Ville Perttilä

Investigating and comparing the premiums and benefits of recent quality-based profitability ratios

Evidence from OMXH

School of Accounting and Finance
Master's thesis in
Finance

Vaasa 2020

UNIVERSITY OF VAASA
School of Accounting and Finance
Author: Ville Perttilä
Title of the Thesis: Investigating and comparing the premiums and benefits of recent quality-based profitability ratios : Evidence from OMXH
Degree: Master of Science in Economics and Business Administration
Programme: Finance
Supervisor: Klaus Grobys
Year: 2020 **Pages:** 78

ABSTRACT:
The recent development of profitability ratios has led to the discussion whether different measures of profitability have explanatory power for the cross-section of expected returns. During the last few years, the academic literature has shown that certain profitability ratios can predict cross-sectional returns to a similar extent as the book-to-market ratio or market capitalization. The latest modification of profitability ratios shows that excluding the effect of accruals can improve the profitability factor. There is also recent evidence, with justifying arguments that Nordic markets provide an interesting setting to study the returns from the standpoint of profitability. This thesis provides tests on various profitability ratios in attempt to explore which of the below ratios is the most suitable in factor models: operating profitability or cash-based profitability. It also provides an implemented strategy of both ratios, testing whether the accrual free, cash-based profitability can outperform the operating profitability in generating returns.

This will be the first study examining profitability measures in the Finnish equity market investigating a nine-year period during the post financial crisis era. Employing 45 stocks that exhibited the highest market capitalization and liquidity illustrate that the Finnish equity market is an interesting vehicle to observe profitability in a market setting, that has been in distressed, recovering as well as bullish state during the 9-year period after the financial crisis. Creating long-only, and long-short strategy portfolios for the nine-year sample during 30.6.2010-30.6.2019 shows that classifications with both profitability ratios managed to beat the OMXH market index, and the long-short cash profitability outperforms operating profitability. Albeit both profitability ratios can outperform the markets, but however it seems that cash operating profitability is able to rule out the unprofitable firms to low portfolio more efficiently. The yearly average holding period return of long-short cash-based portfolio is 14,06%. Also, sorting out the portfolios based on the level of profitability shows that high profitability companies tend to on average earn more and have lower standard deviations than low profitability companies. When explaining the market returns of OMXH together with Fama-French five-factor model, the cash operating profitability factor captures positive and statistically significant coefficient. Moreover, when the cash operating profitability risk factor is added, the size factor becomes insignificant.

The main result of this study concludes the evidence that cash operating profitability explains above average returns in Finnish equity exchange better than operating profitability. It also outperforms the size and value factors during the investigating period. Cash operating profitability adds quality on investors portfolio during bullish periods by sufficiently identifying the highest quality growth firms, making the cash operating profitability a useful tool to generate purposeful and efficient strategies to invest in the Finnish equity market.

KEYWORDS: Profitability, Operating profitability, Cash operating profitability, Accruals, OMXH, Five-factor model

VAASAN YLIOPISTO
Laskentatoimen ja Rahoituksen Yksikkö

Tekijä:	Ville Perttilä
Tutkielman nimi:	Investigating and comparing the premiums and benefits of recent quality-based profitability ratios : Evidence from OMXH
Tutkinto:	Kauppatieteiden maisteri
Oppiaine:	Rahoitus
Työn ohjaaja:	Klaus Grobys
Valmistumisvuosi:	2020 **Sivumäärä:** **78**

TIIVISTELMÄ:
Kannattavuutta mittaavien tunnuslukujen viimeaikainen kehitys on herättänyt keskustelua siitä, kuinka hyvin pörssikurssien tuotot ovat selitettävissä eri kannattavuuden tunnuslukuja hyödyntäen. Viime vuosina akateemiset tutkimukset ovat osoittaneet, että tietyistä kannattavuuden tunnusluvuista johdetut riskifaktorit ovat pystyneet selittämään markkinatuottoja. Kyseisten tunnuslukujen merkittävyyttä voidaan pitää jopa yhtä olennaisena kuin aikaisemmin hyviksi todetut arvo- sekä kokofaktori. Tuoreimman tutkimuksen mukaan, operatiivisen kannattavuuden tunnusluvun laatua voidaan parantaa eliminoimalla kirjanpidolliset kertymät. Lisäksi akateemiset tutkimukset osoittavat, että pohjoismaiset osakemarkkinat tarjoavat mielenkiintoisen ympäristön tuottoja selittävien tekijöiden tarkasteluun kannattavuuden tunnuslukujen näkökulmasta. Tässä tutkimuksessa testataan kahta ajankohtaisinta kannattavuuden tunnuslukua - operatiivista kannattavuutta ja kassaperusteista kannattavuutta. Tutkimus pyrkii selvittämään, kumpi tunnusluvuista soveltuu paremmin tuottojen riskifaktorimallinnukseen Suomessa, ja vertaillaan näihin kahteen tunnuslukuun perustuvien sijoitusstrategioiden tuottavuutta.

Tämä on ensimmäinen tutkimus Suomen markkinoilla, jossa tutkitaan ajankohtaisimpia kannattavuuden tunnuslukuja finanssikriisin jälkeisellä ajanjaksolla. Tutkimuksessa hyödynnetään vuosittain 45 suurinta yhtiötä aikavälillä 30.6.2010-30.6.2019. Tunnuslukuihin pohjautuvat sijoitusstrategiat tuottivat OMXH–markkinaindeksin paremmin. Lisäksi kassaperusteisen tunnusluvun strategia, jossa ostetaan korkean kannattavuuden yhtiöitä lyhyeksi myymällä matalan kannattavuuden yhtiöitä, tuotti tutkimusjaksolla keskimäärin 14,06 % vuosituottoa. Positiivisten tutkimustulosten vuoksi Suomen pörssiä on mielekästä tutkia juuri kannattavuuden tunnuslukujen näkökulmasta. Jaottelemalla Suomen pörssin yhtiöt operatiivista ja kassaperusteista kannattavuuden tunnuslukua hyödyntäen kyetään poimimaan korkean tuottavuuden yhtiöitä huonommin tuottavien yhtiöiden joukosta. Kassaperusteisen kannattavuuden tunnusluvun avulla voidaan myös kohdistaa tarkemmin heikosti tuottavia yhtiöitä matalan kannattavuuden portfolioihin. Lisättynä Fama-French –viiden faktorin malliin kassaperusteinen tunnusluku kykenee selittämään tuottoja Helsingin pörssissä positiivisella kertoimella tilastollisesti merkittävästi. Lisäksi tutkimus osoittaa, että kun kassaperusteinen riskifaktori lisätään osaksi mallinnusta, yhtiöiden kokoa kuvaava riskifaktori menettää tilastollisen merkittävyytensä.

Tämän tutkimuksen merkittävin löydös on se, että kassaperusteinen kannattavuuden tunnusluku kykenee selittämään tuottoja paremmin suomen markkinoilla finanssikriisin jälkeisellä ajanjaksolla kuin operatiivinen kannattavuuden tunnusluku. Kassaperusteisen tunnusluvun avulla pystytään lisäämään laatua sijoittajien portfolioihin ja identifioimaan laadukkaita kasvuyrityksiä, tehden kyseisestä tunnusluvusta hyvän työkalun osakkeiden tutkintaan ja sijoitusstrategian luomiseen Suomen pörssissä.

AVAINSANAT: Kannattavuus, Operatiivinen kannattavuus, Kassaperusteinen kannattavuus, Kirjanpidon kertymät, OMXH, Viiden faktorin malli

Contents

Figures

Tables

1 Introduction

Investment strategies generating outperformance and abnormal returns are in constant scrutiny among of investors as well as academic researchers. Although the academic field of finance is relatively young in comparison to other fields of academics, it has still managed to broadly develop itself during the past three decades. During this period, it has produced a large variety of different strategies and explanations of returns which have helped investors to improve their successful recipes of seeking the portfolio outperformance. When it comes to fundamentals, such as financial statements, wisely chosen factors start to play a key role in modern portfolio management. Carefully chosen ratios can be helpful tools for investors to track individual company performance, or when the performance of company is compared to a pool of stocks within the same industry. An excellent ratio can even stand for investment strategy.

Academic research has greatly shapen investor strategies during the past few decades. Statman (1980) finds that undervalued companies had positive relationship with equity markets. Later similar results have captured Rosenberg, Ried and Landstein (1985). Eventually Fama and French (1993) made this undervaluation factor popular, and the phenomena is known as book-to-market ratio. Studies have shown that historically, this ratio has been in great focus among academic finance studies, but it has also been a key tool of value investing. Buying securities of which are undervalued relative to their intrinsic value is a corner stone of value investing.

The growth investing is generally an opposite to value investing. Even though the value investing has been a dominant relative to growth, it would be easy to assume that growing firms should generate better returns. On the other hand, growth companies usually tend contain more risk that might out come as a loss of profit. Novy-Marx (2013) presents the gross profitability as a significant influencer and explainer for returns. Even more, the gross profitability ratio itself can explain returns almost with similar extent such as book-to-market factor. Among with explanatory power, the ratio seems to sort out well the best performing growth stocks among other growths stock. The result of

Novy-Marx (2013) are so robust, that it did not only challenge the position of Fama and French's (1993) powerfulness of the book-to-market ratio, but it started the debate of using profitability ratios when it comes to factor modeling of stock returns. These results have lifted the status of growth investing advocating that the best profitable companies can be identified with a greater accuracy.

As an outcome of the ignited debate of the use, Ball, Gerakos, Linnoinmaa and Nikolaev (2015) modified the profitability ratio with adding more business-related cost into it. The outcome of their study is known as operating profitability, and the result are even more significant than with gross profitability. The saga of this hot topic continues as the same authors started to consider the effect of accruals in their measurement. Sloan (1996) finds that accruals are negatively correlated with earnings. To modify their profitability measurement, Ball et al. (2016) exclude the effects of accruals from the operating profitability ratio, and the results strongly supported their thesis. The new ratio of profitability is known as operating profitability.

The impact of recent development in profitability ratios has strengthen role of profitability as a factor for investing. Fama and French (2015) introduce profitability in their five-factor model. Later, Fama and French (2018) compare operating profitability and cash operating profitability in terms of which of these factors explains better returns in their factor model. Among the latest profitability ratios, the results show that cash operating profitability was a better factor.

1.1 Purpose of the study

Market value of equity, undervaluation of equity and past performance are in the core of explaining the return in cross-section. Banz (1981) show that smaller firms generate better returns relative to bigger firms. Fama anch French (1993) show similar evidence of the high book-to-market ratio companies, same time confirming the earlier result of Statman (1980). Jegadesh and Titmam (1993) show that stock with stronger past performance can generate better returns in future. This also known as momentum. The benefits of these previously presented concepts are widely known anomalies which explanatory power for returns have been documented countless times. Later some of these studies are presented further in this thesis.

During the past few decades, high book-to-market ratio has become one of the most important indicators in the concept of value investing. Even though value investing has become popular among investors as well as researchers, the concept has at the same time paved way to a newer form of investing widely recognized as growth investing, which in some extent is regarded as an opposing strategy to the former.

Novy-Marx (2013) adds quality to growth strategies, showing that measuring the profitability by scaling the company´s gross profits to its assets, gives more accurate measure of profitability than earnings-based methods. The strong results of his study show that gross profitability can explain returns in cross section almost as good as book-to-market does. Ball et al. (2015) subtract the selling, administrative and general costs from gross profits resulting with an even more accurate measure of profitability. Sloan (1996) show that companies with high level of accruals have a negative relationship with returns. As a continuum of their prior study, Ball et al (2016) make their measurement cash based by excluding the effect of accounting accruals from the operating profitability. Their results show that cash operating profitability explains returns better than operating profitability. Fama and French (2018) compare these two similar but still different factors to determine which one of them should be used in factor modelling.

Asness (1997) show that momentum is stronger among growth stocks even though it works as well for value stocks. Grobys and Huhta-Halkola (2019) combines value and momentum with a very recent method of rank-based approach to observe the returns in Nordic equity exchanges. They find strong evidence that value anomaly occurs better when the small stocks are considered in the portfolio. In addition, they find that in OMX-markets, the growth stocks seem to drive the negative relation between momentum and value.

The Nordic markets offers an interesting setting to observe the performance of investment strategies. Grobys and Huhta-Halkola (2019 p.2874) provide motivation for further investigation of Nordic markets convincingly. They argue that Nordic countries are economically developed and liquid markets with low level of corruption. Also, The governmental bond yields of Nordic countries co-move similarly as U.S. yields. Among with bond yields, credit ratings of Finland and U.S. are identical.

Novy-Marx (2013) pioneering results of gross profitability, and the recent development of profitability ratios by Ball et al. (2015, 2016), the concept profitability is an interesting topic in literature of finance. Among with Fama and French (1993) book-to-market and Banz (1981) size premiums, profitability has become a factor which has reclaimed stabilized position in the factor models. Motivated by the recent and strong evidence of profitability, this thesis will provide a survey how the two latest developments of profitability, cash operating profitability and operating profitability can explain returns after financial crisis. The examination period is from the end of June 2010 to the end of June 2019. This period provides and interesting time-series to observe profitability investing that is also able to sort out the most quality growth companies.

Since almost all of profitability evidence of Ball et al (2015, 2016) is from the American equity markets, this thesis is excited to study the profitability phenomena in Finnish equity markets. Albeit Grobys and Huhta-Halkola (2019 p.2872) study value and momentum as a combination, their result provides an evidence that in Nordic markets, the negative correlation between momentum and value seems to be driven by the growth stocks. This result allows a great opportunity to investigate whether the growth measured by recent and high-quality profitability ratios explain the returns in similar conditions. Also paying attention to Grobys and Huhta-Halkola (2019) argumentation of the characteristics and reasons to observe Nordic markets, this thesis is motivated to study how the latest profitability ratios perform in the Finnish equity market from the most recent and relevant sense. To the best of my knowledge, there is no existing literature or evidence either of cash operating profitability or operating profitability from Finnish markets. Based on the exiting gap, this thesis provides a fulfilling part to the profitability literature, making OMXH market an interesting vehicle to observe the performance of profitability strategies.

This study tries to figure out whether the recent profitability ratios, operating profitability and cash operating profitability can explain returns in Finnish equity markets. Following the literature of Ball et all (2015, 2016), I have created strategies based on these measures of profitability. The thesis tries to prove, whether constructing a portfolio based on the levels of profitability can generate abnormal returns for investor in Finnish equity markets. The strategies are compared with each other and benchmarked to illustrate if the development from operating profitability to cash operating profitability have improve the ratio. I also test whether the profitability ratios can predict returns and are they capable to produce risk premium for investor.

1.2 Research hypothesis

To set the hypothesis of this study I follow the literature of Ball et al. (2015, 2016). Testing of these hypothesis is done by carrying out a simple and multiple OLS regressions. These regressions try to identify whether the stock returns can be predicted based on cash operating- or operating profitability ratios. The regressions are executed for both ratios individually, and for portfolios that are sorted out based on the level of profitability ratio. The first two hypothesis are set as follows :

H_1 *: Cash-based profitability ratio predicts OMXH stock returns better than operating profitability ratio.*

H_2 : Operating profitability ratio predicts OMXH stock returns better than cash-based profitability ratio.

Furthermore based on the existing literature of Fama and French (2015) I present the five-factor model to demonstrate if profitability factors contains any risk related premiums for investors, and whether they are capable to explain the excess market returns of OMXH. To observe results of five-factor model, I set my secound two hypothesis as follows :

H_3 : Cash-based profitability factor explains the OMXH stock returns better than operating profitability factor.

H_4 : Operating profitability factor explains the OMXH stock returns better than operating profitability factor.

1.3 Structure of the study

The structure of this thesis is planned to equip the reader with the basic theories that are related, or otherwise provide a supportive back up for the core subjet of this study. Firstly, the relation between information and stock prices are presented through the theory of efficient markets. Despite the efficient market hypothesis is relatively old, it works as a frame work tool to observe markets and same time gives a continuum with its assumtions to further tools.

Secoundly, this thesis wil provide a recap of asset pricing and valuation of an assets. The tools and theories are selected in order to support the futher analysis of portfolios both in risk adjusted sense and regression analysis sense. All the chosen theories and models are familiar from the academic literature of finance, and there are existing result of their benefits. To keep the focus on the main point, these tools are presented briefly, but all their core characteristics are tried to centralize in this chapter.

After presenting the asset pricing and valuation tools, the thesis will move forward to the literature review. In this study I will present the most recent academic literature of profitability ratios. During the last ten year, there has been a huge developement and discussion how the profitbility ratios can be used in explaining return. These result have been ground breaking. The last two presented profitability mesures play the key role of the center of this study.

Following literature review I present the data and methodolgy. To giva a more sufficient picture of this study, this part will include all from the managing of data to the exploited regression methods. It will also provide formulas of the chosen two profitability ratios. Also the sources of the gathered data are annouced.

I have divided the part of results in two different chapters. In first chapter of results, I analyse the risk-adjusted performance of the selected strategies choosing the most compatible tools that are presented in asset pricing chapter. In secound part of the analysing, the regression result are presented. Both parts provides a tables and figures that indicates the results. In conclusion, the main findings are presented, hypothesis are handled, and the results are summarized. Vital appendicies for the analysing are also presented in after the reference list of this thesis.

2 Information and market efficiency (EMH)

Information is crucial in the context of stock pricing. The effect of information has generated a topic, which tries to explain the efficiency of equity markets. The general assumption based on the academic literature states the level of market efficiency is dependent on how stock markets react on new information. In other words, equity markets are efficient if the new information is immediately adapted to the stock price, and equity prices reflect all available information of any given stock at any given time. Malkiel and Fama (1970) state that a market where prices fully reflect the information available can be called efficient. This chapter conforms their study.

To fully understand the efficient theory, the basic ideology and functions should be presented. Firstly, there is a numerous amount of investors who are trying to maximize their profits by executing valuations for stocks. Secondly, the new stock related information is received to markets randomly. Thirdly, the investors react to this information quickly, which is then priced in the stock price.

In the Malkiel and Fama (1970) study, Fama divides equity markets to three different forms. These forms are weak form, semi-strong form, and strong form. These forms represent the impact time of an information to reflect the stock price. The following chapter presents the forms of efficiency briefly. Figure 1 illustrates the relationship between information and the forms of market efficiency.

2.1 Weak form of market efficiency

The weakest form of the efficiency hypothesis is a description of a stock market where the stock price is already reflecting available information. In basic sense, this means that investor can use the past data such as historical prices and trading volumes while analyzing the stock. Another important and notable assumption in the weak form EMH is the independency presumption. This means that while past data is reflected into the stock price, they are not linked to future returns. This is an important notation for those who use technical analysis which emphasis past stock price patterns to gain returns in future.

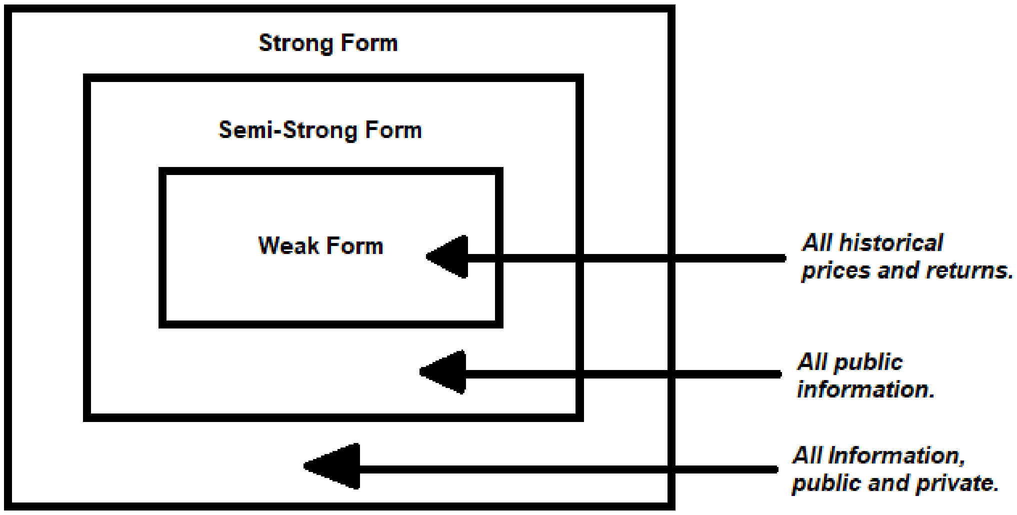


Figure 1. Forms of efficient markets (Adapted from Malkiel & Fama (1970 p.388)).

2.2 Semi-strong form of market efficiency

The semi-strong form presumes that stock price reflects all the publicly available information in the market. In other words, this means that market participant cannot earn continuously higher abnormal returns. This form of the market efficiency also includes the weak-form market efficiency. By publicly available information can be seen for example to annual financial statements such as income statement, balance sheets and cash flow statements, as well as the ratios, which are derived from them. Since the semi-strong form only focuses on public information, this leads to a situation where the private information is excluded. This means that in Semi-strong markets, private information would be the only way for investor to profit from excess return.

2.3 Strong form of market efficiency

The last and most efficient form of the markets is strong form. This form includes the features of both weak- and semi-strong forms. Basically, this means that in the sense of strong form, investor cannot earn abnormal returns with public or private information, since that information is immediately reflected to stock price. The strong form of efficient markets is a theoretical framework where the market is described as perfect and where the information is free and available for the market participants. The idea of this hypothetical framework is presented in figure 1.

3 Asset pricing and valuation

This chapter of the thesis will equip the reader for better understanding of the basics in asset pricing and valuations. The idea of asset pricing is developed during the history. Basically, this means that the literature of finance has moved more and more towards to the form, where the returns are tried to explain with different factors. Thus, the basic understanding of mathematics, and the derived development of formulas and so-called theories provide a solid framework of working tools to observe the performance of companies and assigning them with fair values based on given assumptions. This section will undergo the basic formulas which are functions that in the theoretical sense determine company specific valuations. For example, discount models work mathematically as an easy demonstration for the reader to grasp on the process of deriving intrinsic value.

Calculating intrinsic value provides vital information in portfolio formation, such as whether the equity is under- or over valuated. When an investor is formulating a portfolio, the correlation between stocks and markets should be considered. Even though correlations change all the time, observing the correlation coefficients might help us identify the risk and possible return in the different type of market settings. Typical approach to risk and return is that they should be linked together through the ideology where the investor requires higher returns to compensate for the higher identified risk. Albeit investors are interested in high returns, they are at the same time interested to minimize their portfolio risk. This leads to constructing a portfolio following a strategy which provides an optimal portfolio that is aligned with a given investors risk appetite and preference, while minimizing risks. Thus, there can be formed a theoretical linear relationship between risk and return, there is substantial evidence that choosing the portfolio based on financial ratios can generate risk premiums. Risk premium related studies are discussed more in the literature review section of the study.

Finance literature provides a broad selection of different strategies that offers hints where to identify the best risk premiums. Among with discounting models, this chapter will present briefly portfolio optimizing and factors that have historically generated risk premiums. Simultaneously it will go through portfolio performance measures which scale returns from the risk-adjusted standpoint. Later, in this thesis, some of these methods are used in portfolio analyzing.

3.1 Dividend discount model

The dividend discount model gives a basic mathematic theorical approach to returns. The idea of discounting models was firstly presented by Williams (1938) in his book, where he explains the usefulness of discounting the company´s cash flows to explain the value of an asset. This section will briefly explain three different forms of discounted models. As the first form of a discounted models, this section presents the model where only the cash flow and the return expectation of an investor are considered. The cash flow is presented as a dividend of a company, and the rate of return includes the risk related to upcoming returns. The first model can be calculated as follows:

$$P0 = \frac{D_1}{(1+R)} + \frac{D_2}{(1+R)^2} + \frac{D_3}{(1+R)^3} \cdots = \sum_{t=1}^{\infty} \frac{D_t}{(1+R)^t}, \quad (1)$$

Where:
$P0$ presents the intrinsic value of an asset in year 0,
D_1 refers to the dividend that company is paying in year 1,
R is the rate of return that the investor is requiring based on the risk and future view of the asset.

3.1.1 Gordon´s constant growth model

Where the William´s (1938) discounting model identifies the basic relationship between risk and return in asset valuation, it has still suffered criticism, since it does not consider the growth variable. Gordon and Shapiro (1956) reinforce the model with a growth aspect. The second model thus presents the Gordon´s constant growth model, which can be formed as follows:

$$P0 = \frac{D_1}{r-g}, \tag{2}$$

Where:

$P0$ is the intrinsic value of an asset,

D_1 present the dividend paid by the company in year one,

r refers to investor´s required rate of return,

g is the growth rate asset that is expected for an asset.

3.1.2 Cash flow discount model

The two earlier presented models contain the early mathematical background of asset valuation. Thus, the growth factor is added in Gordon´s (1956) model, but it does not consider the fact that investors does not hold the asset for an infinity. The other problem occurs when the company does not pay any dividends. Since both presented models are based on the dividends, this make them more likely to be theoretical tools for understanding the valuation. In case where the company does not pay a dividend, the earning gains are an alternative way to approach the valuation of an asset. This is typical for example in growth companies, which usually re-invest their earnings than pays compensation for investors. In their study, Miller and Modigliany (1961) present a model to calculate valuation, when the dividend policy of the company affects to valuation. The model of cash flows can be calculated as follows:

$$Mt = \sum_{t=1}^{\infty} E \frac{(Y_{t+\tau} - dB_{t+\tau})}{(1+r)^{\tau}}, \tag{3}$$

Where:

Mt represent the market value of the company,

$Y_{t+\tau}$ is the equity yield and,
$dB_{t+\tau}$ refers to change in book value of equity during time $t + \tau$,
r is defined as an investor´s required rate of return.

Based on this formula, the increase of equity earnings $(Y_{t+\tau})$, have a positive effect on company´s value Mt, when the required rate of return $(1 + r)^{\tau}$ is held fixed. On the other hand, if the company does invest its earnings, this affects to change in equity $(dB_{t+\tau})$ by decreasing the company´s value Mt. Titman Xie and Wei (2004) study the relationship between investments and stock returns. They find that companies that do capital investments more often than others, then to earn lower returns for five-year period. Fairfield, Whisenant and Yohn (2003), and Richardson and Sloan (2003) capture similar result earlier.

Fama and French (2006) study the relationship between book-to-market ratio, investments, and profitability. They use the similar cash flow equation model and divide it by book value. Now the model is formed as follows:

$$\frac{M_t}{B_t} = \frac{\sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau})/(1+r)^{\tau}}{B_t}, \qquad (4)$$

Where:
the B_t is the book value of equity.

In their study, they find that higher expected rates of investments are related to lower expected returns. Their idea is based on the power of book-to-market ratio which is discussed more later in this thesis. In a general logic, it is still vital to understand, that in today´s fast developing business world, it is normal and necessary for a company to do investments to retain the competitiveness.

3.2 Modern portfolio theory

The capital asset pricing model, known as CAPM approaches asset pricing from the perspective of risk more broadly than previously covered discounting models. Before introducing CAPM, the thesis will present a summary of the theory behind the asset pricing model. Harry Markowitz (1952) studies the asset selection from theoretical perspective. Among with this and his later study (1959), he shapes the academic literature of finance by creating a modern portfolio theory. According to Markowitz (1952) in modern portfolio theory, investor can optimize one´s portfolio by scaling the risk and return. Markowitz (1987) show that investor scale the mean-variance of the portfolio during the formation. The risk in this theory is divided to systematic and unsystematic risk. Systematic risk is known as undiversifiable risk, which describes the risk that is in the whole market portfolio. Unsystematic risk is the risk that is in the company, and which investor can affect whether to choose an asset to a part of his portfolio or not. Figure 2 presents the basic idea of modern portfolio theory.

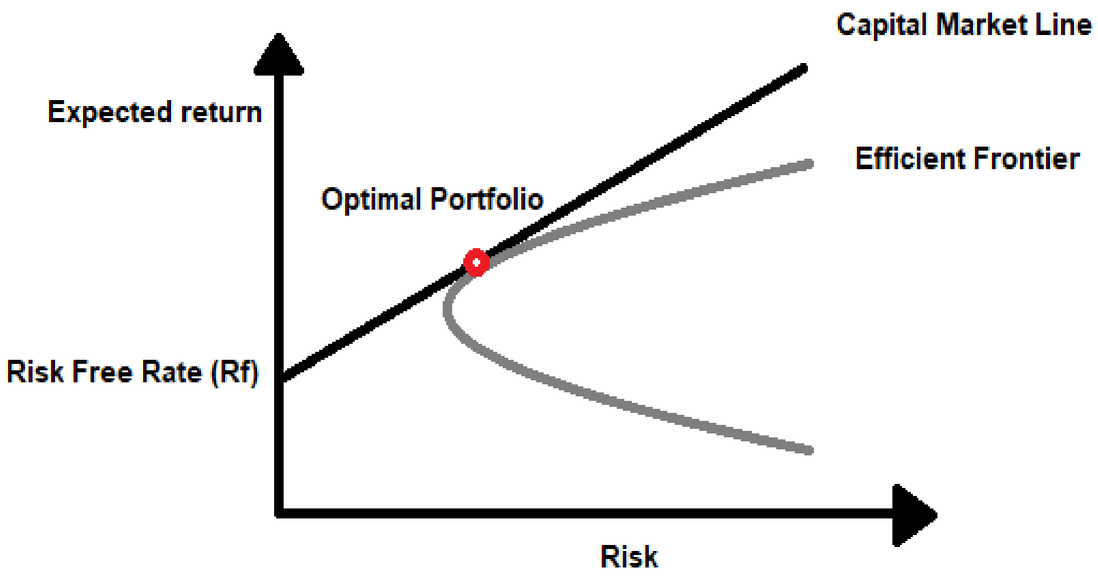


Figure 2. Intercept of an optimal portfolio (Adapted from Merton (1972 p.1867)).

The capital market line describes the relationship between risk and return in theoretically the best possible way. Risk by in its mathematical form is described as a standard deviation. Efficient frontier describes the best optimal portfolios where the risk and return meet. If the portfolio is below the efficient frontier, it is riskier compered to its returns. Based on Markowitz´s (1952) theory, the optimal portfolio is the interception of capital market line and efficient frontier.

3.2.1 Beta coefficient

The mathematical approach of modern portfolio theory has impact on today's risk calculating. Where standard deviation or volatility are known risk measures, so is beta coefficient. Beta coefficient describes risk from the standpoint, where the risk of an individual asset, and the existing risk in the markets is considered. In other words, this mean that beta observes the sensitivity of an asset to changes in markets, where asset is traded. The beta coefficient can be calculated as follows:

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}, \tag{5}$$

Where:
$Cov(R_i, R_m)$ describes the covariance between the return of an asset i and the return of a market portfolio m.
$Var(R_m)$ means the variance of market portfolio m.

Since the beta coefficient measures the risk based on the asset´s movement relative to market´s movement, the interpretation of beta is done in the following way. When the beta of an asset is higher than one, this indicates that the change in price of that asset is greater than one when the general market portfolio changes in price by one. The beta of a market portfolio is always one. Beta coefficient is vital to understand in order to understanding the CAPM. It is also discussed more in the econometrical testing of this thesis.

3.2.2 Capital Asset Pricing model (CAPM)

Based on foundations of Markowitz´s (1952) study, the capital asset pricing model was firstly introduced by Sharpe (1964). Afterwards Lintner (1965 a, b), Mossin (1966) and Black (1972) have individually developed the CAPM. The model has reached to a remarkable position in academic literature. The basic idea of the CAPM is to solve the expected return for an asset when the market sensitivity is known. The equation of CAPM can be formed as follows:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f], \tag{6}$$

Where:
$E(R_i)$ is the expected return of an asset i,
R_f describes the risk-free rate. For example, U.S. three-month T-Bill rate is often considered as a risk-free rate.
β_i represent the beta coefficient of an asset i and,
$E(R_m)$ is the expected return of market portfolio.

Thus, the position of CAPM is solid in an educational sense, and it is easy to use for an asset as a benchmark to another asset in same markets, it is notable that from the common standpoint it does have its limitations. For the CAPM to function, few theoretical assumptions must be made before from the investor’s perspective. In his study, Sharpe (1964) explains these conditional assumptions, which Nikkinen, Rothovius and Sahlström (2002, pp. 68-69) present in their book of investing in a clearer form. Here is a highlighted list of CAPM related assumptions based on the previously mentioned literature:

1. Investors do not face trading costs or taxes.
2. Traded investment objects, such as stocks, can be divided to extremely small parts. This helps the market liquidity.

3. Investors are price-takers and cannot set the price individually, meaning that the markets are perfect.
4. To have perfect markets, everybody has access to all information, and it is available for all in same time as well.
5. All investors make rational decisions and are risk averse, so the expected returns and standard deviations are considered within investment decision.
6. Shorts selling is allowed in markets and there are no limitations for that.
7. Markets are liquid, so all capital assets can be traded in fast time.
8. All the market participants act homogenously. This means that all investors do have similar way to act in markets, such as compounding the risk for an asset.
9. Investors can lend and borrow money with risk-free rate.

Black (1972) present a CAPM where the existence of risk-free borrowing was excluded. This model of CAPM is based on his assumption where there are no risk-free assets.

3.2.3 Sharpe Ratio

After publishing the CAPM model, Sharpe (1966) represent another measurement which focus more on the stock´s performance from the risk-approach. This measurement, known as Sharpe ratio, is afterwards affected broadly to investors´ toolboxes becoming a one of the worlds known measurement of risk-adjusted performance. To measure the quality of returns, Sharpe ratio considers risk as a standard deviation or volatility. When the risk is measured as a standard deviation or volatility, it refers that risk is based on the changes in the stock´s price. Since the standard deviation works as a denominator in Sharpe ratio, the lower the risk (lower standard deviation), the higher the Sharpe ratio. The ratio can be used such as benchmark rate for stocks or measure individual performance.

Even though the Sharpe ratio is often described as a measurement of single stock, it can be used to measure portfolio as well. In the understanding of this thesis, Sharpe ratio is a vital part of measuring the performance of portfolios. It will be calculated to each portfolio every year as a measure of risk-adjusted performance. Notable is that Sharpe ratio can be measured as ex-ante and post-ante. Ex-post means that Sharpe calculation is based on the expected return to project the future event, and post-ante measures the past prices. The formula of Sharpe ratio is presented in following way:

$$S = \frac{E(R_i - R_f)}{\sigma_i}, \tag{7}$$

Where:

R_i is the return of asset i ,

R_f denotes for risk-free rate, such as U.S. three-month T-bill,

σ_i describes the volatility of an asset i.

3.3 Jensen´s model

CAPM of Sharpe (1964), Lintner (1965 a,b) and Mossin (1966) provides a great platform for modeling the relationship between risk and return. Jensen (1968) utilize the risk-adjusted ideology of CAPM. The Jensen model, as well known as "Jensen´s Alpha" illustrates the abnormal returns of CAPM calculation. For example, the two assets might have same return but different beta. Investor should choose less risky since it delivers alpha for investor. This thesis will provide calculated Jensen´s alphas in the part of performance analysis. The formula of Jensen´s alpha can be modelled as follows:

$$R_{i,t} - R_f = \alpha_i + \beta_i\left[R_{m,t} - R_f\right], \tag{8}$$

Where:

$R_{i,t}$ is the return of stock i in time t,

R_f denotes to risk-free rate, such as U.S. 3-month T-bill,

β_i defines the beta coefficient of stock i ,

$[R_{m,t} - R_f]$ describes the return of market portfolio subtracting the risk-free rate, and,

α_i measures the risk adjusted abnormal excess return "alpha".

3.4 Factor modeling

While being a relevant tool for understanding the relationship between risk and return, CAPM has faced critique since its simplicity and the restrictive assumptions. Friend and Blume (1970) find evidence, that conversely to CAPM theory, the high-risk portfolios tend to earn lower returns, while low risk portfolios represented a relatively good performance. Fama and French (1992, 2004) as well argue the successfulness of CAPM by Sharpe (1964), Linter (1965a, b) and Mossin (1966), summarizing the fact that the beta factor is more poor proxy for returns than it is assumed to be. They also point out same time that CAPM by Black (1972) tend to have some success.

To understand returns more specifically, Fama and French (2004) call for the role of factors when indicating explanation of the returns. These variables are company's size, book-to-market-ratio, and past 12 month returns. Banz (1981) argue that firm´s size measured as a market value, does matter when it comes to explaining returns. He finds that relative to company´s beta factor, large firms tend to earn lower return and small firms' higher returns. Book-to-market ratio tries to emphasis whether the equity is undervalued or not. In this done by scaling the company´s current market value to its book value. Since the market value is represent the valuation of investors, and book value is a mathematical result of accounting, relative to book value, higher market value indicates over pricing of an asset. In other words, if the book value is higher than a market value, this indicates that company have valuable assets which markets have not valued yet. Stattman (1980) and Rosenberg et al.(1985) result a positive relationship in the U.S. markets between the average returns and book-to-market ratio. Chan, Hamao and Lakonishok (1991) capture similar relationship from Japan equity market.

To explain returns more accurately than CAPM, Fama and French (1993) present their three-factor model. This model explains the equity returns with the market-, size- and value risk factors. Noteworthy is as well that the model is constructed on mathematical regression. At this part, the thesis only represents the idea of three factor model. Regression-based mathematics is discussed more in chapter of data and methodology. For reader it is still necessary to understand the factor modelling for the future reading of this thesis. Fama and French (1996: 55-56) describes their three-factor model as follows:

$$E(R_i) - R_f = \beta_i\left[E(R_M) - R_f\right] + s_i E(SMB) + h_i E(HML), \tag{9}$$

Where:

$E(R_i)$ is the expected return of portfolio i,

R_f denotes to risk-free rate, such as U.S. 3-month T-bill rate,

$\left[E(R_M) - R_f\right]$ describes the excess return of market portfolio,

β_i is the coefficient for measuring the sensitivity of market portfolio excess return $\left[E(R_M) - R_f\right]$,

$E(SMB)$ describes the size factor, which is the premium between small and big companies,

s_i is the sensitivity coefficient of size factor,

$E(HML)$ is the risk-factor of book-to-market ratio, which considers the value premium between high minus low book-to-market companies, and,

h_i measures the sensitivity of factor (HML).

Furthermore, Charhart (1997) expands the Fama-French three-factor model to a four-factor model by adding the momentum factor which is based on the past 12-month performance of the company. Later, Fama and French (2015) construct a five-factor model by fitting the profitability factor and investment factor on the foundation of three-factor model. The results of Novy-Marx (2013) are the main influencer of adding the profitability factor to a part of the factor model. Fama and French (2018) include the momentum factor in their six-factor model implementation. Even though the six-factor model exists, this thesis conforms the literature of Ball et al (2016) focusing on the five-factor model. Also, despite of the fact that both latest factor models are relatively young, the five-factor model has been more used method so far. The five-factor model is presented more detailed in the methodology and regression parts of this thesis. To examine whether the profitability factors can explain returns in Finnish equity markets, this thesis carries out a Fama-French five-factor model, leaving the six-factor model for further studies of Nordic markets.

4 Literature review

This chapter discusses the recent history of profitability studies. To understand the dialogue of the development of profitability ratios, it is vital to briefly summarize other common ratios before heading into profitability ratios. Firstly, this chapter presents the literature of value investing and the book-to-market ratio. Subsequently, the thesis will move on its focus area of profitability ratios. During the past seven years, the discussion of profitability measures has gained significant momentum since strong results of Novy-Marx (2013) and Ball et al. (2015,2016). This research has developed and paved way to the use of a company's profitability in a new way in the search for alternative strategies to supplement traditional value-based factors and strategies for investing.

4.1 Value investing

The concept of value investing was first presented by Graham and Dodd (1934). While the concept of value investing has developed among the investors and researchers, it has largely remained true to the same fundamentals and characteristics laid out by the original authors, today known as the fathers of value investing. This idea leans strongly on buying assets which are undervalued relatively to their intrinsic value. In other words, you purchase securities which should be more valuable, but you pay less than what they are truly worth. This corner stone violates the idea of efficient market theory, where the information should be always reflected in the stock prices at any given time.

To understand the mispricing of stock more clearly, it is necessary to use financial ratios. Nicholson (1968) uses price-to-earnings ratio to calculate the under valuation of stocks. He finds that companies with low price-to-earnings ratio tend to generate better returns than their counterparts. In a logic sense, price-to-book ratio explains the basic idea of value investing, since buying with lower price relative to its high earning is buying value.

Basu (1977) presents similar results from the U.S. stock markets. These results have had an empowering effect on value investing. The study builds a solid ground for value investing to become a suitable strategy for investors who are aiming to optimize their portfolio construction. Fama and French (1992) approach value investing through a different, but somewhat similar ratio. In their study, they scale company's market price to its book value. This ratio is known as price-to-book. They find that low price-to-book companies earn more excess returns than companies with higher ratios. Using constructed portfolios, Fama and French (1992) capture an interesting but clear result where the value strategy outperformed growth strategy. Later in this chapter, the thesis will discuss more of growth investing.

4.2 Book-to-market effect

Since value investing can be explained simply as buying assets at a discount to their intrinsic value, comparing company's book value to its market value, became an excellent measure of misvaluation true perceived value. Like mentioned earlier before, the usefulness book-to-market where firstly captured by Stattman (1980). He finds the positive relationship between returns and high book-to-market companies. Similar results have later captured Rosenberg et al. (1985) and Chan et al. (1992).

Among with price-to-book ratio, Fama and French (1992) study other variables to explain the returns in cross section more accurately. Testing all their variables together, they find more significant power in book-to-market ratio and size variables. Their cross-sectional regression shows that high book-to-market ratio companies and companies with smaller size tend to explain returns better. These two variables are also included in Fama French (1993) three factor model which is presented in the asset pricing chapter of this thesis. The use of book-to-market ratio have become popular among with investors a scientific, and the power of the ratio has been captured countless times afterwards.

4.3 Profitability

Profitability is a criterion that investors typically require from the company they are investing in. It is something that should be a self-evident, since without being profitable, company should end up going bankrupt. While the concept profitability seems obvious in the business world, academic studies have shown results where the profitability can be considered from another perspective. When it comes to explaining returns, studies in the past few decades suggest profitability ratios tend to underperform against value metrics. It is as well commonly accepted that measuring profitability is often linked into growth investing.

Lakonishok, Schlaifer and Vishny (1994 p. 1542) argue the returns of high book-to-market stocks, like Fama and French (1992) show, is that these stocks are fundamentally riskier, and higher returns are simply compensation for taking this risk. Basically, this means that the ideology leads to an undervaluation of value stocks and over valuation of growth stocks. Still Lakosnishok et all (1994) conclude that value tend to perform better than growth strategies. Capaul, Rowley and Sharpe (1993) capture similar results of value. In their study, they observe returns between the value and growth stocks, and find that growth stocks represent weaker risk-adjusted performance than value stocks. Fama and French (1998) shows strong evidence, that value stocks tend to outperform growth stocks globally. Later, Fama and French (2008) illustrate similar results where profitability strategies performed poorly from the perspective of returns. In this thesis the difference between value and growth is tried to explain to reader, since the focus is later in the revolution of profitability ratios.

4.3.1 Gross profitability

The long lasted and mitigated position of growth and profitability started to change recently. Novy-Marx (2013) shows significant and challenging results against the nearly dominant position reached value parameter, book-to-market. He scales gross profits to companies' total assets, providing a ratio which should imply higher returns. Novy-Marx (2013 p. 2) argues that more profitable companies tend to earn higher returns, even though they have lower book-to-market and bigger size. This is basically an opposite to Fama and French (1992) and Banz (1981) conclusions, arising a confrontationally good argument whether the great two factors are suitable standalone explainers for returns.

Before Novy-Marx (2013) study, a typical approach to calculate firm´s profitability was to observe bottom line results of income statement, such as net income. Earlier Fama and French (2006) find that earning generate statistically significant results with explanatory power. Net income is relatively simple measure of profitability and easy to scale with assets. On the other hand, net income does not consider the benefits of some accounted expenses such as research and development costs, leading to a situation where these costs are observed and matched effecting only negatively on the current year's earnings. Instead, these costs might be vital and compulsory for company to generate returns in future. Novy-Marx (2013 pp. 2-3) argues that gross profitability is the cleanest measure of profitability, and the further down we move on income statement, the more polluted the measure of profitability comes.

An additional interesting finding of Novy-Marx (2013) study is that where gross profitability explains returns almost as good as book-to-market ratio, both strategies are slightly negatively correlated with each other. Since book-to-market is considered as a value strategy and gross profitability identified more likely as a growth strategy, this finding captures that adding quality-level of growth to a value strategy offers a free hedge for an investor.

Due to the usefulness of gross profitability, it has started a new debate of profitability ratios. Fama and French (2015) take part of this dialogue by adding a profitability factor in their five-factor model. They have still done modifications to the profitability ratio measure from, so that it is slightly different than the gross profitability on its original form. They subtract selling and administrative expenses, and interest expenses from gross profit, and divided the difference with book value of equity, which is total asset minus total liabilities.

4.4 Operating profitability

Even though Fama and French (2015) presented the terminology of operating profitability, as an alternative for gross profitability, Ball et al. (2015) came out with their version of operating profitability. The results are interesting and boosted up the debate of profitability ratios. Ball et al. (2015 pp. 225-242) argue that net incomes can predict returns as good as gross profitability, and it is dependent on the denominator of earnings. Furthermore, they challenge the results of gross profitability stating that operating profitability generate better alphas in portfolio testing using Fama & French (1993) three-factor model. In their study, they also test different deflators for profitability resulting that total assets works best for operating profitability.

Where Novy-Marx (2013) points out the benefit of research and development costs for future earnings, Chan, Lakonishok and Sougianis (2001 p. 1453-1454) study the relationship of these expenditures and equity returns. They find that companies with research and development expenses and high valuation of market equity, tend to earn excess returns. Another important and operating cost for company is selling, administrative and general expenses. Eisfeldt and Papanikolau (2013 p. 1366) show that selling, administrative and general expenditures can be used to predict returns. In their study, they conclude that in long-short strategy, buying companies with higher investments on organization capital, and selling their counter peers, earn 4,7% on average. Basically selling, administrative and general expenses contain similar features as cost of goods sold, and both are easier to target on recent fiscal year than research and development costs which are usually considered to effect in future. Ball et al. (2015 p. 226) find that subtracting both cost of goods sold and selling, administrative and general expenses from revenue, without considering the research and development costs, conclude as even more accurate measure, and it predicts returns more significantly than gross profitability. They also find that both used expenditure types and future returns covariates similarly.

Based on the documented evidence and the recent development of explaining returns with profitability, this thesis will consider operating profitability of Ball et al. (2015) as a one of the strategies of this thesis. The calculations of operating profitability are presented in more detail in the methodology part of this study.

4.4.1 Cash operating profitability

Scrutinizing both gross profitability and operating profitability, there is one specific and interesting nuance that rejoins these ratios. This nuance is the effect of accruals. Accruals are accounting adjustments, which are reported in financial statements. One typical feature of accruals is that they hold the information of upcoming cash flows. Basically, to observe accruals better, company´s earnings can be divided into two parts, where first part represents the cash flow that are collected to company's bank account, and second part, which are not, refers to accruals. In other words, accrual adjustments are cash flow transactions that have not been made but which still effect financial statements.

Since accruals presents an accounting item where the money transaction has not been made, a certain level of a credit risk between the company and the customer exists. Basically, this means that in the logical sense, the received money would be more safe and firm measure of earnings. Even before previously discussed profitability ratios, Sloan (1996 p. 290) find that companies with high level of accruals do have a strength and negative relationship between returns. He also states that this result is because investors observe only earnings, but not the two components of it, so that they tend to miss valuate an equity price. Moreover, considering accruals and cash flows as a one entity, investor is more likely to be exposed to negative effect of accruals. Sloan´s (1996) result of the negative relationship between accruals and returns has become known as the accrual anomaly.

To improve their measure of profitability, Ball et al. (2016) generated a new measure which exclude the effect of accruals. The measure of cash based operating profitability is derived from their previous year presented operating profitability. In this thesis I use name cash operating profitability or cash-based profitability to describe their latest profitability measure. Ball et al. (2016 pp. 28-29) find that cash operating profitability explains returns more precisely than gross profitability or operating profitability. They also conclude that cash operating profitability can predict returns with a ten-year window. Third interesting finding is that cash operating profitability can include the positive effect of accrual anomaly. These robust results have been noticed. Fama and French's (2018 p. 241) recent study paves way to more precise characteristic of risk factors. They result that cash operating profitability is more dominant to operating profitability when they test the max Sharpe squares ratios of their six-factor model. Cash operating profitability represent the second strategy which I have chosen for this thesis. More precise calculations of the measurement are also provided in the methodology part of this thesis.

5 Data and methodology

This chapter of the thesis presents the data and methodology, which are used in the examination of the profitability ratios. The processing and managing of data are a vital part since the Finnish equity markets are relatively smaller than the U.S. Markets. After the data is presented, the thesis moves forward on to the methodology part. The chapter of results provides for the reader the part of descriptive statistic, which are derived from the managed data, and as well for the portfolio descriptive data, which are examined in this study.

5.1 Data

To construct the sample of this thesis, I follow Ball et al. (2016) study from the part of operating profitability and cash operating profitability. I take both annual accounting data, and monthly return data from Thompson & Reuters Data Stream. The benchmark index is as well from the Thompson Reuters Data Stream. To execute the portfolio performance calculations, the risk-free rate data is taken from the Bank of Finland's database of Euribor interest rates. For further investigation, I have gathered the European data from Kenneth French data library to add the investment factor so that the execution of five-factor model can be done. All the other factors are manually constructed from the give data. Noteworthy is that all the used data from prices to financial statements are considered in Euros.

To investigate whether the profitability premium exist in the post financial crisis period of Finnish equity markets, I have gathered the data from years 2009-2019. The period provides an interesting after crash time-series to examine whether the companies scaled by their profitability can help us identify those stocks that generates the best returns in recovering markets. The first sample includes eleven years of balance sheet and monthly return data of Finnish stocks between 2009-2019. The thesis uses only common shares which are listed in the Finnish main equity market, OMX Helsinki. I match the firm's annual accounting data and monthly return data of Thompson & Reuters Data Stream. The annual accounting data is lagged by six months relative to the return data. This lagging is relevant and should ensure that the year-end information of financial statements, which are typically published not until spring, are reflected at least on equity prices by the end of June of the current year. Similar assumption between the equity price and information is used in Ball et al. (2016).

The sample includes only companies with existing market value of equity, revenue or gross profits and the amount of total assets, and the returns from current month, and one-year period. Additionally, the values of companies' sales, general and administrative expenses, research and development expenses, and the values of account receivable, inventory, and accounts payable are vital for further calculations. To calculate the cash operating profitability, Thompson Reuters data stream provided only balance sheet data, thus, to capture the changes in accruals for year 2010, the starting data is required from year 2009. Due to this, the observation period for ratio calculating is 2009-2018, but the examination period of calculated ratios is from 2010 to 2018. The equity return data is starting from the end of June every year, so that the last equity prices considered are from 30.6.2019.

During this nine-year examination period, I started with 1170 company observations. Since the companies from bank industries provide different type of financial statements, all bank observations were excluded from the data, reducing the amount of observations to 1116 companies. Also, the companies which provided balance sheet data but were not listed before every year in the end of June were excluded, so that there were 1058 firm observations left. To protect the result from twin share biases, all companies, which present only one financial statement but have two different equity series listed in OMXH, are considered only by the equity series that can be recognized as "one share, one vote" stocks. In other words, this means that those equity series that are for high voting power, are omitted from the sample. After this management, there were total of 1004 company observations. For these companies, the following profitability ratios were calculated. I calculate the operating profitability by following the guidelines of Ball et al. (2015). The formula of operating profitability is formed as follows:

$$Operating\ Profitability = Revenue - COGS - SG\&A - R\&D, \tag{10}$$

And the operating profitability ratio is formed in the following way:

$$Operating\ Profitability\ Ratio = \frac{Revenue - COGS - SG\&A - R\&D}{Total\ Assets}, \tag{11}$$

Where:
$COGS$ are company’s cost of goods sold during the fiscal year.
$SG\&A$ refers to sales, general and administrative expenses of a company and,
$R\&D$ stand for research and development expenses of a company.

The idea of this ratio is to capture the company´s operating performance so that the non-operating items of accounting, like the effect of leverage or taxes can be excluded.
The ratio of cash operating profitability conforms highly operating profitability. To calculate the cash operating profitability, I follow Ball et al. (2016). The formula of cash operating profitability is formed as follows:

$$Cash\ Operating\ profitability = Operating\ Profitability - DAR - DI - IAP, \tag{12}$$

Where:
DAR refers to decrease in account receivable,
DI describes decrease in inventory, and,
IAP stand for increase in account payable.

Compared to operating profitability, cash operating profitability is a measure of profitability, where the impact of accounting accruals is excluded from the calculations.

Accounting accruals, such as changes in account payable, inventory or account receivable, are those items that effects on firms' earnings even though the transaction of cash have not been made. The ratio of cash operating profitability can be formed as follows:

$$Cash\ Opertaing\ profitability\ ratio = \frac{Operating\ Profitability - DAR - DI - IAP}{Total\ Assets}, \quad (13)$$

5.2 Methodology

After the profitability calculation was made, I firstly rank the companies based on their size from the biggest to smallest corresponding to their market value. I am interested only of companies which are bigger in local market, so that the data will describe more reliably on the most traded stocks in OMXH. Eliminating the small stocks also trims away the possible outliers made by penny stocks, but same time makes the data more comparable internationally.

Ranking the companies based on their market value and collecting the 45 largest ones every year during a nine-year period leads to an outcome where 405 company observations are made. To create the strategy portfolios, every year these 45 companies are ranked and divided based on previously presented profitability ratios, so that one portfolio consists of 15 companies presenting either high, mid, or low level of profitability in each. Summing up the number of portfolios for both strategies, during the examination period, there are total of 27 cash operating portfolios and 27 operating profitability portfolios.

To execute the profitability strategies of this study, I keep the focus on long portfolios and long-short portfolios. Each year in a long portfolio for both strategies are selected the top 15 companies based on the highest profitability to asset ratio. Long-short portfolios are considered as zero cost portfolio where the buying of long portfolio is financed by selling the short portfolio. As a benchmark index, I use OMXH (PI) -index, which is a value weighted all-share price index of Helsinki equity exchange. Since this thesis does not consider the dividend adjustments, the OMXH (PI) gives the most suitable benchmark index for the strategy portfolios. The risk-free rate used in this study is the 3-month Euribor-rate. This thesis tests the profitability in two different categories. The first part presents the performance and risk analysis, and the second part consist of two different regression analysis.

5.2.1 Performance and risk calculations

In performance and risk analysis, this thesis presents several measurements that are common in portfolio analysis. To measure the portfolio performance, I use similar methods and formulas that are discussed earlier in the chapter of asset pricing and valuation. Returns are calculated as the value weighted so that they are comparable within benchmark index. I calculate the returns as a natural logarithm of monthly price change.

Excess holding period returns are calculated subtracting the risk-free rate from the portfolios raw holding period return. Holding period for the implemented strategy is one year, starting always from the end of June. The risk-free rate is always fixed for the holding period by quoting the rate of the start day. For risk calculations, I use standard deviation and beta, so that the price variation and co-movement with market index can be identified. To measure the performance relative to risk, the Sharpe ratios are also calculated. In addition, this thesis presents Jensen´s alpha to measure whether portfolios generate any abnormal returns beyond what is theoretically expected. Lastly a noteworthy comment is that this thesis does not include transaction cost or tax-based cost in the calculations.

5.2.2 Regression calculations

To examine whether the profitability ratios provide any statistically significant coefficients, three different type regressions are carried out. These regressions are simple regression, multiple regression and Fama and French (2015) five-factor model. Based on the used methods, the regression examination is divided into two parts. In first part the simple and multiple regressions are executed for both profitability ratios, and as well for their generated portfolios. With these regressions the chosen dependent variable is the average monthly raw return from the annual holding period. This describes the stock's price development. Independent variables are either the ratios of cash operating profitability or operating profitability. In addition, I use two control variables which are natural logarithms of market equity and Book-to-market ratio. These control variables are similar than in Ball et al. (2016). The regressions are formed as follows:

Simple OLS-regressions:

$$R_i = \alpha + \beta_C * COP + \varepsilon, \tag{14}$$

$$R_i = \alpha + \beta_O * OP + \varepsilon, \tag{15}$$

Where:
$\mathrm{R_i}$ is the monthly averaged holding period return of stock i ,
α is the intercept term,
β_C is beta coefficient of cash operating profitability ratio COP,
β_O is beta coefficient of operating profitability ratio, and OP,
ε is the error term.

Multiple OLS-regressions:

$$R_i = \alpha + \beta_C * COP + \beta_M * LogM + \beta_{LogBM} * LogBM + \varepsilon, \tag{16}$$

$$R_i = \alpha + \beta_O * OP + \beta_M * LogM + \beta_{BM} * LogBM + \varepsilon, \tag{17}$$

Where:

$\mathrm{R_i}$ is the monthly averaged holding period return of stock i ,

α is the intercept term,

β_C is the beta coefficient of cash operating profitability ratio COP,

β_O is the beta coefficient of operating profitability ratio OP,

β_M is the beta coefficient for natural logarithm of market value LogM,

β_{BM} describes the beta coefficient for natural logarithm of book-to market ratio LogBM, and,

ε is the error term.

During the examination period between 30.6.2010-30.6.2019, every year, both simple and multiple regressions are executed. These regressions are cross-sectional. To avoid the biases in standard errors, the observed heteroscedasticity is corrected with Stata calculating software´s heteroscedasticity corrector to get more robust standard errors. The results of the mean beta coefficients are presented in Table 4. Similarly, the coefficient averages for portfolios are presented in Tables 5 and Table 6. All the coefficient in previously mentioned tables are multiplied by 100. The t-values are calculated by dividing the averaged beta coefficients with mean standard errors. This method tries to explain, whether the profitability ratios does have any predictive power. Lakonishok et al. (1994: 1557) use similar method to examine the relationship between stock returns and stock characteristics. By averaging the coefficient means, and reporting t-values based on time varying of the coefficient, they refer to the procedure used by Fama & Macbeth (1973).

I recall that for single investigations there are nine regression per profitability ratio, and in categorized examination there are 9 portfolios for each level high-, mid- and low of operating- and cash-based profitability. Summing up the numbers of carried out regressions, there are total of 180 regressions. Since the presented results tables are mean average coefficients, the results of year by year regression are presented in Appendix part of the thesis.

5.2.3 Fama-French Five-Factor model

Second part of the regression analysis is focused on Fama-French Five-factor model. The factor-modeling is known as a powerful tool to measure the returns through the generally good approved risk factors. During the years, the factor model has expanded with new factors. One of the latest factors has been operating profitability of Ball et al. (2015) Fama and French (2018: 241) study of choosing factors shows that cash operating profitability outperforms operating profitability. Based on the previously mentioned recent results, it is relevant to proceed a five-factor model to test which of the risk factors perform better in Finnish stock markets. The five-factor model of this thesis can be formed as follows:

$$R_{OMXH} - R_f = \alpha + \beta_{OMXH} * Market + \beta_M * SMB + \beta_{BM} * HML + \beta_C * RMW_C + \beta_I * CMA + \varepsilon, \quad (18)$$

$$R_{OMXH} - R_f = \alpha + \beta_{OMXH} * Market + \beta_M * SMB + \beta_{BM} * HML + \beta_o * RMW_O + \beta_I * CMA + \varepsilon, \quad (19)$$

Where:
$R_{OMXH} - R_f$ is the excess return of OMXH market portfolio,
α denotes to alpha,
β_{OMXH} is the sensitivity of market risk factor Market,
β_M is the beta coefficient of size factor SMB (small minus big),
β_{BM} describes the beta coefficient of book-to-market factor HML (high minus low),
β_C is the beta coefficient of cash operating profitability RMW_C (robust minus weak),
β_o is the beta coefficient of operating profitability RMW_O (robust minus weak),
β_I is a beta coefficient for investments CMA (conservative minus aggressive) and,

ε is the error term.

The data set for the five-factor model was created mainly from the Thompson and Reuters data stream. Since the observed market for both profitability ratios is the same, I have created risk factors for both each and presented the result where models 4 and 5 are for cash operating profitability and from 6 to 7 are for operating profitability. Other risk factors are also created manually except for the investment factor I have used European risk-factor data of Kenneth French data library. The results of five-factor model are presented in Table 7.

6 Results

This part of the thesis will discuss the more detailed description of data. I will also present the result of both aggregates, and all profitability sorted portfolios individually. The results of this part are focused more on the risk adjusted performance. Also, the mid-level portfolios are introduced to give a more multidimensional picture of the data and the performance. In further parts I will focus more on the performance of strategy portfolios. The high profitability portfolios are considered as long portfolios and low portfolios are discussed short portfolios. After the performance analysis, this thesis moves toward regression analysis.

6.1 Summary statistics

After managing the data of Finnish equity market OMXH, every year, the 45 largest companies are chosen and summed up to illustrate the following descriptive statistics. Table 1 shows the descriptive, where Cop stands for the cash operating profitability ratio Op refers to operating profitability ratio. Control variables Log M is a natural logarithm of size calculated from the company's market value of equity, and Log B/M is the natural logarithm firms' book-to-market ratio. Like earlier mentioned, the market values and book values are denoted in Euro currency.

The data interestingly suggests that the mean of cash operating profitability ratio is slightly higher than with operating profitability. Since the difference of these ratios can be explained by the effect of accruals, it seems that during a sample period from 30.6.2010-30.6.2019, Finnish companies have either increased sales or managed to decrease the account payables such as short-term payments to suppliers. The increase of sales would also explain logically the increase of inventory. Both ratios still have quite similar means and medians and as well the standard deviations. Another notable mention would be the deviation of size. Even though the data is managed to present the largest companies in Finnish equity markets in order to presents the most realistic outcome of the liquid and active stocks in OMXH, the market value of equities create a large spread between 45 biggest stocks. Thus, the OMXH is a relatively smaller market than American peers, the largest companies in Finnish equity markets are big. As Table 1 shows the natural logarithm of size is 7,031 and the maximum rate is 10,350. Relative to Ball et al. (2016 p. 32) their company average size calculated as natural logarithm from dollar market value of equity is 4,577 and the 99-percentile rate of biggest companies is 9,407. In their study they still have a much larger data and deviation of the size variable.

Table 1. Descriptive statistics

Panel A: Descriptive Statistics of Overall Data

	Mean	*Median*	*Std*	*Min*	*Max*	*Obs.*
Cop	0,155	0,145	0,149	-0,299	1,370	405
Op	0,133	0,129	0,158	-0,626	0,821	405
Log M	7,031	6,945	1,317	0,278	10,350	405
Log B/M	-0,707	-0,743	0,660	-2,767	0,948	405

Panel B: Descriptive Statistic Averages of Portfolios

	Cash Operating Portfolio			Operating Profitability		
	High	Mid	Low	High	Mid	Low
Ratio	0,304	0,144	0,015	0,277	0,131	-0,011
Log M	6,828	7,171	7,093	6,936	7,142	7,035
Log B/M	-0,848	-0,692	-0,582	-0,921	-0,574	-0,567
Observations	135	135	135	135	135	135
Obs./Year	15	15	15	15	15	15

Panel C: Correlation

	Cop	Op	Log M	Log B/M
Cop	1			
Op	0,3026	1		
Log M	-0,0440	-0,0929	1	
Log B/M	0,0094	0,0655	-0,004	1

Panel B describes the similar values based on the portfolio deviation of each profitability ratio. While the size is on average similar regardless to portfolio, the behavior of book-to-market ratio within portfolios is prominent. Basically, it is in line with Fama and French (1993) where higher book-to-market ratios explain better returns than growth strategies. Therefore, based on previous literature, controlling stocks with profitability, leans the effect of book-to-market to portfolios where the profitability ratio is lower. This does not still mitigate Novy-Marx (2013 p. 2) argument where the profitability strategy can perform statistically significant even though, profitable companies tend to have higher valuation ratios. Sorting the portfolios based on the latest profitability ratios, provides an interesting setup where the highest levels of profitability portfolios seems to contain more growth companies than value firms. With panel C, there can be seen that between the ratios there is no high correlations, except between profitability ratios. Also, both profitability ratios are negatively correlated with size. This statistic gives an interesting set up from size perspective, since Banz (1981) find that small companies generate better returns on average, and the question of this thesis is whether high level of profitability provide benefits to investor portfolios. So far this offers great opportunity to observe whether smaller companies can generate any better returns within high ratio of profitability.

6.2 Performance statistics

Before moving towards the strategy performance. The basic risk and performance measures are presented in Table 2. Based on the level of profitability, I have calculated the previously presented measurements for both profitability ratios. These calculations represent the averages from all the nine holding periods. Mean holding period return (HPR) excess return is calculated subtracting the risk-free rate every year. I remind that holding period in this study is one year starting from every end of June (30.6.). The benchmark index is OMXH(PI).

Based on the average holding period return, the high-level cash operating profitability slightly outperforms the high operating profitability portfolio by earning 7,35% on average. This is only 0,18% more than operating profitability. Also, the low level of cash operating profitability generated 1,68% more loss comparably to low operating profitability portfolio on average. This illustrates well that during bullish period of Finnish equity markets between 2010-2019, both profitability ratios seems to find out well most profitable companies, but cash operating profitable sorts out better the unprofitable firms. The results support the long short portfolios, since on average, the holding period return for long-short cash operating profitability is 14,06% per year, where operating profitability earns 12,56%. Paying attention to sort out ability of the profitability ratios, comparing the holding period returns against the average market return, both high portfolios and long-short portfolios beat the markets. Based on the sort out ability, it seems that cash operating profitability sort the companies better between low- and mid-level portfolio than operating profitability.

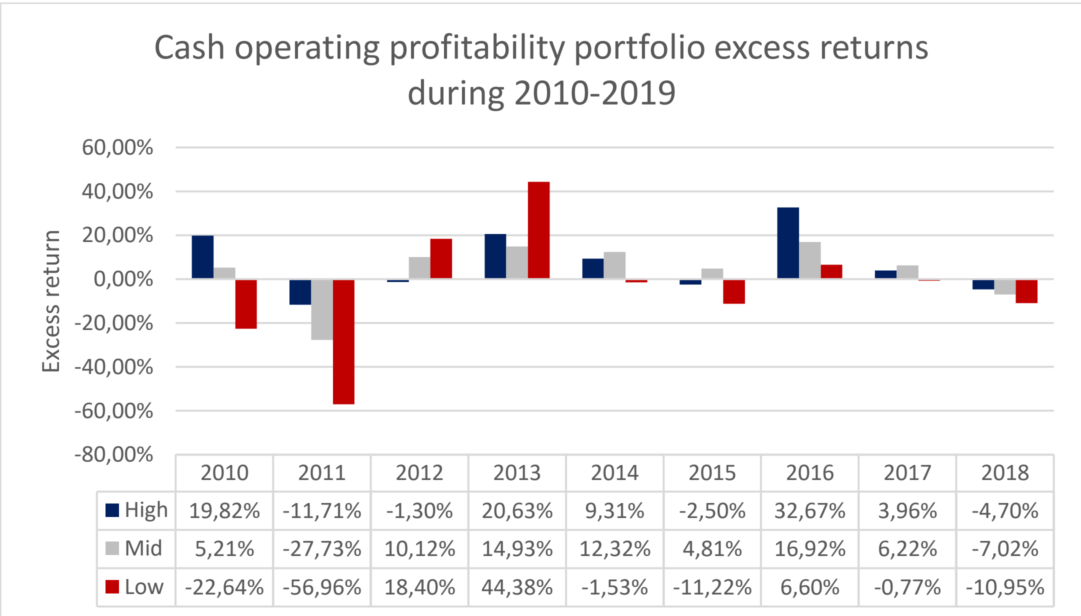
Table 2. Performance and risk averages

Profitability Portfolio and Market Averages during 30.6.2010-30.6.2019					
	Cash Operating Profitability				Market
Portfolio	High	Mid	Low	Long-Short	OMXH (PI)
Mean HPR Excess Return	*7,35 %*	*3,98 %*	*-3,85 %*	*14,06 %*	*5,46 %*
Monthly Average Return	*0,61 %*	*0,38 %*	*-0,42 %*	*1,02 %*	*0,10 %*
Standard Deviation	*3,92 %*	*4,87 %*	*6,53 %*	*5,40 %*	*4,49 %*
Beta	*0,81*	*1,28*	*2,41*	*1,80*	*1,00*
Sharpe Ratio	*2,62*	*1,52*	*-0,27*	*2,03*	*2,06*
	Operating Profitability				
Portfolio	High	Mid	Low	Long-Short	
Mean HPR Excess Return	*7,17 %*	*-0,21 %*	*-2,17 %*	*12,56 %*	
Monthly Average Return	*0,70 %*	*0,03 %*	*-0,29 %*	*0,97 %*	
Standard Deviation	*4,93 %*	*5,30 %*	*5,87 %*	*6,32 %*	
Beta	*1,74*	*1,60*	*2,00*	*2,52*	
Sharpe Ratio	*2,30*	*1,23*	*0,34*	*1,37*	

Comparing profitability portfolios from risk standpoint, both long and long-short strategies of cash-based strategy are less risky than their counter peers on average. The average standard deviation of high cash operating profitability portfolio is the only portfolio with less standard deviation than in the benchmark index. Albeit the long-short cash based operating profitability provides the best average holding period return, the average Sharpe ratio is highest of 2,62 with long only portfolio. This happens similarly with operating profitability. Based on averaged beta coefficient of 0,81 the high cash-based profitability portfolio seems to co move less relatively market index. The averaged risk-performance measurements also illustrate an interesting point out within the two sorts out ratios. It seems that in within cash-based profitability portfolios moving from highest to lowest level of profitability, the average holding period return decrease, but the portfolio specific average risk measurements increase. The similar behavior seems to be within operating profitability portfolios. The only exception is mid-level portfolio of operating profitability in which average beta was the lowest of the three 1,60. Regardless, the averages of performance and risk measurement illustrates that both profitability ratios and their long and long-short strategies performs well against the benchmark index.

Figure 3 presents the holding period excess returns of portfolios sorted out by cash operating profitability. The quoted years above returns refers to starting year of holding period. The high portfolios of cash-based profitability generate returns almost every

Figure 3. Cash operating profitability and excess returns

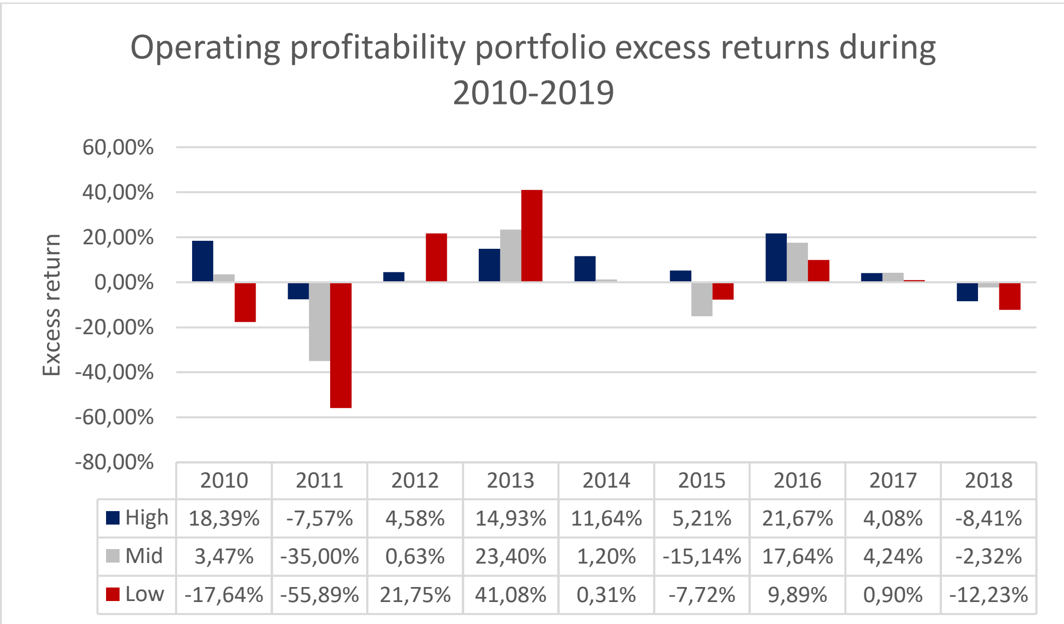


year more compared to low-level portfolios. Exceptionally, during holding periods 2012 and 2013, the low portfolio generated more returns than high portfolio.

The highest peak for cash based high portfolio was in 2016 when it generated 32,67% return. Albeit high portfolio tends to outperform low portfolio on average, the overall highest return peak of 44,38% was generated by low portfolio in 2013. This can be explained by the two-year prior downfall of low portfolio. During years 2010 and 2011, the low portfolio contained stock with relatively bigger market value. The negative trend of low portfolio suffered most in the second year when the big companies struggled causing a major loss. This led to a situation where the value weighted return of low portfolio was -55,96%. In 2012, the portfolio made a correcting move from the turbulent previous year.

Figure 4 presents the excess holding period returns of operating profitability portfolios. Even though the best holding period of high operating profitability portfolio was also in 2016, it was more than 10% less than with cash based high portfolio in same year.

Figure 4. Operating profitability and excess returns



	2010	2011	2012	2013	2014	2015	2016	2017	2018
High	18,39%	-7,57%	4,58%	14,93%	11,64%	5,21%	21,67%	4,08%	-8,41%
Mid	3,47%	-35,00%	0,63%	23,40%	1,20%	-15,14%	17,64%	4,24%	-2,32%
Low	-17,64%	-55,89%	21,75%	41,08%	0,31%	-7,72%	9,89%	0,90%	-12,23%

Albeit the high portfolios of operating profitability seem to earn bit less than cash profitability portfolios, the patterns of high and low portfolios of both ratios tend to have relatively similar patterns during the time-series.

Thus, the high and low portfolios are in the core interest from the strategy standpoint, the mid portfolios show an interesting difference. During holding periods of 2011, 2012, 2014 and 2015, there is almost 10% difference every year, between mid-level cash operating profitability and mid-level operating profitability portfolio returns. It also seems that when mid- level portfolio of cash profitability generates higher returns than similar operating profitability portfolio, the low cash-based portfolio tends to earn less than low operating profitability portfolio. This supports the previous consideration where the cash operating profitability tend to sort out better the profitable companies, but also identify the unprofitable ones more efficiently than operating profitability.

6.3 Strategy performance

This part of the thesis will provide the two strategies for each profitability ratio. The section presents both long and long-short portfolios. Long strategy created by buying the high level of profitability for one year holding period. The Long-short strategy is constructed from combination where the low profitability portfolio is sold, and high portfolio is bought. The performance is measured as value weighted returns, and both long and long-short portfolios are benchmarked to the OMXH (PI) Index.

Figure 5 presents the cumulative returns of the cash operating portfolio strategies. It can be seen, that during a sample period, both strategies outperform the market index seemingly well. Albeit both strategies and OMXH have similar bullish trend during the investigation period, the long portfolio has a relatively more similar co-movement with benchmark index. The average beta coefficient of long cash-based portfolio is 0,81. Along with other portfolio, this is the most closes to market beta (see Table 1).

The long-short portfolio managed to outperform both long only and the market portfolio. Between first two years, the long-short strategy generated exceptional return peak. This sharp peak can be mainly explained by the poor performance of relatively larger stocks of the short portfolio. Unlike the strategies, the market index started to generate better returns after year 2012. Notable is that there is also some periodical negative co-movement between long-short strategy and market index, especially during the periods when the OMXH index was declining. This relation is also shown the panel A of Table 3, which illustrates the holding period excess returns of strategy portfolios and market index.

Figure 5. Benchmarked performance of cash operating profitability.

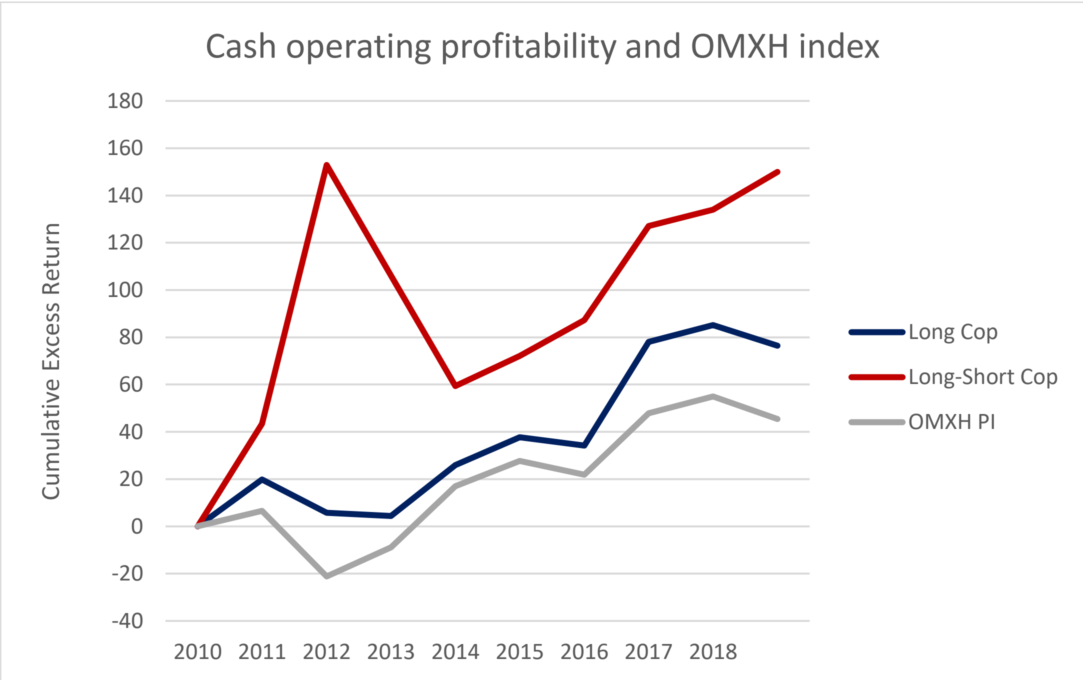
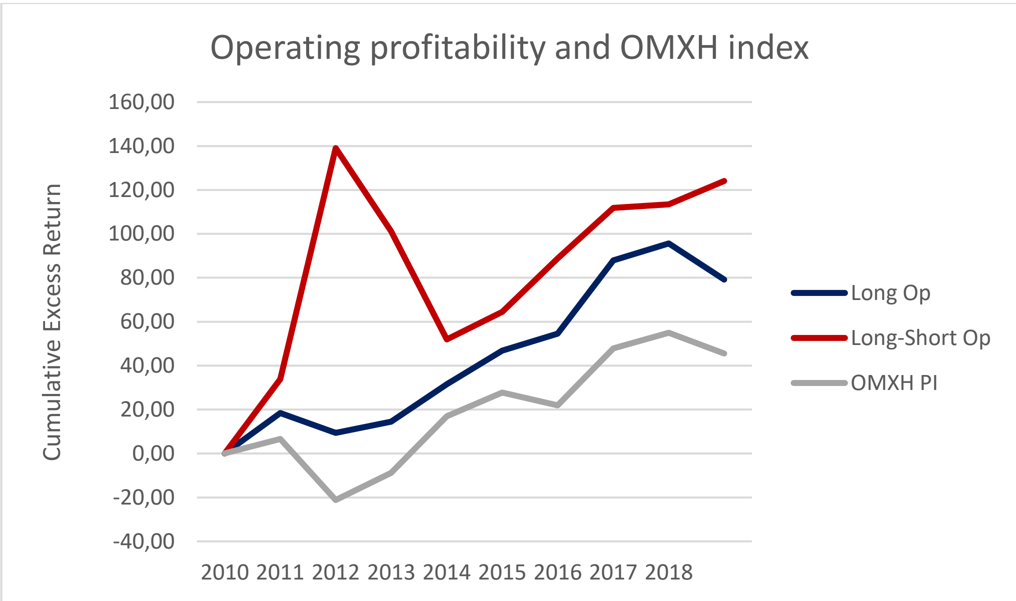


Figure 6 reports the cumulative holding period returns and the benchmark for operating profitability strategies. As it can be seen, the co-movement pattern is quite similar along with cash operating strategies. The high peak of long-sort operating profitability portfolio between 2010-2011 can be also explained by the poor performance relatively larger companies.

Even though both long and long-short strategies have similar co-movements, the spread between cumulative returns during the investigation period of nine years varies a lot. The difference between long strategies is interesting. Long operating profitability strategy generated 2,71% more returns than cash operating profitability. This result is surprising, since the long-short cash-based strategy outperforms long-short operating profitability strategy by 26,00%. Although the difference between long only portfolios is very low, the difference between long-short portfolios support again the previously discussed effect that the cash operating profitability ratio seems to more efficiently exclude the unprofitable companies to low portfolio.

Figure 6. Benchmarked performance of operating profitability.



Among with holding period returns, Table 3, presents Sharpe ratios for all profitability strategies. Captivatingly the Sharpe ratios of both long-short strategies seems to be positive while the Sharpe of markets is negative. Conversely when the Long-short strategies resulted negative Sharpe ratios, the market seems to result positive. Like Table 1 show, long cash operating portfolio has the best average Sharpe ratio.

During the investigation period, the highest Sharpe ratio of 10,39 was reported between 2016-2017 for cash-based long only portfolio. Even though the result is relatively high, the other portfolios were able to generate as well high Sharpe ratios casually. Regardless to previous, all the strategies were able to generally generate Sharpe ratios with good quality.

Table 3. Portfolio HPRs and Sharpe ratios

Panel A: Holding Period Excess Returns of Strategy portfolios					
Year	Long Cop	Long-Short Cop	Long Op	Long-Short Op	OMXH PI
(2010-2011)	*19,82 %*	*43,44 %*	18,39 %	33,92 %	6,60 %
(2011-2012)	-11,71 %	76,31 %	-7,57 %	78,49 %	-26,06 %
(2012-2013)	-1,30 %	-18,52 %	4,58 %	-15,82 %	15,70 %
(2013-2014)	20,63 %	-22,69 %	14,93 %	-24,47 %	28,33 %
(2014-2015)	9,31 %	7,99 %	11,64 %	8,15 %	9,10 %
(2015-2016)	-2,50 %	8,85 %	5,21 %	14,87 %	-4,57 %
(2016-2017)	32,67 %	21,26 %	21,67 %	12,17 %	21,35 %
(2017-2018)	3,96 %	3,03 %	4,08 %	0,73 %	4,81 %
(2018-2019)	-4,70 %	6,85 %	-8,41 %	4,99 %	-6,14 %
Panel B: Sharpe Ratios of Strategy Portfolios					
Year	Long Cop	Long-Short Cop	Long Op	Long-Short Op	OMXH PI
(2010-2011)	*5,53*	*6,76*	*5,16*	*5,31*	*1,17*
(2011-2012)	*-1,59*	*8,65*	*-1,09*	*8,02*	*-3,32*
(2012-2013)	*-0,44*	*-5,30*	*2,18*	*-4,67*	*6,13*
(2013-2014)	*7,22*	*-2,82*	*5,78*	*-3,20*	*6,69*
(2014-2015)	*2,45*	*1,41*	*5,33*	*1,64*	*2,28*
(2015-2016)	*-0,48*	*2,77*	*0,63*	*2,60*	*-0,83*
(2016-2017)	*10,39*	*3,83*	*2,05*	*1,28*	*5,83*
(2017-2018)	*1,72*	*0,69*	*2,09*	*0,14*	*1,93*
(2018-2019)	*-1,17*	*2,22*	*-1,37*	*1,19*	*-1,37*

7 Regression analysis

The regression analysis section provides two different types of regressions. Firstly, I try to identify using simple and multiple regressions, whether the profitability ratios can predict the returns. The regressed returns are annualized monthly averages and the provided control variables are the natural logarithms of market value (Log M) and book-to-market ratio (Log B/M). Both market values and book values are considered in Euros. The regression methodology is adapted from Lakonishok (1994) study, where he explains the returns with accounting-based ratios. Calculating the averages of regression coefficients, this thesis aims to model the Fama and Macbeth (1973) style like Lakonishok (1994). The chosen control variables are similar than in Ball et al. (2016). The only exception is that return based control variables are not considered. The regressions are carried out for overall data and sort out portfolios based on profitability. Furthermore, this thesis executes the Fama-French five-factor model to identify how the profitability factor explains the excess return of Finnish equity markets.

7.1 Profitability regressions

To show the co-movement between returns and profitability ratios, Table 4 represent the coefficients. These coefficients are averaged from cross sectional regressions during a sample period. Similarly represented t-values are calculated by dividing the coefficient with mean standard errors. Regression 1 and 3 are simple regression, and 2 and 4 are multiple regressions. Coefficients are multiplied by 100. As it can be seen overall, cash operating profitability has a higher coefficient and lower standard errors in both regressions than operating profitability on average. Interestingly, the added control variables effect differently to both main dependent variables. The coefficient of cash-based profitability decreases, which is the opposite than with operating profitability. The adding of control variables effects positively to the adjusted R-squares, which are in similar or even higher level than in Ball et al. (2016 p. 33). Still none of the regressions do not present any statistically significant values, measured as t-values or in the level of R-squares. For both ratios there are some periods, where the regressions do have statically significant coefficients. The problem occurs that depending on the year, these coefficients travel between from positive to negative values. The year by year result of both simple and multiple regressions are presented in the appendices.

Table 4. Profitability coefficient averages

Profitability Regressions				
Explanatory	*Regression*			
variable	*1*	*2*	*3*	*4*
Cash Operating Profitability	2,55	2,39		
	(1,27)	(1,15)		
Operating Profitability			1,27	1,35
			(0,64)	(0,70)
Log (M)		0,09		0,14
		(0,37)		(0,53)
Log (B/M)		-0,04		-0,17
		(-0,08)		(-0,32)
Intercept	-0,28	-0,94	-0,02	-1,21
	(-0,60)	(-0,49)	(-0,05)	(-0,60)
Adjusted R2	5,40 %	8,90 %	2,47 %	6,54 %

7.2 Portfolio regressions

This part of the regression analysis, both profitability ratios are divided into three different portfolios based on the level of profitability that they are representing. Single and multiple regressions are executed, and the returns and control variables are calculated similarly than in regressions of Table 4. Table 5 represent the coefficients of cash operating profitability portfolios. The beta coefficient of high portfolio co-moves most positively with returns. Interestingly the large negative coefficient comes from the mid-level portfolio. Based on the previous studies of Novy-Marx (2013) and Ball et al (2015,2016), the higher level of profitability should outcome in higher level returns. Thus, the level of mid cash operating profitability portfolio negative coefficient, the results of the portfolio segmentation remains insignificant and is similar like in overall testing of Table 4.

Independent from the level of profitability, the adding of control variables increases the level of Adjusted R-squares, but neither of the coefficient are statistically significant.

Table 5. Cash operating profitability coefficient averages

Cash Operating Profitability Portfolio Regressions						
Explanatory	*Regression*					
variable	*1*	*2*	*3*	*4*	*5*	*6*
High Cop	*3,16*	2,70				
	(0,68)	(0,57)				
Mid Cop			-6,70	-6,74		
			(-0,41)	(-0,41)		
Low Cop					1,36	1,15
					(0,15)	(0,12)
Log (M)		0,08		0,21		0,09
		(0,20)		(0,46)		(0,17)
Log (B/M)		-0,41		-0,14		-0,29
		(-0,40)		(-0,14)		(-0,30)
Intercept	*-0,62*	-1,55	1,08	-0,69	-0,10	-0,76
	(-0,39)	(-0,59)	(0,45)	(-0,15)	(-0,17)	(-0,21)
Adjusted R2	*8,11 %*	24,02 %	3,51 %	15,40 %	5,80 %	19,61 %

Table 6 shows the corresponding deviation for the operating profitability portfolios. The results are as well similar than in previous tables. Independent from the level of profitability, there is no statistical significance between the mean coefficient. Adding the effect of control variable, multiple regression results in low portfolio of operating profitability turns the coefficient positive, when it was negative in simple regression. The adjusted R-squares behave also corresponding, raising the explanatory level, when control variables are included, but keeping the level still insignificant . Within operating profitability portfolios, the coefficients grew slightly in multiple regressions.

To conclude the unfortunate results of all predicting profitability regression there are no significant results in any of the mean coefficients. While there were some statistically significant periods, independent from the level of profitability, there can be found no strong evidence that either of the profitability ratios, can predict returns. Another interesting finding is that in every regression, the intercepts are negative. Fama and French

(2015 p. 13) have shown these multiple times that small measuring extreme growth stocks and microcap stocks results problems with providing a negative intercept. problems with providing a negative intercept.

Table 6. Operating profitability coefficient averages

Operating Profitability Portfolio Regressions						
Explanatory variable	*Regression 1*	*2*	*3*	*4*	*5*	*6*
High Op	3,20	3,22				
	(0,63)	(0,60)				
Mid Op			2,30	2,48		
			(0,12)	(0,12)		
Low Op					-0,61	0,08
					(-0,30)	(0,03)
Log (M)		0,12		0,17		0,03
		(0,30)		(0,34)		(0,06)
Log (B/M)		-0,41		0,24		-0,32
		(-0,41)		(0,24)		(-0,29)
Intercept	-0,50	-1,75	-0,18	-1,22	-0,14	-0,34
	(-0,32)	(-0,62)	(-0,07)	(-0,25)	(-0,25)	(-0,09)
Adjusted R2	13,29 %	30,70 %	4,30 %	19,51 %	4,67 %	17,82 %

These results indicate the recent measures of profitability ratios are uncapable to predict returns in Finnish Stock markets. Making the results being offset to what previous literature like Novy-Marx (2013) or Ball et al. (2015, 2016) have shown.

7.3 Fama-French Five-Factor model

To finish the regression analysis section, the study progresses on to the Fama-French Five-factor model. Fama and French (2015) presented the five-factor model which have an added profitability factor. The result of model is presented in Table 7. Fortunately, the five-factor model was able to find statistically significant results which supports the results of performance and risk analysis. At the same time, it indicates that Finnish stock markets are an interesting platform to investigate the profitability during the post financial crisis period.

The levels of significance are marked in after presented t-values such as where, (*) means 10% level-, (**) refers 5% level-, and (***) indicates 1% level of significance. In regressions 4. and 5. the cash operating profitability factor is consisting and models 6. and 7. considers operating profitability factor. The correlation panel of five-factor model is presented in appendices.

Table 7. Fama-French Five-Factor model

Fama-French 5-Factor Regressions							
Explanatory	*Regression*						
variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Alpha	0,24 %	0,18 %	0,19 %	0,21 %	0,21 %	0,18 %	0,19 %
	(2,89)***	(2,24)**	(2,32)**	(2,63)***	(2,60)***	(2,31)**	(2,32)**
Market	0,88	0,81	0,80	0,94	0,95	0,78	0,79
	(49,91)***	(18,15)***	(17,65)***	(13,50)***	(13,56)***	(17,50)***	(17,55)***
SMB		-0,01	-0,01	0,00	0,01	-0,02	-0,02
		(-1,71)*	(-1,95)*	(0,47)	(0,53)	(-2,32)**	(-2,10)**
HML			0,03	0,03	0,03	0,03	0,03
			(1,38)	(1,52)	(1,53)	(1,30)	(1,32)
RMW cop				0,07	0,07		
				(2,54)**	(2,49)**		
RMW op						-0,01	-0,01
						(-0,84)	(-0,89)
CMA					0,08		0,09
					(0,99)		(1,13)
Adjusted R2	96,16 %	96,34 %	96,44 %	96,64 %	96,68 %	96,46 %	96,51 %
Obs.	108	108	108	108	108	108	108

Regressing the OMXH market excess returns against the risk factors Table 7 shows, that the size factor (SMB) is negative and statistically significant, but when the cash operating profitability factor (RMW cop) is added, the SMB factor becomes insignificant. The negative and statistically significant size factor is opposite to Banz (1981) finding, where smaller companies tend to earn higher returns relatively to larger ones. Even though the size factor is negative, the coefficients are relatively small. This result is not surprising. Albeit there are differences between the largest stocks (see Table 1), the median of company size is tilting more towards larger stocks. This automatically give more weight to bigger companies excluding the effect of smaller companies. It is also a typical feature that larger companies do have important in Finnish stock markets.

The results of size are also inconsistent with Ball et al. (2016 p. 38) where they find that selling big companies and buying small companies generated on average a 2,88% annualized premium. Also, another interesting finding is that adding operating profitability factor (RMW op), the level of significance in size factor increases. Even though the 45 largest companies are chosen every year, Table 1 shows that both high profitability portfolios do have slightly smaller companies.

Interestingly the value factor (HML) did not have any statistically significant coefficients during the bullish trending investigation period after financial crisis. Thus, the results of HML factor are insignificant, the period after financial crisis seems to suit more for growth stocks. Table 1 shows that on average the high level of profitability contains more growth stocks. The results of cash profitability risk factor illustrate that excluding the effect of accruals adds more quality on profitability factor. Regressions 4 and 5 of Table 7 shows that cash operating profitability factor explain returns better than size, value, or investments factors. The coefficients are also larger than and statistically significant in 5%-level. Conversely to value factor, it seems that cash based operating profitability identify good quality growth stocks during the sample period.

Even though operating profitability as a long, or long-short strategy, can beat the markets (see figure 6.), comparing the profitability factors RMW cop and RMW op with each other, it can be seen that operating profitability cannot explain returns with statistically significance. Also, noteworthy results from five-factor model are that in every regression, the alphas seem to be statistically significant. This indicates that the model leaves questions whether there is another risk factor that would suit better for Finnish equity markets. On the other hand, the level of adjusted R-squares is over 96% and shows that the models explain returns with statistically significant level.

8 Conclusion

Novy-Marx (2013) find that gross profitability explains returns almost as efficiently as book-to-market. From the evidence of gross profitability, Ball et al. (2015) developed an even more accurate measure, the operating profitability. The development continued when Ball et al. (2016) excluded the negative effect of accruals, making the cash operating profitability to the most dominant measure among all profitability measures so far. Moreover, Grobys and Huhta-halkola (2019) show robust evidence from the Nordic markets that value strategy is driven by size effect of small companies, while momentum is unassociated with size. Additionally, they find that growth equities seem to drive the negative correlation of value and momentum in Nordic markets. Adding contribution to Nordic based studies, this thesis concludes evidence that during a nine-year period after the financial crisis, the cash-based operating profitability explains returns better in Finnish equity markets than operating profitability, size or book-to-market factor with statistically significant level.

Testing both operating and cash operating profitability ratios in the context of Finnish equity markets, the result of performance analysis indicates that during a bullish period of OMXH between 2010-2019, both profitability ratios seems to find out well the most profitable companies, but cash operating profitable sorts out better the unprofitable firms to low portfolio. Additionally, categorizing the portfolios based on the latest profitability ratios, provides an interesting setup where the highest levels of profitability portfolios seem to contain more growth companies than value firms.

The results of performance analysis show that cash based operating profitability seems to generate returns better on average than operating profitability. The long-only cash-based portfolio generate on average a holding period return of 7,35% while the average holding period for market was 5,46%. Although both strategies were able to beat the market index, the long-short cash-based portfolio outperformed operating profitability by 26% during a nine-year investigation period after the financial crisis.

Even though profitability strategies of cash-based and operating profitability ratios seem to classify well the profitable, both failed the simple and multiple regressions. Neither of the ratios were unable to result any statistically significant coefficient that would have implied whether the profitability ratios have power to predict returns. Albeit the profitability ratios were allocated on high, medium, and low levels, there was no significant interpretation. The existence of negative intercepts was a common phenomenon for all simple and multiple regressions. Fama and French (2015 p.13) find similar problem when observing the growth stock. Thus, the strategy portfolios managed to generate returns better than markets on average, based on the results of simple and multiple regressions, both profitability ratios do not have power to predict returns, meaning that hypothesis 1 and 2 are rejected.

The result of Fama-French five factor model supports the evidence of Ball et al. (2016) and Fama French (2018) that cash-based operating profitability outperforms the operating profitability. When the cash-based profitability factor is added to Fama-French five-factor model, it is the only factor among with market risk factor that explains the returns with significant level. Even more, the adding of cash profitability makes size factor insignificant. These results justify that the hypothesis 3 remains and hypothesis 4 is rejected.

This thesis shows evidence of testing the recent profitability ratios in the context of Finnish equity market post financial crisis, the cash based operating profitability explains returns better than operating profitability. Fulfilling the existing gap of Nordic market research, this thesis shows that excluding the part accruals of and focusing more on cash-based measures, does improve the profitability ratio.

Even though Grobys and Huhta-Halkola (2019) show strong evidence that the negative relation between value and momentum is mainly driven by growth stocks, for further investigations it would be interesting to investigated whether combining the cash based profitability with momentum can add quality based growth premia to investors portfolio in Nordic markets. Also, the existing Fama and French (2018) six-factor model would provide an interesting way to investigate both momentum and cash profitability as individually in the context of Nordic equity markets.

References

Ball, R., Gerakos, J., Linnainmaa, J. T., & Nikolaev, V. V. (2015). Deflating profitability. *Journal of Financial Economics*, 117(2), 225-248.

Ball, R., Gerakos, J., Linnainmaa, J. T., & Nikolaev, V. (2016). Accruals, cash flows, and operating profitability in the cross section of stock returns. *Journal of Financial Economics*, 121(1), 28-45.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of financial economics*, 9(1), 3-18.

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.

Black, F. (1972). Capital market equilibrium with restricted borrowing. *The Journal of business*, 45(3), 444-455.

Capaul, C., Rowley, I., & Sharpe, W. F. (1993). International value and growth stock returns. *Financial Analysts Journal*, *49*(1), 27-36.

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of finance*, *52*(1), 57-82.

Chan, L. K., Hamao, Y., & Lakonishok, J. (1991). Fundamentals and stock returns in Japan. *The journal of finance*, 46(5), 1739-1764.

Chan, L. K., Lakonishok, J., & Sougiannis, T. (2001). The stock market valuation of research and development expenditures. *The Journal of Finance*, *56*(6), 2431-2456.

Eisfeldt, A. L., & Papanikolaou, D. (2013). Organization capital and the cross-section of expected returns. *The Journal of Finance*, *68*(4), 1365-1406.

Fairfield, P. M., Whisenant, J. S., & Yohn, T. L. (2003). Accrued earnings and growth: Implications for future profitability and market mispricing. *The accounting review*, 78(1), 353-371.

Fama, E. F., & French, K. R. (1992). The cross‐section of expected stock returns. *The Journal of Finance*, 47(2), 427-465.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* February 1993, Vol.33(1), pp.3-56

Fama, E. F., & French, K. R. (1996). Multifactor explanations of asset pricing anomalies. *The journal of finance*, 51(1), 55-84.

Fama, E. F., & French, K. R. (1998). Value versus growth: The international evidence. *The journal of finance*, *53*(6), 1975-1999.

Fama, E. F., & French, K. R. (2004). The capital asset pricing model: Theory and evidence. *Journal of economic perspectives*, 18(3), 25-46.

Fama, E. F., & French, K. R. (2006). Profitability, investment and average returns. *Journal of financial economics*, 82(3), 491-518.

Fama, E. F., & French, K. R. (2008). Dissecting anomalies. *The Journal of Finance*, *63*(4), 1653-1678.

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of financial economics*, *116*(1), 1-22.

Fama, E. F., & French, K. R. (2018). Choosing factors. *Journal of Financial Economics*, *128*(2), 234-252.

Friend, I., & Blume, M. (1970). Measurement of portfolio performance under uncertainty. *The American economic review*, 60(4), 561-575.

Graham, B., & Dodd, D. (2003). *Security Analysis: The Classic 1934 Edition*. McGraw Hill.

Gordon, M. J., & Shapiro, E. (1956). Capital equipment analysis: the required rate of profit. *Management science*, 3(1), 102-110.

Grobys, K., & Huhta-Halkola, T. (2019). Combining value and momentum: evidence from the Nordic equity market. *Applied Economics*, *51*(26), 2872-2884.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945–1964. *The Journal of finance*, 23(2), 389-416.

Lakonishok, J., Shleifer, A., & Vishny, R. W. (1994). Contrarian investment, extrapolation, and risk. *The journal of finance*, 49(5), 1541-1578.

Lintner, J. (1965a). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The review of economics and statistics*, 13-37.

Lintner, J. (1965b). Security prices, risk, and maximal gains from diversification. *The journal of finance, 20(4), 587-615.*

Malkiel, B. G., & Fama, E. F. (1970). Efficient capital markets. A review of theory and empirical work. *The Journal of Finance* 25, 383, 417.

Markowitz, H. (1952). Portfolio selection. *The Journal of finance*, *7*(1), 77-91.

Markowitz, H. (1959). Portfolio selection: Efficient diversification of investments *(Vol. 16). New York: John Wiley*.

Markowitz, H. M. (1987). Mean-Variance Analysis in Portfolio Choice and Capital. *New York: Jolin Wiley Publ*, 211-213.

Merton, R. C. (1972). An analytic derivation of the efficient portfolio frontier. *Journal of financial and quantitative analysis*, 1851-1872.

Miller, M. H., & Modigliani, F. (1961). Dividend policy, growth, and the valuation of shares. *the Journal of Business*, 34(4), 411-433.

Mossin, J. (1966). Equilibrium in a capital asset market. Econometrica: *Journal of the econometric society*, 768-783.

Nicholson, S. F. (1968). Price ratios in relation to investment results. *Financial Analysts Journal*, *24*(1), 105-109.

Nikkinen Jussi, Rothovius Timo & Sahlström Petri. Arvopaperisijoittaminen, s. 86-88. WSOY, 2002. ISBN 951-0-26627-2.

Novy-Marx, R. (2013). The other side of value: The gross profitability premium. *Journal of Financial Economics*, 108(1), 1-28.

Richardson, S. A., & Sloan, R. G. (2003). External financing and future stock returns. Rodney L. White Center for Financial Research Working Paper, (03-03).

Barr Rosenberg, K. R., & Lanstein, R. (1984). Persuasive evidence of market inefficiency. *Journal of portfolio management*, 11, 9-17.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance*, 19(3), 425-442.

Sharpe, W. F. (1966). Mutual fund performance. *The Journal of business*, 39(1), 119-138.

Stattman, D. (1980). Book values and stock returns. The Chicago MBA: *A journal of selected papers*, 4(1), 25-45.

Titman, S., Wei, K. J., & Xie, F. (2004). Capital investments and stock returns. *Journal of financial and Quantitative Analysis*, 39(4), 677-700.

Williams, J. B. (1938). The theory of investment value (Vol. 36). Cambridge, MA: *Harvard University Press*.

Appendices

Appendix 1. Simple and multiple regressions of Cop

Simple regressions of Cop

Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
COP	0,033	0,096	-0,004	0,016	0,008	-0,003	-0,005	0,031	0,057
Se	0,023	0,023	0,013	0,028	0,024	0,020	0,017	0,014	0,019
T-value	1,460	4,100	-0,340	0,560	0,340	-0,150	-0,280	2,230	2,940
P-value	0,151	0,000	0,733	0,576	0,734	0,885	0,782	0,031	0,005
Intercept	0,002	-0,039	0,005	0,014	0,005	-0,001	0,014	-0,007	-0,018
Se	0,005	0,005	0,004	0,006	0,005	0,005	0,003	0,004	0,006
T-value	0,330	-7,580	1,050	2,300	1,020	-0,170	4,660	-2,040	-3,220
P-value	0,740	0,000	0,298	0,027	0,315	0,869	0,000	0,048	0,002
R2	0,039	0,230	0,002	0,015	0,003	0,000	0,002	0,027	0,169

Multi regressions of Cop

Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
COP	0,023	0,091	-0,002	0,019	-0,001	-0,007	-0,004	0,040	0,058
Se	0,026	0,024	0,012	0,029	0,022	0,021	0,017	0,016	0,021
T-value	0,880	3,850	-0,200	0,650	-0,060	-0,340	-0,260	2,550	2,770
P-value	0,385	0,000	0,841	0,519	0,950	0,737	0,797	0,015	0,008
LogM	0,001	0,000	0,004	0,001	-0,002	0,000	-0,001	0,002	0,003
Se	0,003	0,002	0,003	0,003	0,002	0,002	0,002	0,002	0,003
T-value	0,510	0,040	1,450	0,260	-0,840	0,080	-0,730	0,780	1,060
P-value	0,613	0,965	0,155	0,793	0,404	0,940	0,472	0,441	0,296
LogBM	-0,005	-0,005	0,003	0,005	-0,006	-0,005	0,004	0,008	-0,002
Se	0,004	0,006	0,007	0,005	0,005	0,005	0,004	0,009	0,006
T-value	-1,230	-0,880	0,480	0,920	-1,070	-0,910	1,070	0,880	-0,350
P-value	0,225	0,382	0,632	0,362	0,289	0,366	0,293	0,383	0,727
Intercept	-0,010	-0,043	-0,021	0,010	0,015	-0,004	0,026	-0,015	-0,043
Se	0,019	0,018	0,020	0,020	0,015	0,017	0,013	0,024	0,026
T-value	-0,510	-2,450	-1,070	0,530	1,020	-0,240	1,990	-0,630	-1,700
P-value	0,611	0,019	0,290	0,600	0,315	0,811	0,054	0,533	0,098
R2	0,070	0,244	0,056	0,034	0,041	0,029	0,045	0,096	0,188

Appendix 2. Simple and multiple regressions of Op

Simple regressions of Op

Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
OP	-0,007	0,046	-0,019	0,008	0,036	0,007	0,004	0,013	0,027
Se	0,026	0,035	0,019	0,022	0,016	0,013	0,013	0,017	0,016
T-value	-0,260	1,310	-1,000	0,350	2,230	0,560	0,340	0,720	1,630
P-value	0,797	0,198	0,322	0,727	0,031	0,577	0,738	0,472	0,110
Intercept	0,007	-0,032	0,007	0,016	0,001	-0,002	0,018	-0,004	-0,013
Se	0,005	0,007	0,005	0,004	0,003	0,003	0,003	0,004	0,005
T-value	1,270	-4,670	1,460	4,310	0,370	-0,850	7,180	-1,030	-2,740
P-value	0,209	0,000	0,151	0,000	0,715	0,402	0,000	0,309	0,009
R2	0,003	0,081	0,019	0,004	0,064	0,003	0,001	0,007	0,040

Multi regressions of Op

Year	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
OP	-0,011	0,041	-0,011	0,010	0,031	0,008	0,006	0,017	0,029
Se	0,023	0,033	0,019	0,022	0,014	0,013	0,013	0,018	0,018
T-value	-0,460	1,240	-0,560	0,490	2,180	0,580	0,440	0,970	1,620
P-value	0,645	0,223	0,580	0,630	0,035	0,563	0,659	0,338	0,113
LogM	0,001	0,000	0,004	0,001	-0,001	0,000	-0,001	0,005	0,004
Se	0,003	0,003	0,003	0,003	0,002	0,002	0,002	0,003	0,003
T-value	0,460	0,030	1,260	0,330	-0,450	0,060	-0,400	1,460	1,150
P-value	0,648	0,975	0,214	0,744	0,655	0,956	0,688	0,151	0,257
LogBM	-0,007	-0,007	0,003	0,004	-0,005	-0,004	0,007	-0,002	-0,004
Se	0,004	0,006	0,007	0,005	0,005	0,005	0,004	0,006	0,006
T-value	-1,770	-1,200	0,430	0,850	-0,890	-0,900	1,710	-0,280	-0,580
P-value	0,084	0,238	0,672	0,402	0,381	0,373	0,095	0,781	0,562
Intercept	-0,006	-0,038	-0,018	0,012	0,006	-0,006	0,029	-0,044	-0,043
Se	0,021	0,021	0,022	0,018	0,016	0,016	0,015	0,029	0,025
T-value	-0,280	-1,810	-0,840	0,630	0,360	-0,360	1,970	-1,520	-1,710
P-value	0,778	0,077	0,407	0,529	0,718	0,718	0,056	0,137	0,096
R2	0,059	0,108	0,060	0,019	0,087	0,028	0,087	0,075	0,065

Appendix 3. Regressions of high portfolio Cop

Simple regressions of high Cop portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
COP	0,022	0,137	0,003	0,070	0,065	-0,026	-0,058	0,017	0,054
Se	0,058	0,073	0,010	0,049	0,084	0,043	0,025	0,056	0,021
T-value	0,380	1,880	0,360	1,430	0,780	-0,600	-2,300	0,310	2,540
P-value	0,713	0,082	0,725	0,177	0,448	0,559	0,039	0,763	0,024
Intercept	0,006	-0,053	-0,001	-0,006	-0,013	0,006	0,030	-0,001	-0,022
Se	0,018	0,021	0,008	0,018	0,027	0,013	0,008	0,019	0,011
T-value	0,320	-2,490	-0,090	-0,350	-0,500	0,490	3,700	-0,080	-1,980
P-value	0,753	0,027	0,929	0,735	0,626	0,633	0,003	0,938	0,069
R2	0,008	0,199	0,002	0,190	0,034	0,026	0,093	0,006	0,171

Multi regressions of high Cop portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
COP	0,011	0,173	0,004	0,073	0,061	-0,032	-0,063	0,000	0,017
Se	0,070	0,059	0,008	0,047	0,079	0,041	0,039	0,059	0,023
T-value	0,160	2,940	0,510	1,550	0,770	-0,780	-1,610	-0,010	0,750
P-value	0,873	0,014	0,621	0,149	0,460	0,452	0,136	0,996	0,471
LogM	0,003	0,009	0,001	-0,004	-0,004	0,001	0,005	0,001	-0,005
Se	0,003	0,003	0,005	0,006	0,006	0,003	0,003	0,001	0,004
T-value	1,210	3,050	0,320	-0,670	-0,610	0,200	1,860	0,540	-1,150
P-value	0,253	0,011	0,757	0,515	0,552	0,843	0,089	0,600	0,273
LogBM	-0,004	-0,009	0,018	0,000	-0,007	-0,005	0,000	-0,010	-0,019
Se	0,006	0,006	0,009	0,016	0,015	0,006	0,006	0,020	0,010
T-value	-0,810	-1,500	2,110	-0,030	-0,510	-0,830	0,000	-0,490	-1,890
P-value	0,435	0,163	0,059	0,979	0,622	0,425	0,997	0,633	0,085
Intercept	-0,018	-0,132	0,000	0,018	0,009	-0,001	-0,007	-0,012	0,002
Se	0,022	0,030	0,026	0,036	0,015	0,020	0,021	0,031	0,035
T-value	-0,790	-4,430	0,010	0,510	0,580	-0,030	-0,320	-0,390	0,050
P-value	0,445	0,001	0,994	0,619	0,572	0,976	0,752	0,706	0,964
R2	0,078	0,586	0,351	0,236	0,065	0,129	0,261	0,041	0,416

Appendix 4. Regressions of high portfolio Op

Simple Regressions of high Op portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OP	0,032	0,098	-0,047	0,120	0,134	-0,113	0,027	-0,014	0,051
Se	0,044	0,074	0,040	0,079	0,042	0,035	0,051	0,074	0,021
T-value	0,740	1,320	-1,160	1,520	3,180	-3,270	0,530	-0,190	2,450
P-value	0,475	0,209	0,269	0,153	0,007	0,006	0,607	0,854	0,029
Intercept	0,001	-0,043	0,013	-0,022	-0,029	0,034	0,012	0,010	-0,022
Se	0,013	0,022	0,011	0,023	0,013	0,011	0,012	0,027	0,011
T-value	0,050	-1,960	1,200	-0,960	-2,220	3,040	1,020	0,350	-1,990
P-value	0,958	0,072	0,252	0,356	0,045	0,009	0,328	0,729	0,068
R2	0,036	0,105	0,066	0,252	0,344	0,253	0,013	0,002	0,126

Multi Regressions of high Op portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OP	0,022	0,081	-0,028	0,136	0,137	-0,127	0,031	0,024	0,014
Se	0,053	0,057	0,027	0,079	0,028	0,033	0,051	0,120	0,032
T-value	0,420	1,420	-1,030	1,720	4,930	-3,880	0,600	0,200	0,440
P-value	0,684	0,183	0,325	0,113	0,000	0,003	0,559	0,847	0,665
LogM	0,004	0,007	0,007	-0,003	-0,006	0,003	0,001	-0,001	-0,002
Se	0,002	0,003	0,003	0,006	0,003	0,005	0,004	0,006	0,005
T-value	1,660	2,750	2,480	-0,510	-2,000	0,680	0,350	-0,180	-0,340
P-value	0,126	0,019	0,030	0,619	0,071	0,510	0,730	0,857	0,743
LogBM	-0,004	-0,010	0,017	-0,009	-0,028	0,004	0,002	0,009	-0,017
Se	0,005	0,008	0,010	0,012	0,009	0,010	0,009	0,018	0,008
T-value	-0,840	-1,270	1,680	-0,790	-2,970	0,350	0,240	0,520	-2,060
P-value	0,420	0,231	0,121	0,444	0,013	0,732	0,818	0,614	0,064
Intercept	-0,024	-0,100	-0,024	-0,012	-0,019	0,018	0,004	0,016	-0,015
Se	0,023	0,026	0,021	0,037	0,016	0,031	0,026	0,031	0,043
T-value	-1,050	-3,830	-1,130	-0,310	-1,170	0,580	0,140	0,500	-0,360
P-value	0,315	0,003	0,284	0,759	0,268	0,573	0,893	0,624	0,726
R2	0,206	0,486	0,382	0,294	0,747	0,288	0,023	0,052	0,285

Appendix 5. Regression of mid portfolio Cop

Simple regressions of mid Cop portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
COP	0,009	-0,222	0,062	-0,039	0,086	-0,259	-0,125	-0,056	-0,059
Se	0,122	0,176	0,169	0,149	0,188	0,136	0,137	0,259	0,133
T-value	0,080	-1,260	0,370	-0,260	0,450	-1,910	-0,910	-0,220	-0,440
P-value	0,939	0,231	0,720	0,796	0,657	0,079	0,377	0,833	0,666
Intercept	0,002	0,012	-0,001	0,017	-0,009	0,041	0,027	0,004	0,004
Se	0,016	0,023	0,027	0,028	0,032	0,020	0,018	0,033	0,018
T-value	0,130	0,500	-0,040	0,620	-0,270	2,030	1,480	0,110	0,250
P-value	0,902	0,625	0,971	0,544	0,789	0,063	0,162	0,916	0,810
R2	0,000	0,142	0,007	0,005	0,020	0,086	0,041	0,004	0,011

Multi regressions of mid Cop portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
COP	0,022	-0,217	-0,124	0,074	0,160	-0,238	-0,088	-0,089	-0,106
Se	0,156	0,181	0,187	0,224	0,146	0,141	0,121	0,206	0,121
T-value	0,140	-1,200	-0,660	0,330	1,100	-1,690	-0,730	-0,430	-0,880
P-value	0,892	0,254	0,523	0,749	0,294	0,119	0,483	0,673	0,399
LogM	0,000	-0,003	0,000	0,004	0,003	0,002	-0,003	0,010	0,007
Se	0,004	0,003	0,004	0,004	0,007	0,004	0,004	0,007	0,005
T-value	-0,030	-1,250	-0,050	0,910	0,490	0,460	-0,700	1,400	1,280
P-value	0,974	0,238	0,963	0,383	0,632	0,655	0,495	0,190	0,225
LogBM	0,002	0,007	-0,018	0,008	-0,001	-0,005	0,002	0,016	-0,023
Se	0,006	0,012	0,010	0,009	0,011	0,010	0,005	0,013	0,012
T-value	0,290	0,540	-1,790	0,870	-0,090	-0,570	0,460	1,180	-1,850
P-value	0,774	0,599	0,101	0,403	0,926	0,583	0,651	0,263	0,091
Intercept	0,002	0,039	0,019	-0,028	-0,046	0,023	0,046	-0,053	-0,063
Se	0,031	0,039	0,044	0,065	0,056	0,037	0,034	0,055	0,039
T-value	0,070	1,020	0,430	-0,430	-0,820	0,600	1,360	-0,970	-1,600
P-value	0,946	0,330	0,673	0,675	0,427	0,559	0,200	0,354	0,138
R2	0,004	0,226	0,235	0,122	0,050	0,139	0,120	0,238	0,252

Appendix 6. Regressions of mid portfolio Op

Simple regressions of mid Op portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
OP	0,040	-0,074	0,131	0,212	0,327	-0,209	-0,081	-0,178	0,039
Se	0,144	0,126	0,142	0,239	0,317	0,133	0,189	0,241	0,185
T-value	0,280	-0,580	0,920	0,890	1,030	-1,580	-0,430	-0,740	0,210
P-value	0,786	0,569	0,374	0,391	0,320	0,139	0,675	0,474	0,837
Intercept	-0,002	-0,012	-0,011	-0,015	-0,032	0,025	0,026	0,019	-0,014
Se	0,019	0,018	0,019	0,032	0,042	0,018	0,023	0,030	0,025
T-value	-0,090	-0,690	-0,600	-0,480	-0,760	1,440	1,110	0,640	-0,570
P-value	0,932	0,499	0,556	0,639	0,460	0,174	0,286	0,533	0,581
R2	0,004	0,020	0,039	0,087	0,074	0,108	0,010	0,044	0,001

Multi regressions of mid Op portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
OP	0,035	-0,079	0,080	0,272	0,233	-0,094	-0,143	-0,069	-0,011
Se	0,153	0,144	0,126	0,230	0,386	0,161	0,176	0,270	0,204
T-value	0,230	-0,550	0,630	1,180	0,600	-0,590	-0,810	-0,250	-0,060
P-value	0,824	0,594	0,539	0,261	0,559	0,570	0,433	0,804	0,956
LogM	0,000	-0,004	-0,006	0,002	-0,003	0,003	0,001	0,008	0,014
Se	0,004	0,003	0,004	0,004	0,005	0,004	0,004	0,005	0,011
T-value	-0,060	-1,200	-1,620	0,520	-0,630	0,770	0,230	1,510	1,200
P-value	0,951	0,256	0,133	0,613	0,544	0,459	0,824	0,160	0,257
LogBM	-0,001	0,007	-0,009	0,009	0,000	-0,008	0,020	-0,002	0,007
Se	0,007	0,012	0,009	0,007	0,009	0,007	0,005	0,010	0,024
T-value	-0,150	0,580	-1,080	1,280	0,000	-1,170	3,850	-0,220	0,280
P-value	0,886	0,574	0,303	0,225	0,997	0,266	0,003	0,831	0,787
Intercept	0,000	0,018	0,037	-0,035	0,001	-0,015	0,042	-0,054	-0,104
Se	0,037	0,043	0,038	0,039	0,068	0,037	0,049	0,054	0,070
T-value	0,010	0,420	0,970	-0,890	0,020	-0,420	0,850	-1,000	-1,490
P-value	0,992	0,681	0,355	0,393	0,985	0,684	0,414	0,339	0,165
R2	0,006	0,094	0,200	0,197	0,091	0,264	0,522	0,204	0,178

Appendix 7. Regressions of low portfolio Cop

Simple regressions of low Cop portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
COP	0,073	0,048	-0,067	-0,124	0,008	-0,041	0,046	0,001	0,177
Se	0,124	0,096	0,093	0,128	0,061	0,115	0,052	0,073	0,086
T-value	0,590	0,500	-0,720	-0,970	0,120	-0,360	0,880	0,020	2,060
P-value	0,565	0,624	0,485	0,351	0,903	0,726	0,394	0,984	0,060
Intercept	0,003	-0,044	0,004	0,029	0,006	-0,002	0,015	-0,007	-0,014
Se	0,007	0,006	0,008	0,010	0,005	0,006	0,004	0,003	0,006
T-value	0,460	-6,930	0,560	2,800	1,190	-0,350	3,740	-2,380	-2,390
P-value	0,654	0,000	0,584	0,015	0,256	0,735	0,002	0,033	0,033
R2	0,025	0,013	0,031	0,066	0,001	0,011	0,031	0,000	0,344

Multi regressions of low Cop portfolio

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
COP	0,218	0,069	-0,092	-0,173	0,031	-0,065	-0,057	-0,014	0,187
Se	0,108	0,098	0,101	0,127	0,063	0,127	0,070	0,067	0,118
T-value	2,010	0,700	-0,920	-1,360	0,490	-0,510	-0,810	-0,210	1,590
P-value	0,069	0,498	0,379	0,200	0,631	0,619	0,433	0,840	0,141
LogM	0,001	-0,004	0,009	0,005	-0,004	-0,004	-0,007	0,005	0,005
Se	0,007	0,005	0,007	0,005	0,004	0,003	0,003	0,005	0,005
T-value	0,220	-0,790	1,390	1,030	-1,060	-1,050	-2,340	1,070	1,010
P-value	0,829	0,444	0,193	0,326	0,311	0,316	0,039	0,307	0,335
LogBM	-0,021	-0,008	-0,006	0,005	-0,006	0,003	0,012	0,001	-0,006
Se	0,007	0,012	0,016	0,010	0,010	0,010	0,006	0,004	0,014
T-value	-2,970	-0,700	-0,400	0,560	-0,600	0,260	1,990	0,240	-0,480
P-value	0,013	0,497	0,697	0,584	0,561	0,796	0,072	0,811	0,641
Intercept	-0,014	-0,020	-0,057	0,000	0,035	0,026	0,069	-0,047	-0,061
Se	0,044	0,034	0,042	0,037	0,032	0,030	0,020	0,039	0,052
T-value	-0,320	-0,580	-1,340	-0,010	1,080	0,880	3,370	-1,200	-1,160
P-value	0,753	0,576	0,209	0,991	0,302	0,399	0,006	0,254	0,272
R2	0,226	0,083	0,213	0,159	0,146	0,063	0,284	0,215	0,376

Appendix 8. Regressions of low portfolio Op

Simple regressions of low Op portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OP	-0,061	-0,013	-0,008	0,024	0,017	-0,013	0,026	-0,040	0,012
Se	0,025	0,040	0,026	0,018	0,013	0,010	0,012	0,011	0,027
T-value	-2,470	-0,310	-0,290	1,300	1,300	-1,290	2,080	-3,740	0,450
P-value	0,028	0,760	0,775	0,215	0,216	0,220	0,058	0,002	0,662
Intercept	0,004	-0,039	0,005	0,023	0,000	-0,007	0,022	-0,009	-0,013
Se	0,007	0,008	0,008	0,005	0,005	0,004	0,004	0,004	0,005
T-value	0,600	-4,960	0,690	4,740	0,090	-1,710	5,490	-2,210	-2,440
P-value	0,556	0,000	0,502	0,000	0,929	0,112	0,000	0,045	0,030
R2	0,106	0,004	0,002	0,039	0,020	0,017	0,075	0,147	0,011

Multiple regressions of low Op portfolio

Year	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OP	-0,052	-0,033	0,059	0,054	0,013	-0,029	0,010	-0,020	0,004
Se	0,037	0,053	0,028	0,029	0,019	0,016	0,011	0,013	0,026
T-value	-1,410	-0,620	2,150	1,880	0,720	-1,830	0,850	-1,480	0,150
P-value	0,187	0,548	0,055	0,087	0,486	0,095	0,416	0,166	0,886
LogM	0,000	-0,008	0,012	0,005	-0,003	-0,003	-0,006	0,006	0,000
Se	0,008	0,006	0,006	0,004	0,005	0,002	0,003	0,005	0,004
T-value	0,020	-1,210	1,940	1,160	-0,600	-1,260	-1,960	1,140	-0,130
P-value	0,982	0,251	0,079	0,269	0,559	0,233	0,076	0,278	0,900
LogBM	-0,007	-0,006	-0,013	-0,009	-0,005	0,009	0,004	-0,008	0,007
Se	0,011	0,019	0,016	0,011	0,010	0,007	0,007	0,008	0,010
T-value	-0,670	-0,320	-0,820	-0,810	-0,460	1,230	0,520	-1,080	0,750
P-value	0,517	0,755	0,429	0,434	0,652	0,243	0,616	0,304	0,470
Intercept	-0,001	0,010	-0,076	-0,011	0,018	0,019	0,070	-0,057	-0,003
Se	0,058	0,044	0,043	0,027	0,033	0,021	0,027	0,042	0,036
T-value	-0,010	0,230	-1,760	-0,410	0,540	0,950	2,610	-1,360	-0,070
P-value	0,992	0,821	0,107	0,687	0,600	0,365	0,024	0,201	0,942
R2	0,131	0,119	0,226	0,210	0,078	0,110	0,325	0,335	0,070

Appendix 9. Correlations of Five-Factor model

FF Five-Factor correlation with cash operating profitability

	MKT	*SMB*	*HML*	*RMWcop*	*CMA*
MKT	1				
SMB	-0,87906	1			
HML	0,18443	-0,08549	1		
RMWcop	-0,52500	0,13140	-0,24028	1	
CMA	0,04388	-0,13282	-0,07249	0,14132	1

FF Five-factor correlation with operating profitability

	MKT	*SMB*	*HML*	*RMWo*	*CMA*
MKT	1				
SMB	-0,87906	1			
HML	0,18443	-0,08549	1		
RMWo	-0,22002	-0,03638	-0,22528	1	
CMA	0,04388	-0,13282	-0,07249	0,11743	1