5%	-0.4%	19.5%	13.9%

Table 4: Total monthly returns for the period 2003-2018 for long only portfolios

LONG PORTFOLIOS - MONTHLY MIN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	0.3%	-3.2%	-2.1%	-7.5%	-13.5%	-7.0%	-1.3%	-4.7%	-3.0%	-1.2%	-5.8%	-2.6%	-6.3%	-2.4%	-3.3%	-10.6%
BP	-0.9%	-3.9%	-3.9%	-2.4%	-11.2%	-10.5%	-1.8%	-3.2%	-4.5%	-5.3%	-6.0%	-8.9%	-13.0%	-10.2%	-4.6%	-6.7%
EP	0.4%	-2.4%	-1.6%	-6.7%	-14.0%	-10.8%	-2.5%	-3.5%	-2.8%	-1.8%	-4.2%	-5.8%	-9.5%	-8.9%	-3.1%	-5.9%
GPA + BP	1.1%	-2.3%	-3.8%	-5.7%	-13.8%	-8.2%	1.3%	-3.3%	-1.1%	-3.7%	-3.2%	-2.6%	-8.5%	-4.6%	-3.4%	-4.9%
ALSI	-2.8%	-2.6%	-5.2%	-2.7%	-5.6%	-13.2%	-3.5%	-5.1%	-3.6%	-3.6%	-5.7%	-2.6%	-4.0%	-3.1%	-4.2%	-5.8%

LONG PORTFOLIOS - MONTHLY MAX RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	10.3%	11.6%	9.7%	8.7%	7.6%	10.6%	8.4%	10.8%	7.2%	5.8%	4.9%	8.6%	10.9%	5.4%	8.5%	3.6%
BP	13.9%	6.5%	12.7%	6.5%	8.9%	9.1%	9.3%	7.6%	5.3%	6.0%	7.8%	4.6%	20.8%	13.8%	7.8%	4.2%
EP	11.3%	8.0%	12.2%	8.4%	8.6%	8.7%	11.2%	8.6%	6.7%	5.9%	6.2%	4.1%	13.4%	11.5%	4.8%	2.5%
GPA + BP	11.1%	8.4%	11.1%	7.2%	7.9%	10.3%	8.8%	9.1%	5.2%	4.7%	6.4%	5.3%	9.1%	7.8%	3.8%	3.9%
ALSI	14.1%	8.8%	10.0%	6.4%	12.5%	11.0%	10.3%	8.7%	9.3%	4.2%	8.5%	4.1%	7.6%	4.3%	7.0%	5.4%

LONG PORTFOLIOS - MONTHLY MEAN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	5.0%	3.9%	4.2%	2.5%	-0.7%	0.0%	4.0%	2.4%	2.1%	2.3%	1.0%	2.1%	0.6%	1.0%	1.5%	-1.3%
BP	4.9%	3.1%	5.7%	3.3%	0.1%	-2.4%	5.1%	2.0%	1.1%	1.7%	1.6%	-0.2%	0.8%	2.5%	-0.2%	0.4%
EP	4.9%	3.2%	4.4%	2.6%	-0.4%	-1.9%	5.3%	1.5%	2.1%	1.3%	1.6%	0.2%	0.5%	2.8%	1.4%	-1.2%
GPA + BP	5.7%	3.5%	4.0%	2.6%	-0.8%	-0.1%	4.8%	2.2%	2.0%	2.3%	1.8%	1.2%	-0.1%	2.2%	1.1%	-0.5%
ALSI	3.2%	2.2%	4.0%	2.7%	1.0%	-2.5%	3.2%	1.3%	0.7%	1.7%	1.9%	1.0%	0.3%	0.2%	0.8%	0.5%

LONG PORTFOLIOS - MONTHLY MEDIAN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	5.1%	4.0%	3.9%	3.4%	-0.3%	-1.0%	4.3%	1.9%	2.4%	2.3%	1.2%	1.8%	-1.3%	0.5%	1.0%	-1.3%
BP	4.7%	4.1%	7.1%	3.5%	0.3%	-2.8%	6.6%	2.0%	1.4%	2.0%	1.7%	0.9%	0.4%	1.8%	-1.4%	2.3%
EP	4.4%	3.4%	3.9%	1.7%	0.4%	-4.1%	5.4%	1.2%	3.1%	1.1%	2.4%	1.1%	-0.1%	3.4%	2.0%	-1.0%
GPA + BP	5.0%	3.4%	3.7%	3.5%	0.0%	-1.5%	5.4%	2.2%	1.7%	3.1%	1.7%	1.9%	-1.5%	2.3%	2.3%	-0.6%
ALSI	2.6%	1.4%	5.1%	3.0%	0.8%	-2.0%	2.5%	0.2%	-0.5%	2.7%	2.8%	1.0%	-0.1%	0.6%	-0.1%	2.0%

An observation from the monthly mean returns table (Table 4 above) is that during the start of the Global Financial Crisis (end-2007), all portfolios experienced worse mean months than the ALSI (*i.e.* for 2007), but in 2008 they all outperformed the ALSI.

In the Monthly Min Return section of Table 4, it is notable that both the gross profit-to-assets and the double-sort of book-to-price, combined with gross profit-to-assets strategies, have the lowest drawdowns. Both the book-to-price and earnings-to-price strategies on average suffer the worst monthly drawdowns. With regard to the maximum monthly mean return, in 2007 and 2008 all portfolios, except earnings-to-price, underperformed the index. The implication of this result is that during the financial crisis, even with worse drawdowns, all portfolios showed relative outperformance versus the index.

Table 5: Total monthly returns for the period 2003-2018 for long-short portfolios

LONG SHORT PORTFOLIOS - MONTHLY MIN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	-5.5%	-16.1%	-10.2%	-14.0%	-7.8%	-5.1%	-3.0%	-2.7%	-4.0%	-2.9%	-10.9%	-0.7%	-18.3%	-8.2%	-10.7%	-8.6%
BP	-2.1%	-5.3%	-5.1%	-3.2%	-4.1%	-5.4%	-5.0%	-3.3%	-4.4%	-6.0%	-6.8%	-9.7%	-13.2%	-9.5%	-8.3%	-5.8%
EP	-5.4%	-15.6%	-9.6%	-4.2%	-6.2%	-7.8%	-3.2%	-3.2%	-4.5%	-3.7%	-5.9%	-4.6%	-4.2%	-5.6%	-1.5%	-7.2%
GPA + BP	-2.9%	-13.1%	-6.4%	-7.0%	-8.8%	-6.3%	-1.0%	-1.6%	-1.3%	-2.8%	-5.8%	-1.4%	-7.9%	-3.6%	-3.1%	-7.2%
ALSI	-2.8%	-2.6%	-5.2%	-2.7%	-5.6%	-13.2%	-3.5%	-5.1%	-3.6%	-3.6%	-5.7%	-2.6%	-4.0%	-3.1%	-4.2%	-5.8%

LONG SHORT PORTFOLIOS - MONTHLY MAX RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	6.9%	9.8%	3.6%	4.8%	2.6%	14.3%	5.5%	4.7%	8.2%	7.3%	6.1%	10.1%	10.8%	7.7%	10.8%	8.5%
BP	4.3%	4.3%	9.1%	7.5%	5.0%	9.5%	3.4%	4.0%	3.3%	4.6%	6.3%	2.3%	21.0%	11.4%	6.5%	6.6%
EP	5.6%	8.5%	4.5%	3.8%	4.0%	9.2%	6.6%	3.0%	5.6%	5.3%	7.1%	3.1%	3.5%	12.2%	6.0%	2.0%
GPA + BP	6.6%	8.4%	2.1%	3.1%	4.5%	16.3%	5.9%	6.6%	6.1%	5.0%	4.4%	7.2%	4.4%	6.2%	8.1%	3.9%
ALSI	14.1%	8.8%	10.0%	6.4%	12.5%	11.0%	10.3%	8.7%	9.3%	4.2%	8.5%	4.1%	7.6%	4.3%	7.0%	5.4%

LONG SHORT PORTFOLIOS - MONTHLY MEAN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	2.4%	1.5%	-2.5%	-2.2%	-1.4%	2.7%	0.3%	1.1%	2.1%	1.7%	-0.7%	3.5%	-1.6%	-0.6%	1.6%	-2.2%
BP	1.4%	-0.7%	0.5%	0.2%	0.8%	-1.2%	1.4%	0.3%	-1.2%	-0.5%	0.4%	-2.1%	0.4%	1.8%	-0.8%	1.6%
EP	1.2%	0.3%	-1.8%	-0.4%	-1.0%	0.3%	1.9%	-0.2%	1.7%	-0.1%	0.2%	-1.1%	-0.7%	2.4%	2.0%	-2.2%
GPA + BP	2.7%	1.2%	-1.5%	-1.1%	-1.7%	3.1%	2.1%	1.5%	1.5%	1.6%	0.5%	1.7%	-0.8%	1.8%	2.1%	-0.6%
ALSI	3.2%	2.2%	4.0%	2.7%	1.0%	-2.5%	3.2%	1.3%	0.7%	1.7%	1.9%	1.0%	0.3%	0.2%	0.8%	0.5%

LONG SHORT PORTFOLIOS - MONTHLY MEDIAN RETURN																
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GPA	4.0%	3.4%	-2.3%	-0.8%	-0.7%	2.3%	-0.7%	1.4%	2.1%	1.7%	-0.8%	2.2%	0.9%	-0.8%	1.1%	-4.1%
BP	2.0%	0.2%	0.1%	0.1%	1.5%	-2.2%	2.4%	0.3%	-1.5%	0.7%	0.8%	-0.6%	0.8%	1.9%	-0.8%	2.1%
EP	2.0%	0.6%	-1.8%	-0.4%	0.0%	0.3%	2.7%	0.0%	2.3%	0.2%	0.3%	-1.7%	-0.9%	1.0%	1.6%	-1.3%
GPA + BP	3.0%	1.7%	-1.4%	-0.9%	-1.5%	1.0%	2.2%	1.4%	1.0%	1.9%	0.8%	0.7%	0.0%	1.8%	1.8%	0.7%
ALSI	2.6%	1.4%	5.1%	3.0%	0.8%	-2.0%	2.5%	0.2%	-0.5%	2.7%	2.8%	1.0%	-0.1%	0.6%	-0.1%	2.0%

The long-short portfolios in Table 5 above show lower mean monthly returns on average than the long only portfolio, which leads to the performance results outlined further on in this chapter. On average all the portfolios had worse drawdowns and smaller gains, thus resulting in the lower average performance.

5.2 Overview of findings

Table 6 below gives an overview of the results of the portfolios, in terms of their overall average CAGRs over the period 2003-2018 (16 years). Information on individual years is provided in Appendices 1 to 4.

Table 6: Annual CAGRs over the period 2003-2018

LONG ONLY				
	gross profits-to assets	**book-to-price**	**earnings-to-price**	**gross profits-to assets + book-to-price**
Return	24.6%	22.6%	21.9%	26.8%
Excess return (ALSI)	5.7%	5.3%	3.4%	6.8%
Excess return (rf)	16.1%	14.3%	13.6%	17.2%
Abnormal returns	16.7%	16.9%	16.4%	19.7%

LONG-SHORT				
	gross profits-to assets	**book-to-price**	**earnings-to-price**	**gross profits-to assets + book-to-price**
Return	2.7%	-0.2%	1.0%	10.2%
Excess return (ALSI)	-14.7%	-15.7%	-14.7%	-8.5%
Excess return (rf)	-4.7%	-6.3%	-7.1%	2.4%
Abnormal returns	-0.3%	0.5%	0.8%	11.6%

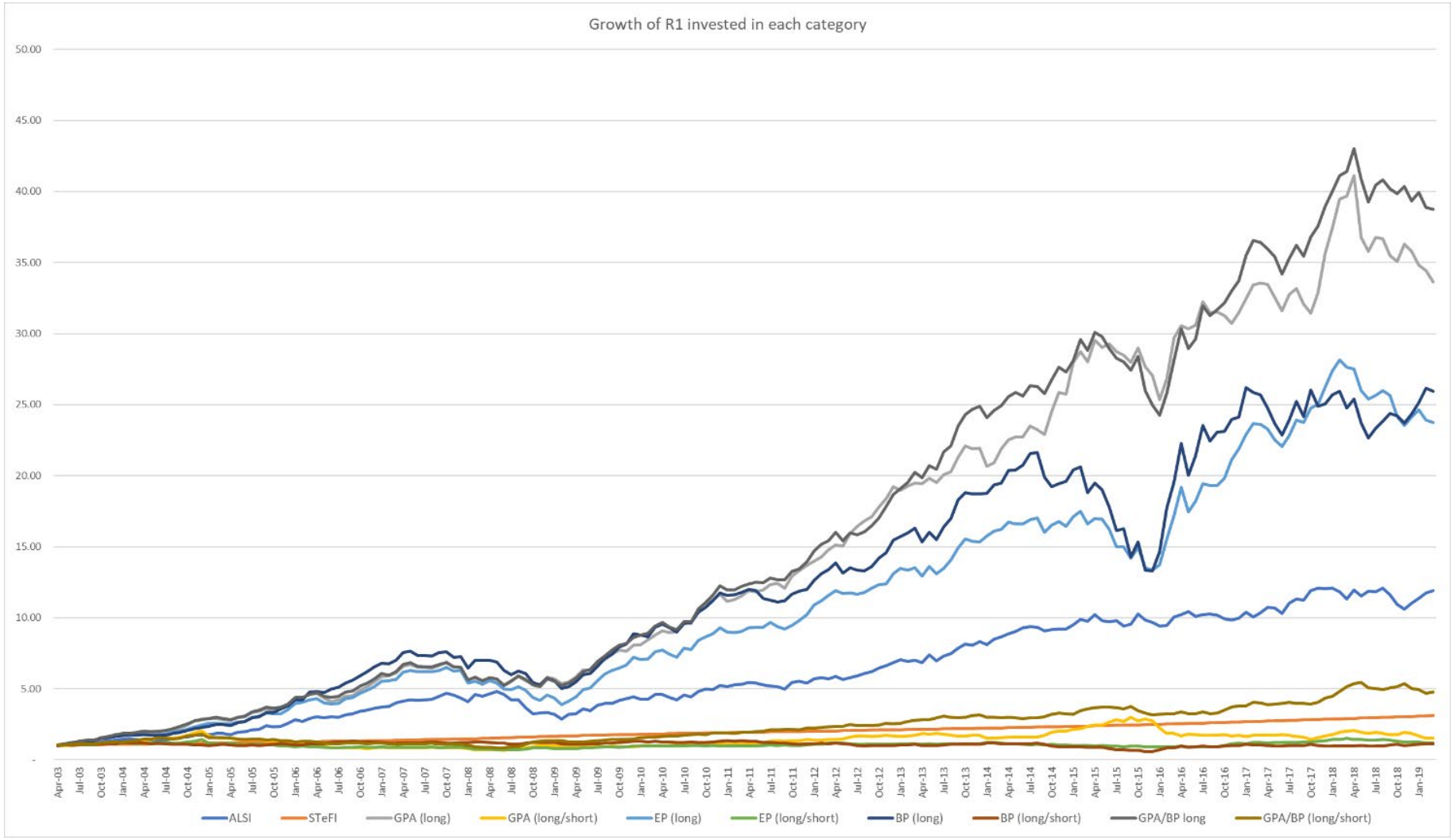
In terms of Table 6 above, overall the double-sort based on the gross profits-to assets and book-to-price ratios outperform all other strategies that were tested for both long only and long-short portfolios. The gross profit-to assets ratio also shows outperformance of the total returns for the portfolios measured by the CAGR against the other two value orientated strategies, based on the book-to-price and earnings-to-price ratios, respectively. The results for the long portfolios were positive for all strategies, i.e. they were all able to earn returns in excess of the ALSI, risk free rate and CAPM. However, for long-short portfolios these strategies did not perform well, with the total returns of the portfolios underperforming against the ALSI, risk free rate and CAPM. While all portfolios beat the market (the ALSI), the double-sort on gross profits-to assets and book-to-price ratios managed to earn excess returns over double that of the earnings-to-price-based strategy in terms of cumulative excess returns. It must be noted that this outperformance is gross of costs and, because costs were not taken into account, it is slightly overstated. However, the impact of this over-calculation is likely to be limited given that the strategies tested involved only annual portfolio rebalancing, which also implies lower trading costs than more active trading strategies.

Figure 1 indicates the growth of a hypothetical R1 invested in the ALSI, the STeFI (risk free rate) and each portfolio (gross profits-to-assets, book-to-price, earnings-to-price and the double-sort gross profits-to-assets and book-to-price) that were tested for the time period under review. This approach is not an indicator of statistical significance but is a useful visual representation of the various strategy returns and their relationship over time. The highest cumulative return strategy is the combined gross profits-to-assets and book-to-price ratio sort (the value-quality hybrid strategy) on a long only basis, with a 16-year CAGR of 26.8%.

Thereafter, the gross profits-to assets ratio-based strategy on a long only basis delivers the next highest cumulative return, with a 24.6% CAGR. Earnings-to-price on a long basis (21.9% CAGR) and book-to-price on a long basis (22.6% CAGR) follow, both exceeding the cumulative return of the ALSI (16.8% CAGR). It is noted that the long/short strategies had very low cumulative returns over the entire time period. From inspecting the data, it is clear that it is the short component that detracts from the strategy, given the returns of the long portfolio in isolation.

This result is most likely due to the general uptrend of the ALSI for the time period under review, which means that the shortened stocks would in general increase in value and detract from overall returns. The other long/short strategies delivered CAGRs as follows: gross profits-to-assets: 2.7%, earnings-to-price: 1.0%; book-to-price: -0.2%, and gross profits-to-assets/book-to-price are again the highest performers with a 10.2% CAGR return.

Figure 1: Growth of R1 invested at the beginning of April 2003 to January 2019 across the strategies tested



5.2 Long only portfolio results

The first assessment of results was used to answer Research Question 1 (see Chapter 1). It is important to note that for this question, excess returns refer to the actual returns of the relevant portfolio over the market (ALSI) returns. The summary of the findings for Research Question 1 are shown below:

Research question 1:	**Finding**
Do long-only portfolios constructed on gross profit-to-assets (GPA) ratios, earnings-to-price (EP) ratios, and book-to-price (BP) ratios respectively, for the JSE, earn returns that exceed that of the market.	
$H1a_0$: gross profits-to assets (long) <= market return **$H1a_{alt}$: gross profits-to assets (long) > market return**	Rejected **Accepted**
$H1b_0$: earnings-to-price (long) <= market return **$H1b_{alt}$: earnings-to-price (long) > market return**	Rejected **Accepted**
$H1c_0$: book-to-price (long) <= market return **$H1c_{alt}$: book-to-price (long) > market return**	Rejected **Accepted**

Table 6 shows that the gross profits-to-assets, book-to-price and earnings-to-price based strategies outperform the market (ALSI) for long only portfolios over the 16-year period (2003-2018). Overall the portfolio constructed on gross profit-to-assets has the highest outperformance to the market (ALSI), followed by book-to-price and then earnings-to-price. Overall all strategies outperformed the market for most years. The only years where all strategies did not outperform the market were 2007 and 2013, as shown in Appendix 2. The highest average excess return (in relation to the ALSI), in a given year, was earned by the earnings-to-price strategy in 2016, with an excess average return of 2.6%, followed by the gross profits-to assets strategy in 2008 of 2.5%.

The time frame of 2008 coincides with the financial crisis, indicating that using gross profit-to-assets as quality a measure may eliminate the "value trap", and protect against underperformance in a weak market. This fact is emphasized by the comparison to book-to-price and earnings-to-price, which only earned an average excess return of 0.1% and 0.6% respectively. However, the latter two strategies do recover in the following year, outperforming the gross profit-to assets strategy. Thus, adding a quality overlay to a value strategy may well protect the overall portfolio against underperformance in bear markets, but retain the value-upside in subsequent periods.

$H1a_0$ is rejected because the gross profits-to assets (long) strategy earns an excess annual CAGR of 5.7%, and $H1b_0$ is rejected because the earnings-to-price (long) strategy earns an excess annual CAGR of 3.4%. $H1c_0$ is rejected because the book-to-price approach earns an excess CAGR of 5.3%.

All four strategies assessed in this study outperformed the market (proxied as the ALSI), with the double-sort and gross profits-to-assets approaches outperforming the market by a substantial amount. This finding differs from that of Emde and Yildirim (2016) on the Stockholm Stock Exchange, namely that both value strategies (book-to-price and earnings-to-price) had underperformed the market.

Research Question 2:	**Finding**
In the context of long-only value strategies, do portfolios sorted on gross profit-to-assets ratios earn returns that exceed that of portfolios separately sorted on a) the earnings-to-price (EP) ratio or b) the book-to-price (BP) ratio?	
$H2a_0$: gross profits-to assets (long) <= earnings-to-price ratio return $H2a_{alt}$: gross profits-to assets (long) > earnings-to-price ratio return	Rejected **Accepted**
$H2b_0$: gross profits-to assets (long) <= book-to-price ratio return $H2b_{alt}$: gross profits-to assets (long) > book-to-price ratio return	Rejected **Accepted**

To answer Research Questions 2 and 3, comparisons were made across the three strategies (gross profits-to-assets, earnings-to-price and book-to-price) by looking at excess returns to the market (proxied by the ALSI), excess returns to the risk-free rate (STF3M), as well as abnormal returns (based on comparison against the CAPM implied expected returns). Table 6 shows that for long only portfolios, gross profits-to-assets outperforms both the earnings-to-price and book-to-price strategies, based on portfolio total returns measured by the CAGR (24.6%, versus 21.9% and 22.6%, respectively). The same applies for the excess returns against the ALSI and the risk-free rate. However, when comparing CAPM-derived abnormal returns, the book-to-price approach slightly outperforms gross profits-to assets by 0.3% when comparing the CAGR.

The only difference in assessment compared to the excess returns, is the beta component of the CAPM, which is used to adjust the expected returns for the associated risk. This disparity may indicate that the shares selected, based on gross profits-to-assets in the portfolio, may have higher betas (and, therefore, higher risk) than those selected in the book-to-price portfolio. There is, however, only a marginal difference in the abnormal return. The study conducted on the Stockholm Stock Exchange by Emde and Yildirim (2016) similarly found that the gross profits-to-assets strategy outperforms the earnings-to-price and book-to-price approaches. However, in contrast to the present study with regard to excess returns (but not for abnormal returns), the Swedish study found that the earnings-to-price strategy outperformed the book-to-price one. $H2a_0$ and $H2b_0$ are thus rejected, as the gross profits-to assets strategy earns a CAGR of 2.7% and 2% higher than the earnings-to-price and book-to-price strategies, respectively, when comparing total actual returns.

Research Question 3:	**Finding**
Considering a combined long-only strategy, would adding a quality strategy overlay, based on the gross profits-to-assets ratio, to a value strategy sorted on the book-to-price ratio, increase the performance of the portfolio?	
$H3_0$: book-to-price and gross profits-to assets (long) <= book-to-price (long) H3alt: book-to-price and gross profits-to assets (long) > book-to-price (long)	Rejected **Accepted**

The double-sort (gross profits-to assets and book-to-price) strategy outperforms the stand-alone value strategy of book-to-price for long only portfolios, when comparing total actual returns by 4.2% when comparing their CAGR. In addition to the outperformance when looking at the total returns of the portfolio, the double-sort of gross profits-to assets and book-to-price also outperform the book-to-price strategy when looking at abnormal returns. As the main impact on abnormal returns compared to excess returns is through the beta, this fact could potentially mean that adding the two strategies together and combining the average of the betas may lower the risk, compared to the basic book-to-price value strategy. This situation is a significant improvement on the value strategy and in line with Novy-Marx's (2013) findings that gross profits-to assets can act as a hedging tool for value investing and, thus, improve the returns earned on a portfolio. $H3_0$ is rejected, because the double-sort gross profits-to assets and book-to-price ratio earns a CAGR of 26.8%, versus 22.6% for the basic book-to-price strategy.

5.2 Long-short portfolio results

Research question 4:	**Finding**
In the context of long-short value strategies, do portfolios sorted on gross profit-to-assets ratio earn returns that exceed that of portfolios separately sorted on a) the earnings-to-price (EP) ratio or b) the book-to-price (BP) ratio?	
$H4a_0$: gross profits-to assets (long-short) <= earnings-to-price ratio return $H4a_{alt}$: gross profits-to assets (long-short) > earnings-to-price ratio return	Rejected **Accepted**
$H5a_0$: gross profits-to assets (long-short) <= book-to-price ratio return $H5a_{al}$: gross profits-to assets (long-short) > book-to-price ratio return	Rejected **Accepted**

For the long-short portfolio, the gross profits-to assets strategy outperforms both the earnings-to-price and book-to-price strategies when comparing total returns. This finding is in line with the findings from Emde and Yildirim (2016). The same results were found for excess returns (both

r_f and ALSI). However, even though a gross profits-to-assets approach outperforms these two strategies, the returns are not favourable for excess returns. When considering abnormal returns, the gross profit-to-assets strategy does not outperform earnings-to-price and book-to-price strategies on a risk-adjusted basis. While a negative (-0.3%) abnormal return (see Table 6) was found for the gross profits-to assets strategy, positive abnormal returns were found for the book-to-price (0.5%) and earnings-to-price (0.8%) based strategies. These findings are the opposite of those of Emde and Yildirim (2016) for the Swedish equity market. This result may indicate that the shares that are in the portfolios for the book-to-price and earnings-to-price approaches have a lower risk (measured by beta) than for the gross profits-to-assets strategy.

Research question 5:	**Finding**
Considering a combined long-short strategy, would adding a quality strategy overlay based on the gross profits-to-assets ratio to a value strategy sorted on the book-to-price ratio, increase the performance of the portfolio?	
$H5_0$: book-to-price and gross profits-to-assets (long-short) <= book-to-price (long-short) $H5_{alt}$: book-to-price and gross profits-to-assets (long-short) > book-to-price (long-short)	Rejected **Accepted**

Adding a gross profits-to-assets overlay to the book-to-price strategy for the long-short portfolio increases the total returns by 4.2%. This addition also improves the outcome with regards to excess and abnormal returns. This result is in line with the findings related to Research Question 3, namely that adding a gross profits-to-assets filter to a book-to-price strategy appears to hedge for downside risk and, therefore, results in an improvement in abnormal returns when measuring risk using beta. $H5_0$ is rejected, therefore, as the double-sort strategy outperforms book-to-price as a stand-alone strategy, and $H5_{alt}$ is accepted.

The double-sort on gross profits-to-assets and book-to-price outperforms the three other strategies considered for both long only and long-short portfolios by a substantial margin. This result is also in line with the study of the Stockholm Stock Exchange (Emde & Yildirim, 2016)

5.3 The Fama French Five Factor Model (2015)

The abnormal returns found using the CAPM, indicate that more than the market risk premium is required to explain these returns and, thus, that there are other risk premiums operating on the JSE. The Fama and French Five Factor Model (2015), which was developed to try to explain some of the additional risk premia built into returns, was thus used as a further check to establish whether a gross profit-to-asset premium exists on the JSE. Therefore, if a zero alpha is found running the Five Factor Model regression, it means that the five factors of this model adequately capture the excess returns of the portfolio, without the need for a gross profit-to-asset premium. A positive alpha, however, would mean that the gross profit-to-asset strategy delivers positive risk adjusted returns, and a negative alpha would indicate that it delivers negative risk adjusted returns.

The regression for the Fama and French Five Factor Model (2015) was run using Stata/IC 16.0 and a Durbin-Watson test was performed to test for autocorrelation. The results of the Durbin Watson Test confirmed that multi-collinearity was not a problem with the various independent variables, and this fact was confirmed again by the results of a Breusch-Godfrey test. Normality and heteroscedasticity were tested through the use of visual representations (see Appendixes 5 to 12). The data distribution was judged to be close enough to normal for the purpose of analysis, and there were no indications of excessive heteroscedasticity.

5.3.1 Long Only

Tables 7 to 10 below show the Five Factor (Fama and French, 2015) regression results of the four long only portfolio strategies tested in this study.

Table 7: Extract of long only gross profits-to-assets excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	178.94
Model	.269976357	5	.053995271	Prob > F	=	0.0000
Residual	.05612684	186	.000301757	R-squared	=	0.8279
				Adj R-squared	=	0.8233
Total	.326103197	191	.001707347	Root MSE	=	.01737

Grossprofit-s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.1586351	.0466967	-3.40	0.001	-.2507583	-.0665118
Size	-.2367322	.1074158	-2.20	0.029	-.4486422	-.0248223
Value	.1619975	.078125	2.07	0.039	.0078725	.3161224
Profitability	1.098277	.0864991	12.70	0.000	.9276317	1.268923
Investment	.0843419	.0835327	1.01	0.314	-.0804514	.2491352
_cons	-.0022353	.0013656	-1.64	0.103	-.0049294	.0004588

Table 8: Extract of long only book-to-price excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	181.33
Model	.422668931	5	.084533786	Prob > F	=	0.0000
Residual	.086709748	186	.000466181	R-squared	=	0.8298
				Adj R-squared	=	0.8252
Total	.509378679	191	.002666904	Root MSE	=	.02159

Book_Price	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	.0599345	.058041	1.03	0.303	-.0545688	.1744378
Size	-.3236047	.1335109	-2.42	0.016	-.5869951	-.0602143
Value	.7742908	.0971043	7.97	0.000	.5827234	.9658582
Profitability	-.2533816	.1075128	-2.36	0.019	-.4654829	-.0412804
Investment	.769298	.1038258	7.41	0.000	.5644706	.9741255
_cons	-.0019136	.0016974	-1.13	0.261	-.0052622	.0014349

Table 9: Extract of long only earnings-to-price excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	143.13
Model	.317303061	5	.063460612	Prob > F	=	0.0000
Residual	.082467461	186	.000443373	R-squared	=	0.7937
				Adj R-squared	=	0.7882
Total	.399770523	191	.002093039	Root MSE	=	.02106

Earnings_Pr-e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	.0083486	.0566034	0.15	0.883	-.1033185	.1200157
Size	.0786499	.130204	0.60	0.547	-.1782165	.3355163
Value	.4033255	.0946991	4.26	0.000	.2165031	.590148
Profitability	.1930565	.1048498	1.84	0.067	-.0137912	.3999042
Investment	.3638191	.1012541	3.59	0.000	.1640651	.5635732
_cons	-.0032408	.0016553	-1.96	0.052	-.0065064	.0000248

Table 10: Extract of long only double sort (gross profit-to-assets and book-to-price) excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	163.47
Model	.248913507	5	.049782701	Prob > F	=	0.0000
Residual	.056643565	186	.000304535	R-squared	=	0.8146
				Adj R-squared	=	0.8096
Total	.305557072	191	.001599775	Root MSE	=	.01745

Grossprofit-e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.026683	.0469112	-0.57	0.570	-.1192293	.0658634
Size	.0822758	.1079091	0.76	0.447	-.1306073	.2951589
Value	.3172896	.0784838	4.04	0.000	.1624568	.4721224
Profitability	.4485591	.0868964	5.16	0.000	.27713	.6199882
Investment	.1313723	.0839163	1.57	0.119	-.0341778	.2969225
_cons	-7.65e-06	.0013719	-0.01	0.996	-.0027141	.0026988

Overall the statistics for the long only portfolios showed that, although there were some exceptions, most of the five model factors were found to have both positive coefficients and were statistically significant at the 5% level. However, the intercepts (alpha values) were weakly negative for all strategies, but statistically significant only for the gross profit-to-assets and earnings–to-price strategies. Further, again in all cases, the Five-Factor Model (Fama and French, 2015) explains around 80% of the return variability within the various strategies. Overall, these

results, therefore, do not statistically support the superiority of any of the tested strategies on a risk-adjusted basis within the Five Factor framework, which is not entirely surprising, because the Fama and French Five Factor Model (2015) to a large extent actually incorporates the factors on which these tested strategies are built.

It, therefore, makes sense that the coefficient of the profitability factor (1.098) has by far the strongest correlation to the excess returns achieved by the gross profits-to-assets strategy, and that the value factor is strongly correlated with the excess returns achieved by the price-to-book strategy. It is interesting to notes that the strongest correlations with the earnings-to-price strategy's returns are found within both the value and investment factors, with a smaller contribution from the profitability factor. The excess returns of the double-sort strategy are, again as expected, most correlated to the profitability and value factors.

5.3.2 Long-short

Tables 11 to 14 show the Five Factor regression results of the four long-short portfolio strategies tested in this study.

Table 11: Extract of long-short gross profit-to-assets excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	19.47
Model	.185034808	5	.037006962	Prob > F	=	0.0000
Residual	.353618862	186	.001901177	R-squared	=	0.3435
				Adj R-squared	=	0.3259
Total	.53865367	191	.002820176	Root MSE	=	.0436

Grossprofit-s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.6919286	.1667151	-4.15	0.000	-1.020824	-.3630331
Size	-.0075385	.2557908	-0.03	0.977	-.5121627	.4970857
Value	.1355279	.1805305	0.75	0.454	-.2206226	.4916784
Profitability	1.145296	.1946649	5.88	0.000	.7612615	1.529332
Investment	-.7036143	.183883	-3.83	0.000	-1.066379	-.3408498
_cons	.0039821	.0033768	1.18	0.240	-.0026796	.0106439

Table 12: Extract of long-short book-to-price excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	21.70
Model	.124432394	5	.024886479	Prob > F	=	0.0000
Residual	.213305403	186	.001146803	R-squared	=	0.3684
				Adj R-squared	=	0.3515
Total	.337737797	191	.001768261	Root MSE	=	.03386

Book_Price	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.318288	.1294816	-2.46	0.015	-.5737294	-.0628467
Size	-.2863553	.1986635	-1.44	0.151	-.6782787	.1055682
Value	.484271	.1402115	3.45	0.001	.2076616	.7608803
Profitability	-.667814	.1511893	-4.42	0.000	-.9660802	-.3695478
Investment	.8952779	.1428153	6.27	0.000	.6135318	1.177024
_cons	.0008415	.0026227	0.32	0.749	-.0043325	.0060155

Table 13: Extract of long-short earnings-to-price excess returns regression

Source	SS	df	MS	Number of obs	=	192
				F(5, 186)	=	4.56
Model	.028736663	5	.005747333	Prob > F	=	0.0006
Residual	.234429446	186	.001260373	R-squared	=	0.1092
				Adj R-squared	=	0.0852
Total	.263166109	191	.001377833	Root MSE	=	.0355

Earnings_Pr-e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.3122554	.1357417	-2.30	0.023	-.5800466	-.0444642
Size	.400585	.2082684	1.92	0.056	-.0102869	.8114569
Value	.0494095	.1469904	0.34	0.737	-.2405732	.3393921
Profitability	-.1885248	.1584988	-1.19	0.236	-.5012113	.1241618
Investment	.0372967	.1497201	0.25	0.804	-.2580711	.3326644
_cons	.0022041	.0027495	0.80	0.424	-.00322	.0076282

Table 14: Extract of long-short double sort (GPA and P/B) excess returns regression

Source	SS	df	MS		
Model	.096736279	5	.019347256	Number of obs	= 192
Residual	.201471408	186	.00108318	F(5, 186)	= 17.86
Total	.298207687	191	.001561297	Prob > F	= 0.0000
				R-squared	= 0.3244
				Adj R-squared	= 0.3062
				Root MSE	= .03291

Grossprofit~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Market	-.7942611	.1258386	-6.31	0.000	-1.042516	-.5460067
Size	-.0084624	.1930741	-0.04	0.965	-.3893589	.3724342
Value	.4366988	.1362666	3.20	0.002	.1678719	.7055256
Profitability	.3333876	.1469355	2.27	0.024	.0435132	.623262
Investment	-.0832908	.1387972	-0.60	0.549	-.3571099	.1905283
_cons	.0103511	.0025489	4.06	0.000	.0053227	.0153795

The first thing to notice in Tables 11 to 14 above is the low R^2 and adjusted R^2 (between 10% and 36%) compared to the long portfolios. The Fama and French Five Factor Model (2015), therefore, does not adequately explain the reasons for the long-short returns. Furthermore, there are now far fewer statistically significant factors in the various models, and only one alpha (that of the double-sort approach) that are statistically significant. It is interesting to note, however, that the coefficient of the market factor is found to be negative throughout, possibly due to the short component of the long-short strategies. The large contributions of the profitability factor in the gross profit-to-assets strategy, and both the profitability and value factors for the double-sort strategy, again make sense, albeit with limited statistical significance in the case of the latter.

In general (and particularly in the long portfolios), the Fama and French Five Factor Model (2015) confirms the dominance of specific and expected factors in explaining the excess returns of the different strategies and, therefore, indirectly confirms the correct construction of these portfolios. However, due to the general lack of statistical significance of the intercept values, it is not possible to draw any conclusions with regard to the abnormal returns of these strategies within the Five Factor Model framework (Fama and French, 2015).

The next chapter concludes this study with a summary of its contents and discussing future potential areas of research.

CHAPTER 6: SUMMARY AND CONCLUSION

This chapter concludes the study with an overall summary of the findings, its implications, and suggestions for further research flowing from this study.

The findings from this study show outperformance for long portfolios for all four strategies tested in this research project, when comparing the actual returns of the portfolios to the excess returns for the ALSI risk free rate, as well as the expected return measured by CAPM. The gross profits-to-assets performed better overall when comparing actual, excess and abnormal returns than the two value investing strategies for both long only and long-short portfolios on the JSE. While the gross profits-to-assets strategy outperformed the earnings-to-price and book-to-price strategies, the earnings per share (derived from net-profit) measure used in earnings-to-price approach is prone to distortion by differing disclosures and once-off items, such as impairments, which could skew the research results. Although value strategies, such as those based on book-to-price ratios, have been successfully applied in practice and are supported by the majority of research findings outlined in the academic literature review in Chapter 2, in future this situation may not exist because many stock markets are becoming increasingly dominated by asset-light business models, where most "value" resides within intangibles or unmeasured items, such as brands, which are not necessarily encapsulated within the book-value metric. In terms of these arguments, gross profits-to-assets is a potentially better measure to address these concerns, because it captures the true economics of a company's operations, products and services, whether it be software or actual goods.

For all measures of returns (total, excess and abnormal) long portfolios exhibited outperformance for all strategies. The opposite was found for the long-short portfolios, which may indicate that the relative strength of the ALSI for the period under review did not favour a long-short strategy.

The positive findings relating to the gross profits-to-assets strategy on the JSE compliment the findings of Novy-Marx (2013), as well as of Emde and Yildirim (2016), and indicate that this option could be a useful quality investing tool for investors in this market. However, more importantly,

the double-sort value-quality strategy, based on a combination of gross profits-to-assets and book-to-price ratios, substantially outperforms all other strategies over the 16 year period, when comparing the CAGR, suggesting that this approach has great potential on the JSE. Specifically, whilst the value component may provide upside, the quality overlay may protect the portfolio against the risk of the so-called "value trap". Further, based on the results of this study, it can be concluded that a gross profitability premium does exist on the JSE, and that this anomaly can be used by investors to select stocks to earn returns that are superior to the market.

6.1 Limitations and areas for future research

This study suffered from a number of limitations which are enumerated below:

Firstly, due to the JSE being a very concentrated stock exchange, liquidity is an issue with many stocks. This fact implies that some betas may be misleading. Ideally, betas should be calculated using methods that compensate for this short-coming. In addition, betas are only available from Bloomberg on an annual basis, even though portfolio returns and expected returns are calculated monthly. To improve this study, it may be worth calculating monthly betas from base data for each stock, to improve the accuracy of the testing.

Secondly, the use of gross profit-to-assets limits the sample to companies that recognise gross profit in their statements of comprehensive income. This fact meant that more than half of the shares within the ALSI had to be removed from the sample. In order to eliminate this constraint on value-quality portfolio formation on the JSE, it may be worth exploring less restrictive quality metrics, such as operating profit adjusted for once-off items. In South Africa, an interesting (and somewhat unique) alternative metric could be headline earnings per share (HEPS). HEPS has been a reporting requirement for all listed companies on the JSE since 2000, and is calculated by only taking into account earnings that are a result of operational or capital investment activities, and excludes any re-measurements (e.g. staff reductions, sale of assets and accounting write-downs). Alternatively, the operating profit metrics of Ball et al. (2015) could also be explored for the JSE.

Thirdly, it may also be interesting to deconstruct the time period under review into various cycles or interesting periods, as per the work of Emde and Yildirim (2016). The latter study analysed the

bull-market and the financial crisis separately, in an attempt to discover whether the gross profits-to-assets strategy exhibits even stronger results in downturns.

Fourthly, as denoted in Chapter 5, the outperformance that was explored in this study did not consider any costs, such as bid-ask spread, broker costs, trading commissions or other costs that may be required to buy and hold the portfolios. The fact that the portfolios are only rebalanced once a year, implies lower trading costs than more active strategies, but it is important to note that the returns earned in real life would be lower than quoted in this study.

Lastly, there is still scope for assessing whether gross profits-to-assets is a better investment strategy than the use of other metrics, such as price-to-cash-flow.

REFERENCES

Auret, C. J., & Sinclaire, R. A. (2006). Book-to-market ratio and returns on the JSE. *Investment Analysts Journal*, *35*(63), 31–38. https://doi.org/10.1080/10293523.2006.11082476

Ball, R., Gerakos, J., Linnainmaa, J. T., & Nikolaev, V. V. (2015). Deflating profitability. *Journal of Financial Economics*, *117*(2), 225–248. https://doi.org/10.1016/j.jfineco.2015.02.004

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3–18. https://doi.org/10.1016/0304-405X(81)90018-0

Basiewicz, P., & Auret, C. J. (2010). Feasibility of the Fama and French three factor model in explaining returns on the JSE. *Investment Analysts Journal*, *39*(71), 13–25. https://doi.org/10.1080/10293523.2010.11082516

Basu, S. (1977). Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios : A Test of the Efficient Market Hypothesis. *The Journal of Finance*, *32*(3), 663–682. Retrieved from http://www.jstor.org/stable/2326304

Black, F., Jensen, M. C., & Scholes, M. (1972). The Capital Asset Pricing Model: Some Empirical Tests. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=908569

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance MARK M. CARHART* ABSTRACT. *The Journal of Finance*, *LII*(1), 57–82. https://doi.org/10.2307/2329556

Chan, L. K. C., & Lakonishok, J. (2004). Value and Growth Investing : Review and Update. *Financial Analysts Journal*, *60*(1), 71–86.

Chen, T. F., Sun, L., Wei, K. C. J., & Xie, F. (2014). *On the Explanations for the Gross Profitability Effect: Insights from International Equity Markets*. https://doi.org/10.1111/eufm.12189

Damodaran, A. (2012). *Value Investing : Investing for Grown Ups ?* (New York University - Stern School of Business). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2042657

Dice, C. A., Hou, K., Xue, C., & Zhang, L. (2017). *A Comparison of New Factor Models*. (April).

du Toit, S. G. (2012). *VALUE INVESTING VERSUS GROWTH INVESTING IN SOUTH AFRICA : VALUATION DISPARITIES AND*.

Emde, L., & Yildirim, C. (2016). *The Performance of Gross- Profit to Asset on the Swedish Stock Market*

(Umeå School of Business and Economics). Retrieved from https://umu.diva-portal.org/smash/get/diva2:1152664/FULLTEXT01.pdf

Enow, S. T., & Brijlal, P. (2016). Determinants of Share Prices : the Case of Listed Firms on Johannesburg Stock Exchange. *Journal of Accounting and Management*, *6*(1), 85–92.

Fama, E. F.. (1970). A Review of Theory and Empirical Work. *The Journal of Finance*, *25*(2), 383–417. https://doi.org/10.1016/0002-8703(53)90182-3

Fama, E. F. (1991). Efficient Capital Markets II. *Journal of Finance*, *46*(5), 1575–1617.

Fama, E. F.. (1998). *Value Versus Growth - the International Evidence.pdf*. *LIII*(6).

Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance*, *47*(2), 427–465. https://doi.org/10.2307/2329112

Fama, E. F., & French, K. R. (1993a). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, *33 (1)*, 3–56. https://doi.org/10.1016/0304-405X(93)90023-5

Fama, E. F., & French, K. R. (1993b). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, *33 (1)*, 3–56. https://doi.org/10.1016/0304-405X(93)90023-5

Fama, E. F., & French, K. R. (2006). *Profitability , investment and average returns*. *82*, 491–518. https://doi.org/10.1016/j.jfineco.2005.09.009

Fama, E. F., & French, K. R. (2015a). A five-factor asset pricing model.[Fama-Miller Working Paper]. 2014. *Acesso Em*, *17*(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

Fama, E. F., & French, K. R. (2015b). A five-factor asset pricing model. *Journal of Financial Economics*, *17*(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

Fama, E. F., & MacBeth, J. D. (1973). Risk, Return, and Equilibrium: Empirical Tests. *Journal of Political Economy*, *81*(3), 607–636. https://doi.org/10.1086/260061

Gordon, M., & De Rossi, G. (2013). *The Profitability Premium in EM Equities*. (December), 10. Retrieved from http://www.pimco.com/EN/Insights/Pages/The-Profitability-Premium-in-EM-Equities-ID.aspx

Griffin, J. M. (2002). Are the Fama and French Factors Global or Country Specific? *The Review of Financial Studies*, *15*(3), 783–803. https://doi.org/10.1093/rfs/15.3.783

Hou, K., Xue, C., & Zhang, L. (2015). Digesting anomalies: An investment approach. *Review of Financial Studies*, *28*(3), 650–705. https://doi.org/10.1093/rfs/hhu068

Jensen, M. C. (1969). Risk , The Pricing of Capital Assets , and The Evaluation of Investment Portfolios. *Journal of Business*.

Keim, B. (1983). *Size-related anomalies and stock return seasonality*. *12*, 13–32.

Kothari, S. P., Shanken, J., & Sloan, R. G. (1995). *Another Look at the Cross-Section of Expected Stock Returns*. *50*(1), 185–224.

Liu, R. (2015). *Pro tability Premium : Risk or Mispricing ? 1 Introduction*. 1–49.

Malkiel, B. G. (2003). *The Efficient Market Hypothesis and Its Critics*. *17*(1), 59–82.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, *7*(1), 77–91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

Marshall E. Blume and Irwin Friend. (1974). Risk, Investment Strategy and the Long-Run Rates of Return. *The Review of Economic and Statistics*, *56*(Aug), 259–269. Retrieved from http://www.jstor.org.ezproxy.uct.ac.za/stable/pdf/1923963.pdf?refreqid=excelsior%3Ac203c5e48dd42c2d9907db4ecf28261c

Novy-Marx, R. (2013). The other side of value: The gross profitability premium. *Journal of Financial Economics*, *108*(1), 1–28. https://doi.org/10.1016/j.jfineco.2013.01.003

Reggiani, F., & Penman, S. (2018). Fundamentals of Value vs . Growth Investing and an Explanation for the Value Trap. *Financial Analysts Journal*, *74*, 103–119.

Rosenberg, B., Kenneth Reid, & Lanstein, R. (1985). Persuasive evidence of market inefficiency PROPERTIES OF THE STRATEGIES. *The Journal of Portfolio Management*, *113*, 9–16. https://doi.org/10.3905/jpm.1985.409007

Schwert, G. W. W. (2003a). Anomalies and Market Efficiency. In *Handbook of the Economics of Finance* (Vol. 1). https://doi.org/10.2139/ssrn.338080

Schwert, G. W. W. (2003b). Anomalies and Market Efficiency. In *Handbook of the Economics of Finance* (Vol. 1). https://doi.org/10.2139/ssrn.338080

Sharpe, W. F. (1964). Capital asset prices: A theroy of market equilibrium under conditions of risk. *The*

Journal of Finance, *19*(3), 425–442. https://doi.org/10.2307/2329297

Strugnell, D., Gilbert, E., & Kruger, R. (2015). *Beta , size and value effects on the JSE , 1994 – 2007*. *3523*(2011), 1994–2007. https://doi.org/10.1080/10293523.2011.11082537

van Rensburg, P., & Robertson, M. (2003a). Style characteristics and the cross-section of JSE returns. *Investment Analysts Journal*, *31*(57), 7–15. https://doi.org/10.1080/10293523.2003.11082444

van Rensburg, P., & Robertson, M. (2003b). Size, price-to-earnings and beta on the JSE Securities Exchange. *Investment Analysts Journal* , *3523*(58), 7–16. https://doi.org/10.1080/10293523.2003.11082449

APPENDICES

Appendix 1: Annual average total returns

Appendix 1 shows the total actual return monthly averages per year for long only and long-short portfolios.

This is the monthly total average that would have been earned for the given portfolio.

LONG ONLY TOTAL RETURN AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	5.0%	4.9%	4.9%	5.7%
2004	3.9%	3.1%	3.2%	3.5%
2005	4.2%	5.7%	4.4%	4.0%
2006	2.5%	3.3%	2.6%	3.8%
2007	-0.7%	0.1%	-0.4%	-0.8%
2008	0.0%	-2.4%	-1.9%	-0.1%
2009	4.0%	5.1%	5.3%	4.8%
2010	2.4%	2.0%	1.5%	2.2%
2011	2.1%	1.1%	2.1%	2.0%
2012	2.3%	1.7%	1.3%	2.3%
2013	1.0%	1.6%	1.6%	1.8%
2014	8.6%	4.0%	4.1%	2.9%
2015	0.6%	0.8%	0.5%	-0.1%
2016	1.0%	2.5%	2.8%	2.2%
2017	1.5%	-0.2%	1.4%	1.1%
2018	-1.3%	0.4%	-1.2%	-0.5%

LONG-SHORT TOTAL RETURN AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	2.4%	1.4%	1.2%	2.7%
2004	1.5%	-0.7%	0.3%	1.2%
2005	-2.5%	0.5%	-1.8%	-1.5%
2006	-2.2%	0.2%	-0.4%	-1.1%
2007	-1.4%	0.8%	-1.0%	-1.7%
2008	2.7%	-2.6%	0.3%	3.1%
2009	0.3%	1.4%	1.9%	2.1%
2010	1.1%	0.3%	-0.2%	1.5%
2011	2.1%	-1.2%	1.7%	1.5%
2012	1.7%	-0.5%	-0.1%	1.6%
2013	-0.7%	0.4%	0.2%	0.5%
2014	3.5%	-2.1%	-1.1%	1.7%
2015	-1.6%	0.4%	-0.7%	-0.8%
2016	-0.6%	1.8%	2.4%	1.8%
2017	1.6%	-0.8%	2.0%	2.1%
2018	-2.2%	1.6%	-2.2%	-0.6%

Appendix 2: Annual average excess returns (Actual return of the portfolio less the return of the market (ALSI)

Appendix 2 shows the excess monthly return averages per year for long only and long-short portfolios. This is calculated taking the actual monthly return for the given portfolio less the average monthly return for the ALSI.

LONG ONLY EXCESS RETURNS (ALSI)				
	Gross profits-to assets	Book-to-price	Earnings-to-price	Gross profits-to assets + book-to-price
2003	1.8%	1.6%	1.7%	2.5%
2004	1.8%	0.9%	1.0%	1.3%
2005	0.2%	1.7%	0.4%	0.0%
2006	-0.2%	0.5%	-0.2%	-0.1%
2007	-1.7%	-0.9%	-1.4%	-1.8%
2008	2.5%	0.1%	0.6%	2.4%
2009	0.9%	1.9%	2.1%	1.6%
2010	1.1%	0.7%	0.2%	0.9%
2011	1.5%	0.4%	1.5%	1.3%
2012	0.6%	1.0%	-0.4%	0.6%
2013	-0.8%	-0.3%	-0.3%	-0.1%
2014	1.1%	-1.2%	-0.8%	0.2%
2015	0.3%	0.5%	0.2%	-0.4%
2016	0.8%	2.2%	2.6%	2.0%
2017	0.7%	-1.0%	0.5%	0.3%
2018	-1.8%	0.0%	-2.0%	-1.0%

LONG-SHORT EXCESS RETURNS (ALSI)				
	Gross profits-to assets	Book-to-price	Earnings-to-price	Gross profits-to assets + book-to-price
2003	-0.8%	-1.8%	-2.0%	-0.5%
2004	-0.7%	-2.8%	-1.9%	-1.0%
2005	-6.5%	-3.5%	-5.8%	-5.5%
2006	-4.9%	-2.6%	-3.2%	-3.9%
2007	-2.4%	-0.2%	-0.4%	-2.7%
2008	5.2%	-0.1%	2.8%	5.6%
2009	-2.9%	-1.8%	-1.3%	-1.1%
2010	-0.2%	-1.0%	-1.4%	0.3%
2011	1.4%	-1.9%	1.0%	0.8%
2012	0.0%	-1.1%	-1.8%	-0.1%
2013	-2.5%	-1.5%	-1.7%	-1.3%
2014	2.5%	-3.1%	-2.2%	0.7%
2015	-2.0%	0.1%	-1.1%	-1.1%
2016	-0.8%	1.6%	2.2%	1.6%
2017	0.8%	-1.6%	1.2%	1.3%
2018	-2.7%	1.1%	-2.7%	-1.1%

Appendix 3: Annual average excess returns (Actual return of the portfolio less the risk-free rate)

Appendix 3 shows the excess monthly return averages per year for long only and long-short portfolios. This is calculated taking the actual monthly return for the given portfolio less the average monthly return for the risk-free rate.

LONG ONLY EXCESS RETURN (rf) AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	4.2%	4.0%	4.0%	4.9%
2004	3.3%	2.6%	2.4%	2.9%
2005	3.6%	3.9%	5.1%	3.4%
2006	1.9%	1.9%	2.6%	2.0%
2007	-1.5%	-1.2%	-0.7%	-1.6%
2008	-0.9%	-2.8%	-3.3%	-1.0%
2009	3.4%	4.7%	4.5%	4.2%
2010	1.9%	1.0%	1.5%	1.7%
2011	1.7%	1.7%	0.7%	1.6%
2012	1.9%	0.9%	1.3%	1.9%
2013	0.6%	1.2%	1.2%	1.4%
2014	1.7%	-0.2%	-0.7%	0.8%
2015	0.1%	0.0%	0.3%	-0.6%
2016	0.5%	2.2%	1.9%	1.7%
2017	0.9%	0.8%	-0.8%	0.5%
2018	-1.9%	-1.8%	-0.1%	-1.1%

LONG ONLY EXCESS RETURN (rf) AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	1.5%	0.3%	0.5%	1.9%
2004	0.9%	-0.4%	-1.3%	0.6%
2005	-3.1%	-2.4%	0.0%	-2.0%
2006	-2.8%	-1.0%	-0.5%	-1.8%
2007	-2.2%	-1.8%	0.0%	-2.5%
2008	1.8%	-0.6%	-3.5%	2.2%
2009	-0.3%	1.3%	0.8%	1.5%
2010	0.6%	-0.7%	-0.2%	1.0%
2011	1.6%	1.3%	-1.6%	1.1%
2012	1.3%	-0.5%	-0.9%	1.2%
2013	-1.1%	-0.2%	0.0%	0.1%
2014	3.0%	-1.6%	-2.5%	1.2%
2015	-2.1%	-1.2%	-0.1%	-1.3%
2016	-1.2%	1.8%	1.2%	1.3%
2017	1.0%	1.4%	-1.4%	1.6%
2018	-2.8%	-2.7%	1.1%	-1.1%

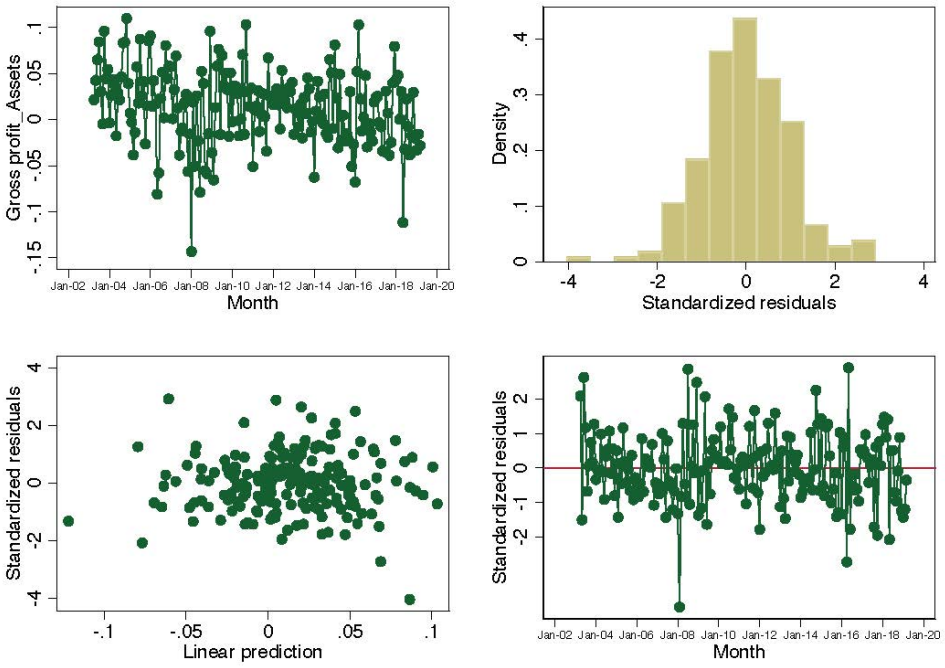
Appendix 4: Annual average excess returns (Actual return of the portfolio less expected return (CAPM))

Appendix 4 shows the abnormal monthly return averages per year for long only and long-short portfolios. This is calculated taking the actual monthly return for the given portfolio less the average expected (calculated using CAPM) monthly return for the risk free rate.

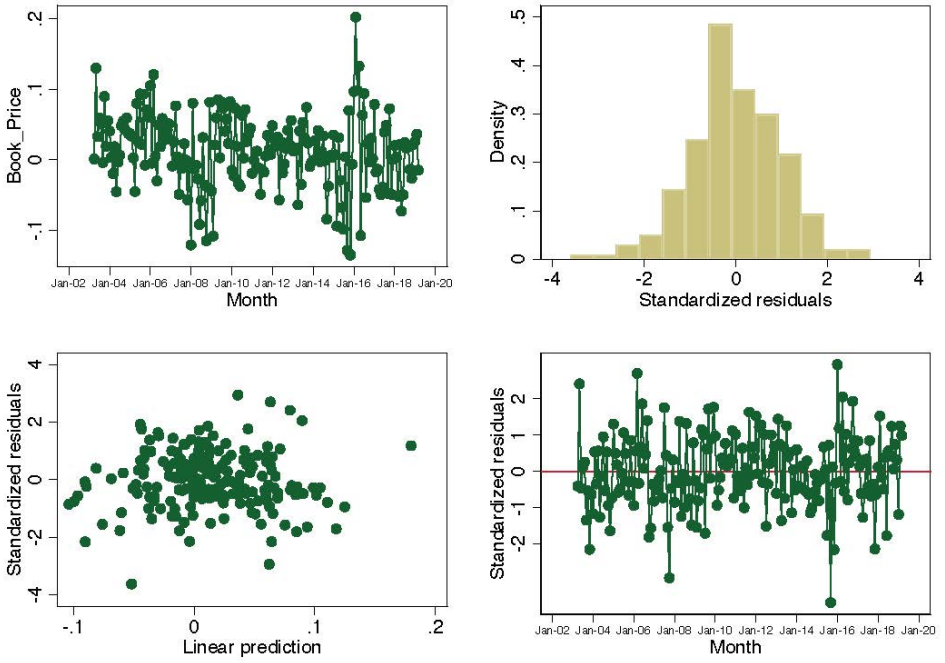
LONG ONLY ABNORMAL RETURN AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	3.8%	3.7%	3.8%	4.5%
2004	3.3%	2.3%	2.4%	2.8%
2005	2.3%	3.7%	2.5%	1.9%
2006	1.3%	1.7%	1.4%	1.4%
2007	0.5%	0.0%	-0.5%	-0.9%
2008	2.3%	-0.2%	0.3%	2.0%
2009	2.4%	3.4%	3.3%	3.2%
2010	1.9%	1.5%	1.0%	1.7%
2011	-0.1%	0.9%	2.0%	1.8%
2012	-0.4%	1.7%	1.3%	1.4%
2013	0.5%	0.4%	0.6%	0.9%
2014	7.0%	2.0%	2.4%	1.2%
2015	0.7%	1.0%	0.6%	0.0%
2016	1.3%	2.8%	3.1%	2.5%
2017	1.3%	-0.5%	1.1%	1.1%
2018	-1.3%	0.5%	-1.4%	-0.5%

LONG-SHORT ABNORMAL RETURN AVERAGES				
	Gross profits-to assets	**Book-to-price**	**Earnings-to-price**	**Gross profits-to assets + book-to-price**
2003	2.2%	1.4%	1.3%	2.7%
2004	1.6%	-0.6%	0.2%	1.3%
2005	-2.1%	0.8%	-1.2%	-1.2%
2006	-1.6%	0.2%	0.2%	-0.6%
2007	-1.3%	0.9%	-1.0%	-1.7%
2008	-3.4%	-2.0%	-0.6%	2.3%
2009	0.7%	1.4%	1.5%	2.5%
2010	1.2%	0.3%	-0.1%	1.7%
2011	2.1%	-1.2%	1.8%	1.5%
2012	1.9%	-0.5%	-0.1%	1.7%
2013	-0.4%	0.3%	0.2%	0.8%
2014	3.6%	-2.1%	-1.1%	1.8%
2015	-1.6%	0.5%	-0.7%	-0.8%
2016	-0.2%	1.9%	2.4%	1.9%
2017	1.7%	-0.9%	2.0%	2.3%
2018	-2.3%	1.6%	-2.4%	-0.6%

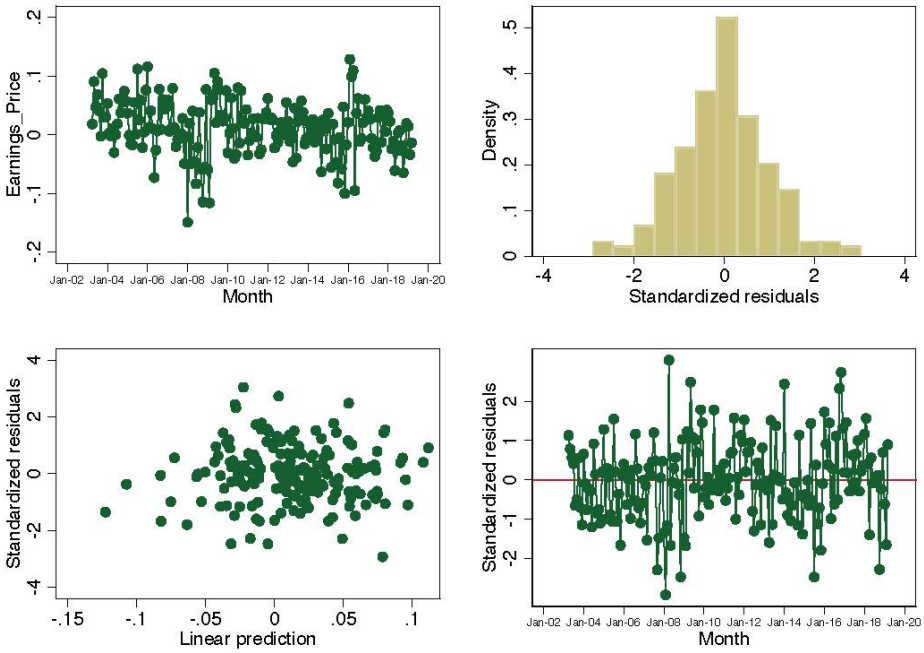
Appendix 5: Extracts of regression analysis performed on Stata/IC 16.0: Long only gross profits-to assets



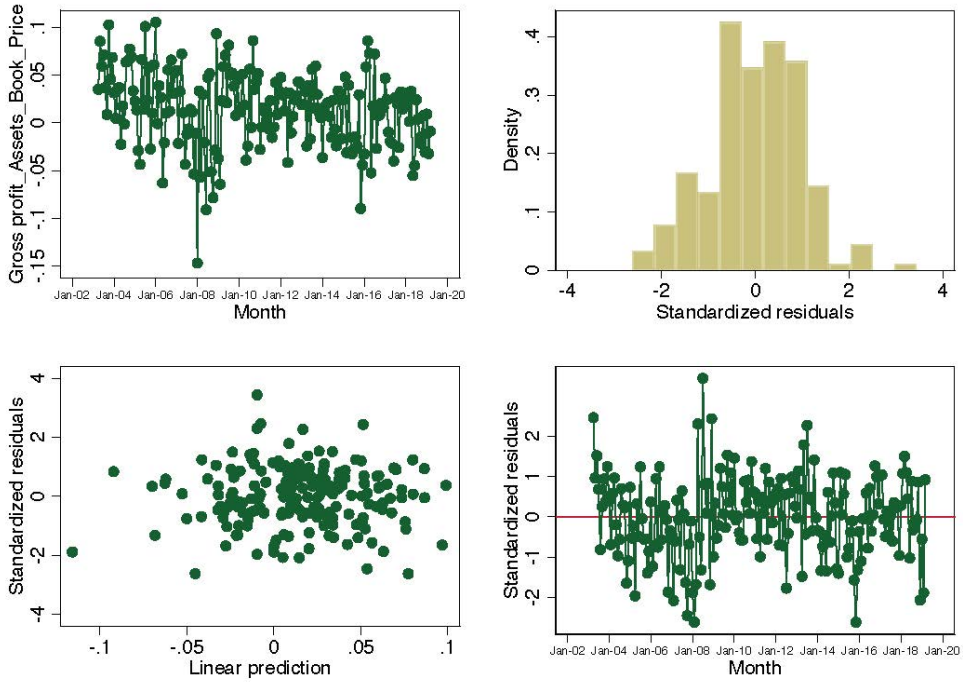
Appendix 6: Extracts of regression analysis performed on Stata/IC 16.0: Long only book-to-price



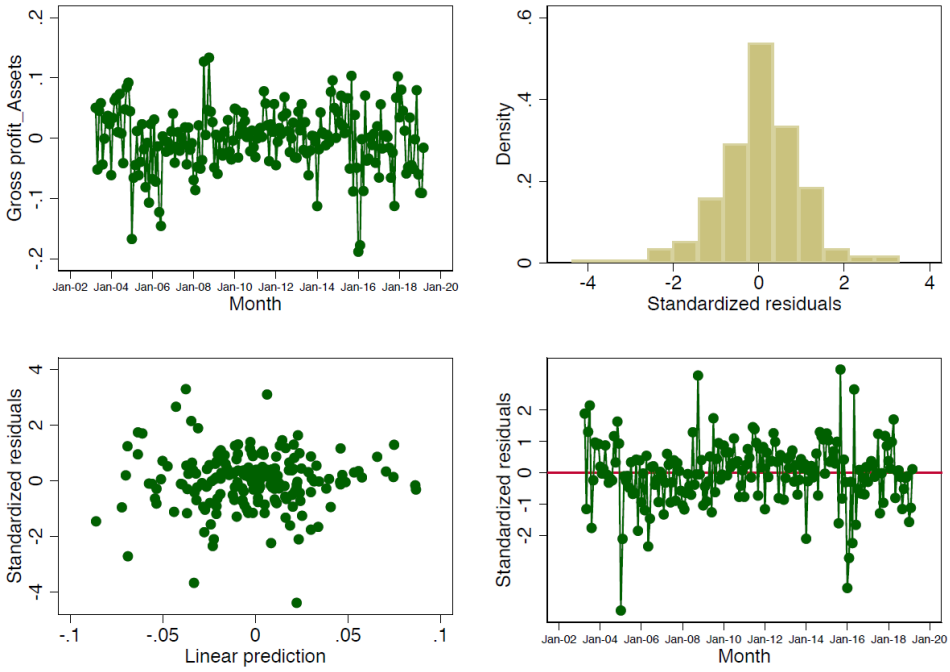
Appendix 7: Extract of regression analysis performed on Stata/IC 16.0: Long only earnings-to-price



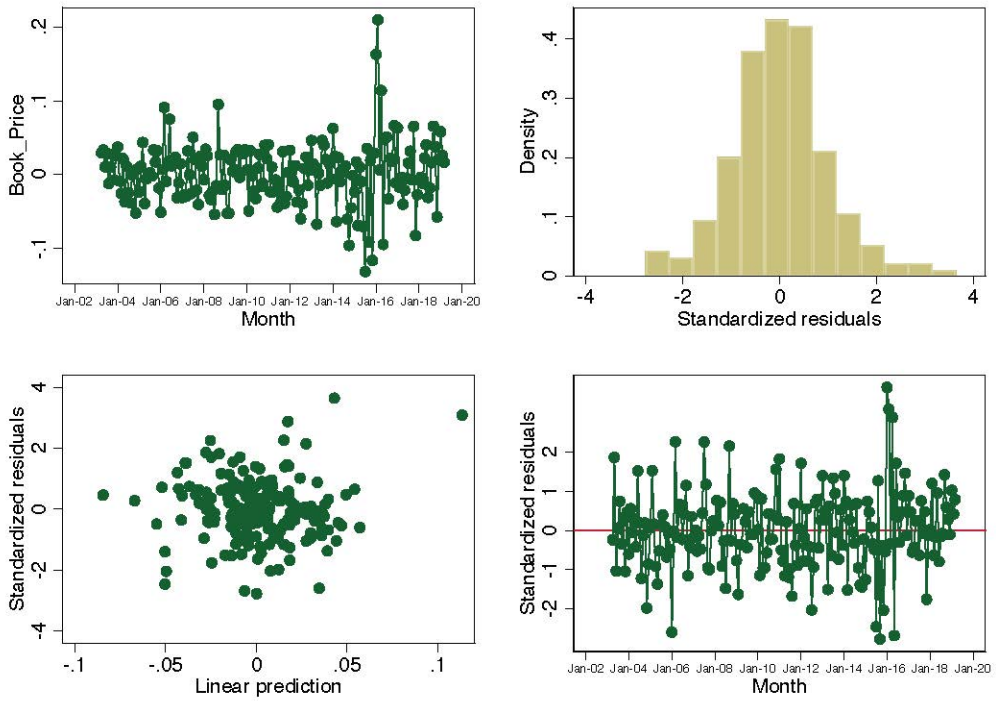
Appendix 8: Extracts of regression analysis performed on Stata/IC 16.0: Double sort gross profits-to assets and book-to-price



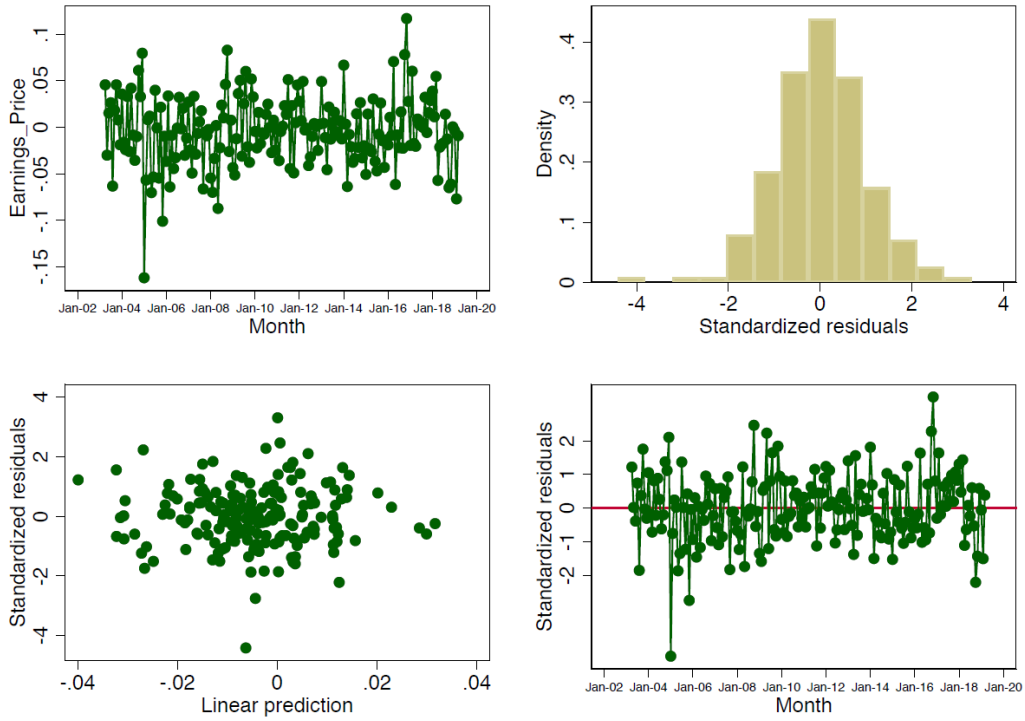
Appendix 9: Extract of regression analysis performed on Stata/IC 16.0: Long-short gross profits-to assets



Appendix 10: Extract of regression analysis performed on Stata/IC 16.0: Long-short book-to-price



Appendix 11: Extract of regression analysis performed on Stata/IC 16.0: Long-short earnings-to-price



Appendix 12: Extract of regression analysis performed on Stata/IC 16.0: Long-short double sort gross profits-to assets and book-to-price