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The anatomy of the profitability premium

Rational and behavioral explanations for the existence of the profitability premium: Evidence from US. Stock Market

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ABSTRACT:
This thesis studies the anatomy of the profitability premium. In other words, it tries to find either rational or behavioral explanation for its existence in the US. stock market. Profitability premium, i.e., the relationship between expected profitability and stock returns, is one of the most economically significant anomalies, which emphasizes the motivation to find the source of the premium. The academic research has presented contradictory results and statements regarding the source of the premium. Two main inconsistent explanations presented by previous research are mispricing and investment frictions. Hence, this thesis studies whether mispricing or investment frictions drive the profitability premium in the data sample comprising S&P 500 companies from 1990 to 2020.

Firstly, the thesis has confirmed that the profitability premium is statistically highly significant among S&P 500 companies. Moreover, the results of this thesis indicate that the profitability premium is driven by its short leg. Furthermore, the thesis has found evidence of the relatively good performance of the premium during the financial crises, which is the topic that have not been studied in academic research.

Secondly, this thesis does not find evidence regarding mispricing as the source of the premium. On the contrary, it seems that the profitability premium is even more substantial among stocks with lower limits to arbitrage. The results have been obtained by portfolio test where independently double-sorted portfolios on the mispricing and profitability proxies are regressed on the Fama and French 3-factor model.

Thirdly, this thesis examines if the investment frictions have an effect on the magnitude of the profitability premium. According to the q-theory, these frictions should negatively affect the profitability premium, but this thesis does not find strong evidence on behalf of the role of investment frictions on the profitability premium. Therefore, this thesis fails to find the reason for the existence of the premium. Hence, the thesis concludes that the premium is likely due to the undiscovered risk.

KEYWORDS: Profitability premium Asset pricing Mispricing Investment frictions

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TIIVISTELMÄ:
Tämä tutkielma tutkii kannattavuuspreemiota Yhdysvaltojen osakemarkkinoilla. Toisin sanoen se pyrkii löytämään joko rationaalisen tai käyttäytymistieteellisen selityksen preemion olemassaololle. Kannattavuuspreemio eli odotetun kannattavuuden ja osaketuottojen suhde on yksi taloudellisesti suurimman merkityksen omaavista anomalioista, mikä toimii motivaationa tutkielman aiheelle. Lisäksi akateeminen tutkimus on esittänyt hyvin ristiriitaisia tuloksia ja mielipiteitä kannattavuuspreemion syyksi. Kaksi oleellisinta ja keskenään ristiriitaista selitystä, jotka aiempi akateeminen tutkimus on esittänyt, ovat väärinhinnoittelu ja investointien kitka. Täten tämä tutkielma tutkii, ajaako jompikumpi näistä selityksistä kannattavuuspreemiota tutkielmassa käytetyssä dataotoksessa, joka koostuu S&P500-indeksin yhtiöistä vuodesta 1990 vuoteen 2020.

Aluksi tämä tutkielmaa todistaa, että kannattavuuspreemio on tilastollisesti hyvin merkittävä dataotoksessa. Lisäksi tutkielman tulokset osoittavat, että preemio johtuu suurimmaksi osaksi sen lyhyeksi myytävästä osasta. Lisäksi tutkielma löytää viitteitä siitä, että kannattavuuspreemio menestyy suhteellisen hyvin taloudellisten kriisien aikaan.

Preemion olemassaolon todistamisen jälkeen tutkielma löytää vastakkaisia tuloksia sille, että kannattavuuspreemio johtuisi väärinhinnoittelusta. Tulokset jopa osoittavat, että kannattavuuspreemio on voimakkaampi osakkeissa, joilla on alhaisemmat arbitraasin toteuttamisen rajat. Nämä tutkimustulokset ovat saatu portfoliotestillä, jossa riippumattomasti lajittelemalla osakkeet väärinhinnoittelu- ja kannattavuuskorvikemuuttujien perusteella on saatu portfoliot, joiden kuukausittaiset tuotot ovat ajettu Faman ja Frenchin 3-faktorin regressiomalliin.

Viimeiseksi tämä tutkielma tutkii, onko investointien kitkalla vaikutusta kannattavuuspreemion voimakkuuteen. Q-teorian mukaan investointien kitkan tulisi negatiivisesti vaikuttaa kannattavuuspreemion voimakkuuteen. Tutkielma ei kuitenkaan löydä tuloksia tämän väitteen tueksi. Täten tämä tutkielma ei pysty löytämään yksiselitteistä syytä kannattavuuspreemion olemassaololle, jolloin tutkielma argumentoi, että preemio on olemassa löytämättömän riskin vuoksi.

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1 Introduction

This thesis studies the positive relationship between a firm's profitability and future stock returns. Many studies have found this relationship at an early stage (e.g., Haugen & Baker, 1996; Fama & French, 2006, 2008). However, for a long time, there were struggles to find a suitable proxy for expected profitability, which was the reason why the relationship was supposed to be relatively weak (Fama & French, 2006). Novy-Marx (2013) revolutionized the issue mentioned above when he proved that gross profitability, one measure of profitability, has approximately the same explanatory power as the book-to-market when forecasting average stock returns. Moreover, he found that firms with high profitability generate substantially higher returns than firms with low profitability (Novy-Marx, 2013). This thesis refers to this phenomenon as the profitability premium.

This thesis aims to provide a better understanding of the anatomy of the profitability premium. The profitability premium has become a current topic in the academic literature because traditional asset pricing models have failed to explain this premium (e.g., Novy-Marx, 2013). Moreover, as an anomaly, profitability premium is one of the most economically significant, and there has been noticed that it can subsume plenty of other anomalies (Novy-Marx & Velikov, 2016; Ball, Gerakos, Linnainmaa & Nikolaev, 2015, 2016; Novy-Marx, 2013). Furthermore, profitability factors have recently been added in asset pricing models, which emphasizes the importance of understanding the profitability premium (Fama & French, 2015; Hou, Xue & Zhang, 2015).

Thus, the main research question of this thesis is why the profitability premium exists in the stock market. The thesis focuses on this question by reviewing main explanations presented as common explanations for the existence of anomalies. Generally, these explanations are interpreted to be mispricing, data snooping, and risk-based explanations. These explanations are usually interpreted to be discordant with each other, especially the mispricing and risk-based explanations. This thesis has focused on these two perspectives in the empirical part, especially when the high economic significance of profitability premium has already been proven (e.g., Novy-Marx & Velikov, 2016).

The primary motivation of this thesis is based on the mixed results presented regarding the source of the profitability premium. There are no unanimous opinion or results which causes the profitability effect in the stock market (e.g., Ball et al., 2015, 2016; Novy-Marx, 2013). To be more precise, the empirical part of this thesis has been inspired by the study of Jiang, Qi, and Tang (2018). The study has examined both mispricing and investment frictions (i.e., rational explanation) perspectives as the source of the profitability premium in the Chinese stock market. Thus, this thesis has done a similar but not identical study to the study of Jiang et al. (2018) in the US stock market, where the general magnitude of the profitability premium, the role of limits to arbitrage, and the role of investment frictions have been examined.

The structure of this thesis goes in the following manner. At first, this thesis focuses on the profitability premium under traditional finance theories in Chapter 2. Chapter 2 is composed of three main topics. One main topic is asset pricing, i.e., what determines the return and the price of a security. The second topic generally discusses anomalies and their existence under finance theories. The third topic presents two finance theories that link the expected profitability to the expected stock return.

Chapter 3 comprises a literature review regarding profitability premium where there is a discussion of the history of profitability premium research. Moreover, there are presented contradictory results regarding mispricing and risk-based explanations for the existence of the profitability premium. Chapter 4 constructs the research questions, i.e., the hypotheses tested in this thesis. In addition to hypotheses construction, it also introduces the corresponding methodology for testing the hypothesis. Chapter 5 discusses the data sample used in this thesis. Moreover, it also presents the summary statistics of the data sample. Chapter 6 shows, analyzes and discusses the results of hypothesis testing. Chapter 7 is the last chapter that concludes this study.

2 Theoretical framework

2.1 Asset pricing

2.1.1 Capital Asset Pricing Model

Capital Asset Pricing Model (CAPM) has been developed to determine the price of the risk for individual risky assets (Sharpe, 1964). It is one of the most famous models, but at the same time, one of the most controversial theories in modern finance (see Chapter 2.2.2). It has influenced almost all of the topics in finance, but it is especially essential to the topic of this thesis because it offers a tool for pricing stocks according to their risk profile. The prevailing opinion is that CAPM has been developed by Sharpe (1964), Lintner (1965), and Mossin (1966) separately in their published papers. However, Treynor has also introduced it before these papers in his unpublished paper (Sharpe, 1964). CAPM is based on modern portfolio theory, first presented by Markowitz (1952), which is the reason why it is presented briefly in this thesis before dealing with the theory of CAPM more closely.

According to Markowitz (1952), rational investors should maximize their portfolios expected returns with as minimum variance as possible, which can be done with diversification. When all available investment and asset combinations are calculated by minimizing variance for per different targets of expected returns, there can be determined inefficient and efficient frontiers of risky assets (Markowitz 1952). The minimum variance portfolio has the smallest variance, and it separates these two frontiers. Investors should be only invested in portfolios in the efficient frontier because these portfolios have the same variances as portfolios in the inefficient frontier, but at the same time, higher expected returns (Markowitz, 1952). Figure 1 illustrates this frontier of risky assets at the end of the next paragraph.

Tobin (1958) continues Markowitz's (1952) work when he includes the risk-free rate in the portfolio theory. According to Tobin (1958), when investors construct portfolios, they have two different tasks that should be done separately. At first, investors should determine the most efficient portfolio from the efficient frontier (*i.e., the portfolio which* *has the best Sharpe (1966) ratio*). The investors' second task is to allocate their capital between this portfolio and the risk-free asset. The allocation ratio between the capital in these assets depends on investors' risk-taking capacity. Hence, investors can adjust the risk of their portfolios by depositing a part of the capital at a risk-free interest rate, which decreases the risk. In contrast to depositing, investors can lend additional capital at a risk-free interest rate, and invest the capital into the portfolio, which increases the risk. The main results of Markowitz (1952) and Tobin's (1958) revolutionary studies are illustrated and summed up in Figure 1 where is drawn Capital Allocation Line (CAL) from the risk-free asset to the tangency point on the efficient frontier that is the most efficient portfolio. Y-axis of Figure 1 represents the expected return, and the x-axis represents the risk measured by the standard deviation of portfolios.

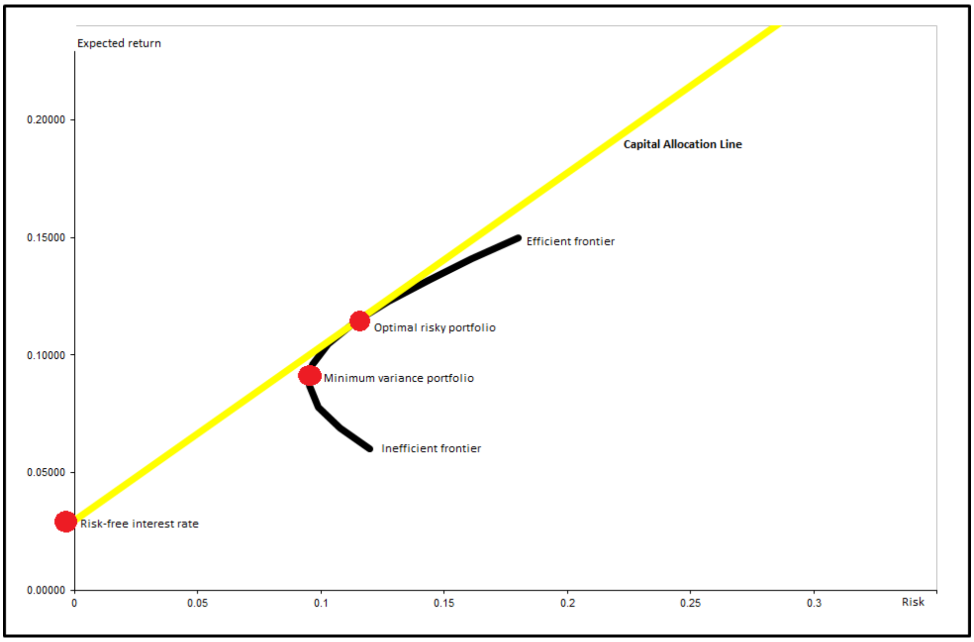

Figure 1. The frontier of risky assets with the optimal CAL

CAPM makes many assumptions which some of are connected to the modern portfolio theory. However, these assumptions cannot hold in the real world, but they are necessary to the theory of CAPM (Sharpe, 1964). All assumptions of CAPM are listed below, according to studies of Sharpe (1964) and Lintner (1965).

1. All investors must be rational and optimize their portfolios' expected returns on risk by the Markowitz' (1952) theory.
2. All Investors must have homogenous expectations, and this is possible because all information must be public to all investors and all assets are publicly traded and held.
3. There does not exist transaction costs or taxes in the market.
4. All investors must have a single period horizon.
5. All investors can borrow or deposit capital with no limit at the same risk-free interest rate.

Under the assumptions, all investors should have the same efficient frontier, and thus they should choose the same most efficient portfolio. Therefore, this most efficient portfolio also represents the market portfolio. Hence, the CAL in Figure 1 should be the same for all investors, which leads to that it also represents the Capital Market Line (CML) in this case (Sharpe, 1964). The slope of the CML is the Sharpe ratio of the market portfolio (*i.e., market return minus risk-free rate divided by the volatility of the market portfolio*) (Sharpe, 1964, 1966). Under the assumptions, all investors should select a combination of the risk-free asset and the market portfolio (Sharpe 1964; Lintner 1965). All of these combinations are on CML, which means that all combinations have the same Sharpe ratio.

According to Sharpe (1964), unsystematic risk can be eliminated with diversification. If all assumptions above are valid and only the systematic risk matters, the expected return of individual assets can be determined with the formula which is presented in Eq. (1)

$$\boldsymbol{E(R_i) = R_f + \beta_i\big(E(R_{m)} - R_f\big)} \qquad \textbf{(1)}$$

where $E(R_i)$ is the expected return of individual asset i. R_f is the risk-free rate of interest. B_i is the beta for individual asset i or, i.e., the ratio of how individual asset moves relative to the market portfolio, and $E(R_m)$ is the expected return of the market portfolio. The beta component can also be written into the formula that is presented in Eq. (2)

$$\boldsymbol{\beta_i} = \frac{\boldsymbol{Cov(R_i, R_m)}}{\boldsymbol{Var(R_m)}} \quad \textbf{(2)}$$

where Cov(R_i, R_m) is the covariance of return of individual asset i and return of the market. In the denominator, there is Var(R_m) that is the variance of the market return.

Security Market Line (SML) illustrates the formula of CAPM graphically (Sharpe, 1964). In this thesis, SML is presented in Figure 2, where the market return is seven percent, and the risk-free rate is three percent. SML differs from CML in that it describes expected returns of individual assets on the risk, unlike CML, which describes expected returns of efficient portfolios on the risk. Therefore, SML measures the risk with the beta, in contrast to CML, which uses the standard deviation to measure the risk (Sharpe, 1964). Under the assumptions of CAPM, prices of individual assets will adjust until all assets are on the SML (Sharpe, 1964). Therefore, the slope of SML, which is the risk premium of market portfolio (*i.e.,* $R_m - R_f$), describes the price of risk for individual assets when risk is measured with the beta (Sharpe, 1964).

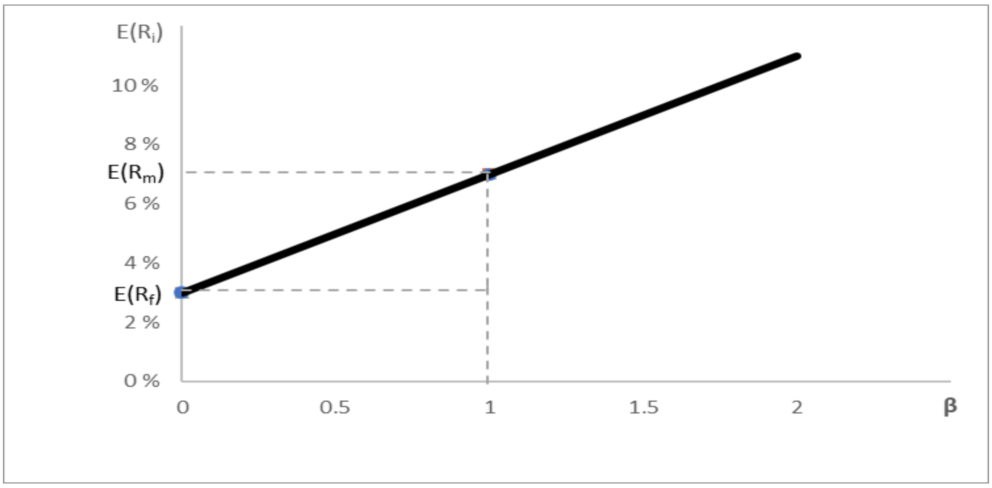

Figure 2. Security Market Line

If it is assumed that CAPM is empirically valid, and the asset is not on SML, the asset has Jensen's (1968) alpha. This alpha can be either positive or negative. According to Jensen (1968), this alpha can be calculated by utilizing the asset pricing model with realized values. This formula is presented in Eq. (3)

$$\alpha = R_i - \left[R_f + \beta_i\left(R_m - R_f\right)\right] \quad \textbf{(3)}$$

where the alpha of asset i is the realized return of asset minus the expected return of asset according to CAPM (Jensen, 1968). The random error term is taken off in Eq. (3) because its expected value is assumed to be zero (Jensen, 1968). Alpha then represents abnormal returns of individual asset i. Jensen's (1968) method to calculate alphas can also be used with other asset pricing models than CAPM, which are presented later in this thesis.

2.1.2 Single-Index Model

Single-index model (SIM) is developed by Sharpe (1963), and it is usually used as a regression model, which makes it practical to utilize. According to Sharpe (1963), it is a simple model that assumes there is only one risk factor that causes the systematic risk for all securities. Even though the risk factor can be anything, generally, this risk factor is some market index, for example, the S&P 500 (Bodie, Kane & Marcus, 2014). Because there is prior data available from indexes and individual securities, the beta and return for individual security can be calculated by utilizing a regression formula (Bodie et al., 2014). This formula is presented in Eq. (4) where the factor is some market index.

$$R_{it} - R_f = \alpha + \beta_i\left(R_{mt} - R_f\right) + \epsilon_{it} \quad \textbf{(4)}$$

In Eq. (4), the left part represents the excess return for security i at the period t. In the right part, there is the beta for security i (*i.e., security's sensitivity to the risk factor*). In the parentheses, there is the risk factor or, i.e., the excess return of the index at the period t (Sharpe, 1963). Moreover, there is also the alpha of security i that is the intercept of the regression line. Hence, it represents the return of security i when the excess return of the index is zero (*i.e., abnormal returns of security i*) (Sharpe, 1963). The last component in Eq. (4) describes residual returns (*i.e., random or unexpected returns*) for security i at the period t. However, it is assumed to be both independent from the risk factor and all stocks, and normally distributed (Sharpe, 1963). Therefore, the random variable's variance represents the security's i unsystematic risk. However, the expected value of the random variable is assumed to be zero (Sharpe, 1963).

2.1.3 Arbitrage Pricing Theory

Arbitrage pricing theory (APT), developed by Ross (1976), is an alternative theory to the CAPM of how the risk of assets affects to their expected returns, and how this relation is linear (see Figure 2). APT differs in various ways from CAPM. The benefit of APT is that its restrictions are not so strict than in CAPM. For example, APT does not assume that all investors are rational and mean-variance optimizers (Ross, 1976). However, APT relies on a few essential assumptions. These are: there is a multi-factor model that can explain individual stocks' returns; there are enough stocks that the unsystematic risk can be diversified away; and there are arbitrageurs who rapidly take advantage of mispricing opportunities, which restores the market equilibrium (Ross, 1976). Under the assumptions, the formula of APT can be written as it is presented in Eq. (5)

$$E(r_i) = r_f + \beta_{i1}F_1 + \beta_{i2}F_2 + \cdots + \beta_{ik}F_k \tag{5}$$

where $E(r_i)$ is the expected return of asset i, and r_f is the risk-free interest rate. F_k represents the risk premium of the systematic risk factor k (*i.e., factor's excess return*), and β_{ik} represents the sensitivity of asset i to the risk factor k (*i.e., factor loading*) (Ross, 1976). In the APT, the asset can be either a portfolio or a security. However, APT is better suited to pricing well-diversified portfolios than individual securities because returns of individual securities are also affected by unsystematic risk in addition to risk factors. (Ross, 1976). From the formula of APT, the risk premium of the individual asset can be calculated by the beta-weighted sum of factors' excess returns (Ross, 1976).

APT does not determine which is the right number of factors or what are these risk factors, unlike in the CAPM, where it can be thought that there is only the one risk factor, which is the market portfolio (Sharpe, 1964; Ross, 1976). However, Chen, Roll, and

Ross (1986) recognize a few macroeconomic risk factors of which the most relevant are changes in the yield curve, the industrial production, unexpected inflation or changes in the expected inflation, and the default premium in the low-grade corporate bonds. Next, this thesis will focus more on multifactor models when it presents Fama and French's (1993, 2015) asset pricing models.

2.1.4 Fama and French’s multi-factor models

Fama and French's (1993) three-factor model has been revolutionary in asset pricing. In this model, there are two other risk factors in addition to the market factor (excess return of the market). These factors are known as size and value factors, which are the names which this thesis also refers later on. Fama and French (1993) construct these factors by portfolios that do not need any capital, which means that factors are hedge or zero-cost portfolios. In practice, the construction of factors is done by first double sorting all stocks according to their market equity (ME) into two groups and by their book-to-market-ratios (B/M) into three groups. After the sorting, Fama and French (1993) define the size factor as small minus big (SMB) and the value factor as high minus low (HML). In other words, the size factor is the average of all small portfolios returns minus the average of all big portfolios returns. In contrast, the value factor is the average of high B/M portfolios returns minus the average of low B/M portfolios returns.

Above mentioned factors' construction should be done with local data because there has been presented evidence that globally constructed factors perform more poorly (e.g., Griffin, 2002; Fama & French, 2012, 2017). However, after defining all factors, a time series regression can be done that the coefficients of the individual stock to the three risk factors can be estimated. Hence, the Fama and French's (1993) three-factor model can be written into the formula that is presented in Eq. (6)

$$\boldsymbol{r_{it} - r_{ft} = \alpha_{it} + b_{im}(r_{mt} - r_{ft}) + b_{is}(SMB_t) + b_{iv}(HML_t) + \varepsilon_{it}} \qquad \textbf{(6)}$$

where t represents the time period, and alpha represents the abnormal returns of stock i. The total return of stock i is r_i, and r_f is the risk-free interest rate. The total return of the market is r_m, and b_i represents the sensitivity of stock i to the risk factors. The last term, ε_i, is the zero mean residual.

The motivation of Fama and French (1992, 1993) to add these factors in the model bases on empirical findings on how variables ME and B/M predict average stock returns. Moreover, they argue that these two variables can describe unmeasured risk, which is not noticed in CAPM (see Chapter 2.2.2). Fama and French's (1993) three-factor model also has some similarities to other previous asset pricing models, for example to Merton's (1973) intertemporal capital asset pricing model (ICAPM) and Ross's (1976) APT. According to Merton (1973), there can arise other risk premiums in addition to the market premium when investors have rational reasons to hedge against other sources of risk, e.g., changes in future investment opportunities. Hence, Fama and French (1993, 2015) argue that their factors can be proxies for these undefined and unknown additional sources of risk, even if size and B/M are not as variables themselves that represent this undefined additional source of risk.

There are also done extensions from the three-factor model. For example, Carhart (1997) finds that the momentum effect, found by Jegadeesh and Titman (1993), explains the result that some mutual funds can generate abnormal returns. Therefore, he adds the momentum factor into Fama and French's (1993) three-factor model. The motivation of Carhart (1997) to add this factor is that the three-factor model cannot explain momentum strategy returns. The momentum factor is also a zero-cost portfolio, and it is usually defined as the average returns of firms with the highest returns minus the average returns of firms with the lowest returns in the prior year. However, Carhart (1997) does not take a stand on why the momentum effect exists or, i.e., is it due to mispricing or unmeasured risk.

After Fama and French (1993) had developed the three-factor model, there had been revealed evidence that there is a positive relationship between firms' profitability and average stock returns(e.g., Haugen & Baker, 1996). Furthermore, there had also been revealed evidence that there might be a negative relation between firms' investments and average stock returns (e.g., Titman, Wei, & Xie, 2004). Therefore, Fama and French (2006) study these effects in their paper. They argue that these effects can be theoretically valid when these are consistent with the valuation theory that is more closely presented in Chapter 2.3.1. Their results from the cross-sectional regressions also confirm these relations. Still, their results are, however, mixed when their portfolio tests show that their proxies for expected profitability and investment do not significantly add more explanatory power when the size and value factors are included in the analysis.

Because of the results mentioned above, Fama and French (2006, 2015) argue that the problem has been to find valid proxies for expected profitability and investment. However, Fama and French (2015) extend their three-factor model because empirical evidence has further increased that the three-factor model is incomplete, and profitability and investment predict future stock returns. Moreover, Novy-Marx (2013) had found a reliable proxy for expected profitability. Therefore, Fama and French (2015) include profitability (RMW) and investment (CMA) factors in their five-factor model. In addition to empirical evidence, Fama and French (2015) argue that these factors are consistent with the valuation theory, which supports adding these factors in the model, as mentioned above.

Fama and French (2015) construct these new factors in the same way as HML in their three-factor model, which means that they are well-diversified zero-cost portfolios. For the profitability factor, the sort is done by operating profitability (OP_{FF}), which is defined as the prior year's revenue minus cost of goods sold minus selling, general and administrative expenses minus interest expenses divided by book equity. For the investment factor, the sort is done by the prior year's growth of total assets divided by one year lagged total assets. After defining these factors, Fama and French (2015) five-factor model can be written in the regression formula, which is presented in Eq. (7). Eq. (7) is similar to Eq. (6) except that there are two factors more in it.

$$r_{it} - r_{ft} = \alpha_{it} + b_{im}(r_{mt} - r_{ft}) + b_{is}(SMB_t) + b_{iv}(HML_t) + b_{ip}(RMW_t) + b_{ic}(CMA_t) + \varepsilon_{it} \quad (7)$$

Fama and French (2015) find that including profitability and investment factors improves their three-factor model performance. The most important result, especially for this thesis, is that the profitability factor has an explanatory power to predict average stock returns. Furthermore, Fama and French (2016) focus on dissecting anomalies with their five-factor model. They focus mainly on anomalies that have produced difficulties for the three-factor model. Their results show that the five-factor model outperforms the three-factor model in explaining anomalies except explaining accruals and size anomalies. This outperformance is highly due to investment and profitability factors when anomalies (*e.g., low beta and low volatility*) load heavily to the new factors, RMW and CMA (Fama & French, 2016). Later on, Fama and French (2018) have found that cash-based operating profitability by Ball et al. (2016) outperforms their initial profitability factor (OP_{FF}) when it is included in the model.

2.2 Anomalies under Finance theories

Before introducing the efficient market hypothesis (EMH), it is essential to understand the hypothesis of the random walk. The basis of the random walk model was already presented in 1900 by Bachelier in his Ph.D. dissertation, but it was ignored over fifty years (Fama, 1970). However, the study of Kendall (1953) concerns the random walk in the stock market. In his study, he finds that the movements of stock prices do not follow any pattern, and thus stock prices follow a random walk. Furthermore, Samuelson's (1965) and Mandelbrot's (1966) studies help to illustrate the random walk in the stock market, and why is it associated with the EMH. In their studies, they have shown that future changes in stock prices are due to future news that is unpredictable when all information is available, and transaction costs do not exist. Therefore, stock prices follow the random walk when current stock prices only reflect current news (Samuelson, 1965; Mandelbrot, 1966). It is good to notice that as the term, the random walk is generally used loosely in the finance-related discussion (Fama, 1970). This "loose" definition is usually understood in a way that future movements of stock prices are not associated with previous movements. Thus, it ignores, e.g., the serial independence of stock returns (Fama, 1970).

Fama (1970) is maybe the most famous person who has remarkably influenced on EMH development. In his opinion, stock prices are always and entirely determined by all available information in the efficient stock market. This expression can be seen very similar to assumptions that have been made in the theory of the random walk. However, "all available information" as conception can be a variable that can change. Therefore, Fama (1970) splits EMH into three different forms that differ in the way how "all available information" is defined. These forms are weak, semi-strong, and strong, which are briefly introduced in the next paragraph.

In the weak–form of the efficient market hypothesis, all available information contains only information that is based on historical market trading data, for example, prices and volumes (Fama, 1970). Therefore, technical analysis is redundant in this form. In addition to technical information, the semi-strong form also includes fundamental data (Fama, 1970). Hence, stock prices reflect all public information in this form (Fama, 1970). The strong form includes the inside information in addition to the information mentioned above (Fama, 1970). Profitability measures are constructed from financial statements that are fundamental data (e.g., Jacobs, 2015). Therefore, the semi-strong form can especially be seen as the most significant from the perspective of the topic of this thesis.

According to Schwert (2003), anomalies are empirical findings regarding the stock returns that are inconsistent with one or both EMH and asset pricing theories (i.e., anomalies are strategies that can generate abnormal returns). At first, it is essential to understand the above sentence completely before interpreting anomalies more closely. There have been difficulties when testing anomalies because there must be made another hypothesis in addition to EMH. The other hypothesis is linked to asset pricing models because EMH does not take a stand on how the price of an individual security is determined in the market equilibrium (Fama, 1991; Jensen, 1978). In other words, EMH is not able to tell can some strategy generate abnormal returns. The other hypothesis will generate the joint hypothesis problem (Fama 1970; 1991; Jensen, 1978). Because of the joint hypothesis problem, it cannot be known if these anomalies are due to market inefficiency or the lack of ability of asset pricing models to price securities based on their risk (Fama, 1991).

Next, this thesis focuses on the most common explanations for the existence of anomalies that academic literature has suggested. These explanations are data mining, mispricing, and risk-based explanations. Next, these explanations are presented from the general perspective of anomalies. In Chapter 3, these explanations are introduced from the profitability premium's point of view.

2.2.1 Data mining as a source of anomalies

There is a large amount of data in the modern world. Moreover, it is easy to access and process. To put it simply, this has led to a situation that researchers focus more on finding new anomalies, which has hugely increased the number of discovered anomalies over the last ten years (Harvey, Liu & Zhu, 2016; Schwert 2003). Harvey et al. (2016) argue that there is a considerable number of anomalies that have been presumed to be significant because of low approval standards (*e.g., t-stat over 2.0*). In their paper, they suggest that discovering and approving a new anomaly requires t-statistic to be at least 3.0 or even higher. In addition to the above-mentioned points about data in the modern world, they base their statement on the fact that the number of undiscovered anomalies that have significance has presumably decreased (Harvey et al., 2016).

As mentioned above, data snooping has become a genuine problem in the literature of anomalies. This problem can be exacerbated by the matter that researchers use the same methods and similar data that have been used in the original study when they examine newly discovered anomaly (Schwert, 2003). For example, Lo and MacKinley (1990) have shown that using data, that is even a little positively correlated with the original data, can lead to misinterpretation of results. Furthermore, McLean and Pontiff (2016) also examine selection bias in their study that includes almost a hundred anomalies that have been all published in the prominent journals. Into these examined anomalies is also included the Novy-Marx' (2013) gross profitability and Balakrishnan, Bartov, and Faurel's (2010) the post loss/profit announcement drift. The results of McLean and Pontiff (2016) show that the returns of anomalies generally decline about one fourth when examining with out-of-sample data. Therefore, there has been suggested that testing anomalies should be done with the data that is independent of the original sample, which can be done by using data from different periods or other countries (Schwert, 2003). The results presented in the recent paper of Hou, Xue, and Zhang (2020) are also consistent with the above-mentioned findings when they find that 82% of asset pricing anomalies are not significant under currently acceptable standards of empirical finance.

2.2.2 Risk-based explanations for anomalies

Risk-based explanations are based on the idea that anomalies are due to failures of traditional asset pricing models to capture all risk of individual assets. In other words, anomaly's abnormal returns are due to the risk which asset pricing models do not measure. For example, CAPM has been plenty criticized because of its restrictions and failures. Roll's (1977) critique is maybe the most famous. He argues that CAPM cannot be testable if the market portfolio, which contains all individual assets, is unknown. Therefore, CAPM is misused if it is utilized as a single-index model where some market index is used as a proxy for the market portfolio (Roll, 1977). Furthermore, there is more empirical evidence regarding the failures of CAPM. For example, the relation between stock's beta and average return is flatter compared to SML by CAPM (e.g., Fama & French, 1992). However, although there are plenty of challenges in CAPM, Sharpe (1964) was already aware in his paper that his model is highly restricted.

If asset pricing models cannot measure all the risk of a security, what kind of risk CAPM or other traditional asset pricing models do not notice? The one suggested answer is that CAPM is an undynamic model, which causes its failure to capture all dynamic risks of different assets (e.g., Harvey, 1989). Moreover, Merton's (1973) ICAPM argues that there can arise other risk premiums because investors hedge against the uncertainty in future investment opportunities. These additional risk premiums can also be due to the uncertainty in consumption, which is the reason why consumption-based asset pricing is invented (e.g., Breeden, 1979). There have also been suggested that the missing risk in CAPM is associated with assets that are not traded in markets, for example, to human capital and private business (e.g., Jagannathan & Wang, 1996; Heaton & Lucas, 2000).

Furthermore, one of the assumptions of CAPM is that there are no transaction costs in the market (e.g., Sharpe, 1964). However, it naturally does not hold in the real world. There has been recognized that the illiquidity of stocks, measured by bid-ask spreads, is positively related to the stocks' excess return (Amihud & Mendelson, 1986). According to Amihud and Mendelson (1986), this premium should not be considered as an anomaly because this premium is rational and due to compensation for the liquidity risk. Therefore, it has been suggested as a rational explanation for some anomalies, for example, for Banz's (1981) size anomaly (Amihud, 2002).

There have also been found that changes in the one stock's liquidity correlate with the other stock's liquidity (e.g., Chordia, Roll & Subrahmanyam, 2000). Therefore, it can be thought to be a part of the systematic risk, which has led to constructing liquidity betas in asset pricing (Pástor & Stambaugh, 2003). Hence, stocks with higher liquidity betas have higher expected returns because they are more exposed to the aggregate liquidity risk (Pástor & Stambaugh, 2003). The alternative way to liquidity betas to measure liquidity risk is, for example, Amihud's (2002) way. He defines stock's illiquidity as the stock's average of daily return divided by the stock's average of the daily trading volume.

However, some of the above-mentioned sources of risk can be hard to measure, for example, consumption risk (Savov, 2011). Therefore, factors of the five-factor model by Fama and French (2015) can be proxies for the risk, even if the variables that are used to construct these factors do not represent the risk themselves (Fama & French, 1993, 2015). Moreover, Fama and French (1993) argue that size and B/M are related to economic fundamentals in their paper. For example, firms with higher B/M tend to have higher distress risk, and small firms tend to suffer more from downturns in the economy (Fama & French, 1992, 1993).

There are research findings that support Fama and French's argument about risk embedded in size and B/M. For example, there have been found that the returns of factors constructed by these variables are positively associated with the future growth of gross domestic product (Liew & Vassalou, 2000). Furthermore, the study of Jagannathan and Wang (2007) reveals also that these variables, and thus factors, are associated with consumption betas. Therefore, these two factors can represent consumption risk (Jagannathan & Wang, 2007). However, there is not much research yet regarding profitability variables and risk yet, and it can generally be hard to interpret that profitability could represent the macroeconomic risk in the same way as, for example, B/M-ratio (e.g., Novy-Marx, 2013)

2.2.3 Mispricing as an explanation for the existence of anomalies

The opposite view for risk-based explanations is that many anomalies are due to mispricing (e.g., Lakonishok, Shleifer & Vishny, 1994; Barberis, Shleifer & Vishny, 1998; Stambaugh, Yu & Yuan, 2012; Jacobs, 2015). According to Shleifer and Summers (1990), explanations that are based on mispricing can be divided into two main parts. The first part leans on behavioral finance that claims that all investors are not rational, which will affect the prices of securities. Therefore, the market values of securities are not necessarily valued by their intrinsic value. The other part concerns the arbitrage limitations. Arbitrage Pricing Theory (*APT*) is based on the idea that even if all investors are not rational, there are arbitrageurs who are rational and take advantage of mispricing opportunities(e.g., Ross, 1976). However, there can be limitations in the market that increases the arbitrage riskiness (Shleifer & Summers, 1990). Therefore, even if there are no arbitrage opportunities in the market, it does not necessarily mean that mispricing does not exist (Barberis & Thaler, 2003). Next, this thesis will discuss more investors' irrational beliefs that cause mispricing, and also what risks are associated with the implementation of arbitrage.

Behavioral finance leans on cognitive psychology when it tries to explain investors' irrational beliefs (Barberis & Thaler, 2003). This thesis focuses on biases that could especially explain investors' underreaction because it is recognized as a potential explanation for the existence of profitability premium. Daniel, Hirshleifer, and Subrahmanyam (1998) argue that investors' overconfidence can lead to underreaction towards public information (*such as profitability information from financial statements*). This underreaction happens because they give too much weight to their personal information, e.g., to own analyses and interviews with the firm's management. In contrast to Daniel et al. (1998), Barberis, Shleifer, and Vishny (1998) argue that especially conservatism can cause underreaction in the stock market.

In addition to the above, other potential biases that can lead to mispricing, and especially to underreaction, are anchoring, availability heuristic, and confirmation bias. According to Kahneman and Tversky (1974), people tend to anchor to their estimation, which means that they do not adjust their estimations sufficiently when they get new information. Moreover, confirmation bias is closely related to anchoring. According to this bias, people pay considerably more attention to information that is consistent with their opinion rather than information that is inconsistent with their opinion (Nickerson, 1998). Availability heuristic concerns how people give too much weight to information that is easily accessible and in the understandable form (Kahneman & Tversky, 1973). These biases are considered from the profitability premium's point of view in Chapter 3.2.

According to Barberis and Thaler (2003), three primary sources of risk affect the implementation of arbitrage in the stock market. These risks are fundamental risk, noise trader risk, and implementation costs. Fundamental risk means that it is hard or almost impossible to find a perfect substitute for the specific stock (Barberis & Thaler, 2003). Therefore, arbitrageurs cannot perfectly hedge against the unsystematic risk of a mispriced stock, which will affect the riskiness of arbitrage (Barberis & Thaler, 2003).

De Long, Shleifer, Summers, and Waldmann (1990) first introduce the noise trader risk in their paper. They argue that irrational beliefs of noise traders cannot be predicted, which creates an enormous risk for arbitrageurs to remove mispricing in the stock market even if the fundamental risk would not exist. In other words, arbitrageurs cannot know the persistence of mispricing because of the irrational beliefs of noise traders

(DeLong et al., 1990). According to Shleifer and Vishny (1997), the agency problem in the stock market (*i.e., arbitrageurs invest other people's large capital*) exacerbates this risk. For example, the owners of capital can force arbitrageurs to liquidate their position on the mispriced asset because the noisy trader risk is realized (*i.e., mispricing has exacerbated because of the irrational beliefs of investors*). Therefore, arbitrageurs can avoid some arbitrage opportunities, especially if these positions are incredibly volatile (Schleifer & Vishny, 1997).

Implementation costs are costs that are due to doing the arbitrage. These are usually known as transaction costs, but liquidity risk, cost of finding mispricing, and short-sale restrictions are generally included in this risk category (Barberis & Thaler, 2003). This thesis has already discussed liquidity risk that can affect the riskiness of arbitrage (Barberis & Thaler, 2003). However, the next paragraph focuses more closely on the impact of transaction costs on interpreting the significance of anomalies.

Jensen (1978) argues early on that transaction costs should not be ignored when interpreting the economic significance of anomalies. Novy-Marx and Velikov (2016) agree with Jensen (1978) when they argue that arbitrageurs cannot eliminate the existing anomaly if the strategy is not profitable after transaction costs. Novy-Marx and Velikov (2016) suggest that investors should be especially skeptical about presented anomalies that have been calculated by equally weighted portfolios. They show that strategies that are based on equal-weighted portfolios have much higher transaction costs than anomalies that prefer value-weighted portfolios. This finding can indicate that strategies that use equal-weighted portfolios can be economically insignificant. Novy-Marx and Velikov (2016) also examine how much capital can be used until anomalies change unprofitable, in addition to the impact of transaction costs. Interesting is that gross profitability as a strategy, found by Novy-Marx (2013) himself, generates low transaction costs, and it can also attract a considerable amount of capital before it becomes unprofitable (Novy-Marx & Velikov, 2016).

2.2.4 Statistical aberrations driven by the incorrect methodologies

There is one alternative explanation for the existence of anomalies, which is partly related to the explanation presented in Chapter 2.2.1. According to Schwert (2003), anomalies can be due to statistical aberrations, but he does not directly take a stand on what causes these statistical aberrations. For example, Grobys (2021) argues that these “statistical aberrations” are not undoubtedly due to data snooping, discussed in Chapter 2.2.1. Instead, he argues that anomalies are more likely due to systematically inflated t-statistics, which is driven by the fact that the traditionally used methodologies in finance are not actually applicable. In other words, Grobys (2021) argues that these traditional methods are inevitably sample-specific, which means that the t-statistics derived from these methods are also sample-specific. Grobys (2021) bases his argument on his results regarding the non-existence of the variance of variance in (main) financial markets. This thesis does not study this possibility, but it wants to highlight it as the potential explanation for the anomalies, especially when it utilizes these traditional methodologies in the empirical part.

2.3 Theoretical link between expected profitability and stock returns

2.3.1 Valuation theory under clean surplus accounting

Valuation theory under clean surplus accounting shows that there is a positive relation between expected profitability and expected stock returns (e.g., Ohlson, 1995; Fama & French, 2006). Furthermore, it shows that firms’ investment and B/M-ratios are also associated with expected stock returns (Fama & French, 2006). This chapter focuses on explaining these relations, especially the relation between expected profitability and expected returns, with the dividend discount model (DDM) that is modified by clean surplus accounting methods. This modified model has been generally used to illustrate the relations mentioned above (e.g., Novy-Marx, 2013; Fama & French 2006, 2015). However, there are also alternative theories that have shown the relation between expected profitability and expected returns.

Miller and Modigliani (1961) introduce a formula that is similar to the traditional DDM formula, but it defines dividends by clean surplus accounting methods. This formula is presented in Eq. (8) where the Miller and Modigliani's signs of original variables are replaced with Fama and French's (2006) variables which are perfect substitutes.

$$\boldsymbol{M_t} = \sum_{\tau=1}^{\infty} \frac{\boldsymbol{E(Y_{t+\tau} - \mathrm{d}B_{t+\tau})}}{\boldsymbol{(1+r)^{\tau}}} \tag{8}$$

In Eq. (8), there is M which is the total market value of the firm at time t, "dividends" are presented as the firm's total earnings at period t+τ, $Y_{t+\tau}$ reduced by the change in total book equity, $B_{t+\tau} - B_{t+\tau-1} = dB_{t+\tau}$. In the denominator, there is r that represents the stock's long-term expected return. Furthermore, Fama and French (2006, 2015) divide the whole formula by the firm's book equity at time t. This formula is presented below in Eq. (9)

$$\frac{\boldsymbol{M_t}}{\boldsymbol{B_t}} = \frac{\sum_{\tau=1}^{\infty} \boldsymbol{E(Y_{t+\tau} - dB_{t+\tau})/(1+r)^{\tau}}}{\boldsymbol{B_t}} \tag{9}$$

By way of equation (9), Fama and French (2006, 2015) demonstrate the relations mentioned above. If expected earnings and changes in book equity are fixed, then higher B/M-ratio means higher expected long-term returns of the stock. If all variables excluding expected earnings are fixed, then higher expected earnings mean that the stock's expected long-term returns have to be higher also. Moreover, if all variables excluding expected changes in book equity are fixed, then greater expected changes in book equity will lead to the situation that the stock has lower expected long-term returns.

However, this model has some general problems when it uses expected values, which forces using forecasted values. Fama and French (2006, 2015) argue that determining r (*i.e., stocks' expected returns or the internal rate of return*) with the formula in Eq. (8) is always "true" even if variables in the formula are not. They base this argument on Campbell and Shiller's (1988) findings of tautology of the traditional dividend discount model, which also concerns the formula in Eq. (8) because it is the same as the DMM but under clean surplus accounting. Therefore, it cannot be known with this model, whether the profitability premium exists because of expectations errors or unmeasured risks (Fama & French, 2006, 2017).

2.3.2 The link of profitability premium under q-theory

Cochrane (1991, 1996) presents a production-based asset pricing model in his papers. Cochrane's model is also known as the investment-based asset pricing model, and it can also be conceived to be a version of the q theory of investment. The q-theory is first proposed by Tobin (1969), but this thesis generally refers also to Cochrane's work as the q-theory. Cochrane's (1991, 1996) model is similar to consumption-based asset pricing models, but it replaces consumers and utility functions with producers and production functions. The basic idea of consumption-based asset pricing is based on Merton's (1973) ICAPM. In more detail, according to consumption-based asset pricing, consumers face an intertemporal choice in each period when they decide how much they consume today and how much they invest and will consume in the future (Breeden, 1979). This choice causes that the stock's expected return is associated with the consumption risk. Therefore, assets that have higher covariance with consumption growth are riskier than assets with lower covariance with consumption growth (Breeden, 1979). However, this thesis focuses more on investment-based asset pricing than consumption-based asset pricing because the first one can explain the relation between expected profitability and expected stock returns (e.g., Hou, Xue & Zhang, 2015). Moreover, it can also offer a rational explanation for profitability premium. This explanation suggests that investment frictions have an effect on the magnitude of profitability effect in the stock market. (e.g., Jiang, Qi & Tang, 2018).

Thus, in addition to the valuation theory, the relationship between expected profitability and expected stock returns can also be illustrated by way of the q-theory (Cochrane, 1991; Hou et al., 2015). This thesis illustrates the relationship in more detail by way of an economic model that Lin and Zhang (2013) have presented in their paper. However, the exception is the impact of adjustment costs that include in the model, which are illustrated by way of Li and Zhang's (2010) methods in this thesis.

According to Lin and Zhang's (2013) model, the economy has two-periods (0, 1), and there are heterogeneous firms amount of N. The economy is in the general equilibrium. It has three features by Long and Plosser (1983) which are: there are rational expectations; both the households maximize their utility with a formula $U(C_0 + \rho E_0(U(C_1)$, and the firms maximize their market value; markets clear. In the model, firms produce only a single commodity that is meant to be consumed or invested. Firms produce in both at date 0 and date 1, but they only exist until date 1 when their liquidation value is zero, which means that deprecation rate is a hundred percent for initial capital, K_{i0}. Firms can have different assets K_{it} and profitability $\prod_{it}$, of which profitability is "subject to a vector of aggregate shocks affecting all firms and a vector of firm-specific shocks affecting only firm i" (Lin & Zhang, 2013, pp.353).

According to Lin and Zhang (2013), $\prod_{it}K_{it}$ is the operating cash flow of firm i at period t. I_{i0} is the firm's investment at date 0, and when deprecation rate is 100 %, then $K_{i1} = I_{i0}$. Firms do not invest anymore at date 1, thus $I_{i1} = 0$ (Lin & Zhang, 2013). According to Li and Chang (2010), when firms invest, they face deadweight costs because there exist investment frictions in the economy. Therefore, investing generate adjustment costs that are defined as $(a/2)\ (I_{i0}/K_{i0})^2K_{i0}$ where parameter a is always >0, and its magnitude represents how high or low investment frictions firm i must face.

For the households, P_{it} is the firm's ex-dividend equity value, and D_{it} is the firm's dividend, as stated in the Lin and Zhang's (2013) paper. Therefore, the first-order condition for consumption can be written into the formula that is presented in Eq. (10)

$$\boldsymbol{P_{i0} = E\big(M_1(P_{i1}, +D_{i1})\big)} \qquad \textbf{(10)}$$

where M_1 represents the stochastic discount factor. Eq. (10) can also be written into a formula where r^s_{i1} is $(P_{i1}+D_{i1})/P_{i0}$, and it represents the stock return of firm i at date 1 (Lin & Zhang, 2013). This formula is presented in Eq. (11)

$$\mathbf{1} = \boldsymbol{E_0}\left(\boldsymbol{M_1 r_{i1}^S}\right) \tag{11}$$

According to Lin and Zhang (2013), firms finance their adjustment costs and investment with their operating cash flow at date 0. Therefore, the free cash flow of firm i at date 0 is the operating cash flow reduced by investment and adjustment costs, D_{i0}. If the free cash flow of firm i is positive, it is distributed back to the households. At date 1, the capital K_{i1} is utilized to attain operating cash flow $\prod_{i1}K_{i1}$ that will be all distributed as dividends D_{i1}. P_{i1} is naturally zero. If M_1 can be taken as given, the firm aims to maximize its market value by choosing optimal I_{i0}, which can be written into the formula that is presented in Eq. (12)

$$\boldsymbol{D_{io} + P_{io} \equiv max \ \prod_{i0} K_{i0} - I_{i0} - \frac{a}{2}\left(\frac{I_{i0}}{K_{i0}}\right) K_{i0} + E_0[M_1 \prod_{i1} K_{i1}]} \tag{12}$$

where is the free cash flow of firm i at date 0 plus the discounted value of date 1's cash flow to date 0. It is a good notice that K_{i1} is equal to I_{i0}, as mentioned above. The first-order condition for investment is presented in Eq. (13) (Lin & Zhang, 2013).

$$\boldsymbol{1 + a\frac{I_{i0}}{K_{i0}} = E_0[M_1 \prod_{i1}]} \tag{13}$$

According to Lin and Zhang (2013), when the D_{i0} is known from Eq. (12) then the P_{i0} must be $E_0[M_1\prod_{i1}K_{i1}]$. Therefore, the stock return can be written into the formula which is presented in Eq. (14)

$$\boldsymbol{R_{i1}^S = \frac{D_{i1}+P_{i1}}{P_{i0}} = \frac{\prod_{i1} K_{i1} + 0}{E_0[M_1 \prod_{i1} K_{i1}]} = \frac{\prod_{i1}}{E_0[M_1 \prod_{i1}]}} \tag{14}$$

where the denominator is the same as is the right part in Eq. (13). Therefore, we can rewrite Eq. (14) into a formula where the denominator is the left part from Eq. (13). This formula is presented in the Eq. (15)

$$\boldsymbol{R^S_{i1}} = \frac{\Pi_{i1}}{\boldsymbol{1+a(I_0/K_0)}} \qquad \textbf{(15)}$$

where the numerator is the marginal benefit of investment at date 1, and the denominator is the marginal cost of investment at date 0. These must be equal when the firm's marginal benefit of investment is discounted from date 1 to date 0. Therefore, R^S_{i1} represents this discount rate, or in other words, the stock return of firm i at date 1 (Lin & Zhang, 2013).

$$\boldsymbol{E_0[R^S_{i1}]} = \frac{E_0[\Pi_{i1}]}{\boldsymbol{1+a(I_0/K_0)}} \qquad \textbf{(16)}$$

Hou et al. (2015) have alter on demonstrated the relations of profitability and investment to the expected stock returns by way of the similar formula as above in Eq. (16) (*the difference is that there is **expected** profitability and stock return*). When the denominator is fixed, firms with higher expected profitability have higher expected stock returns. In the same way, when the numerator is fixed, firms with higher investment-to-assets should have lower expected stock returns (Hou et al., 2015). The formula also reveals how investment frictions affect profitability effect. The parameter "a" represents the magnitude of investment frictions that the firms face. When firms face high investment frictions, the parameter "a" is high, which leads to a higher denominator. Therefore, high investment frictions lower the expected stock returns, as is mentioned in the paper of Jiang et al. (2018). However, it is good to notice that even though q-theory suggest that the expected profitability is positively associated with the higher systematic risk, it does not take a stand on which are these sources of risk, which causes this systematic risk (Lam, Wang & Wei, 2015).

3 Literature review

3.1 History of profitability premium

Profitability premium is a current topic in the academic literature. There have been done plenty of studies after Novy-Marx's (2013) paper regarding this premium. Most of these studies focus on different profitability measures that can predict future stock returns. Overall, recent academic literature has shown that the choice of profitability measure has an enormous impact when predicting future stock returns (e.g., Ball et al., 2015;2016; Hou et al., 2015; Akbas, Jiang & Koch, 2017; Fama & French 2017; 2018). The importance of this choice has further been emphasized since profitability is recently started to use as a factor in asset pricing models (e.g., Hou et al., 2015; Fama and French, 2015). Fama & French (2017) have also encouraged academic research to identify and define factors that genuinely matters and are not subsumed by other well-known factors. However, this thesis does not directly take a stand on this issue and leaves it for further research. This thesis focuses more on the profitability premium's magnitude, pervasiveness, persistence, and robustness when introducing these studies.

Novy-Marx (2013) finds that gross profitability has a strong explanatory power to predict future stock returns. Moreover, as a strategy, it generates abnormal returns measured by CAPM or Fama and French (1993) three-factor model. He defines gross profitability as total revenue minus cost of goods sold divided by the book value of total assets, and it is calculated annually. He also shows that gross profitability outperforms other profitability measures in his paper. Therefore, he argues that the further income statement goes, the more polluted measures of profitability are. Hence, he argues that gross profitability is the measure for firms' true economic profitability because it is not reduced by expenses that are truly investments, for example, research and development costs (R&D). The gross profitability premium also has high economic significance when transaction costs and limits of capital are considered, as mentioned in the previous chapters (Novy-Marx & Velikov, 2015). Moreover, as a factor, the gross profitability helps to price anomalies that Fama and French's (1993) three-factor model fails to price (*except Sloan's (1996) accruals and Ball and Brown's (1968) post-earnings-announcement drift, PEAD*) (Novy-Marx, 2013).

Novy-Marx's (2013) paper also reveals other interesting elements and details about the gross profitability premium. For example, the gross profitability is negatively correlated with the value factor. Hence, Novy-Marx (2013, pp. 6) argues that firms with high gross profitability are "good growth firms". Therefore, the gross profitability, as a strategy, offers a strong hedge for the value strategy when they both improve each other's performance considerably (Novy-Marx, 2013).

There have been presented some evidence that is consistent with the above-mentioned statement of Novy-Marx (2013). For example, Mohanram (2005) finds that a zero-cost portfolio that is constructed by sorting stocks on profitability among growth stocks generates significant excess returns. This return comes primarily from the short-leg, which can be interpreted that sorting helps to avoid "busts" among growth stocks. Asness, Frazzini, and Pedersen (2019) provide more evidence about growth and profitability together when they show that strategy that is long in the high-quality stocks and short in the "junk"-stocks generates both significant excess returns and abnormal returns. They measure quality by 15 variables that are associated with stocks' profitability, growth, and safety (Asness et al., 2019). Furthermore, Sloan and Erhard (2019) provide more evidence about the relationship between growth and profitability. They even suggest that it is both growth and profitability together that generates the profitability premium. The paper of Sloan and Erhard (2019) is more discussed later on this thesis.

Ball, Gerakos, Linnainmaa, and Nikolaev (2015) confirm the result of Novy-Marx (2013) that gross profitability has a significant explanatory power to predict future stock returns. However, they propose an alternative explanation for Novy-Marx's (2013) finding that gross profitability outperforms other profitability measures because it represents firms' true economic profitability. They argue that Novy-Marx's (2013) result is due to deflating numerators inconsistently, for example, when Novy-Marx (2013) deflates gross profit by the total value of assets, but others by the book value of equity. Moreover, Ball et al. (2015) prove their argument by showing that other profitability measures have approximately as much explanatory power as gross profitability when it is used the same deflator, the total value of assets.

There have also been presented more critics about the denominator of gross profitability. For example, Zhang (2017) claims that it is not economic logical divide gross profit by the current period's total assets because the previous period's assets generate the current profit. He also argues that gross profitability contains "a hidden investment effect" (Zhang, 2017, pp. 556). He illustrates this argument by a formula where gross profitability is equal to the gross profit divided by the one-period-lagged total assets divided by the asset growth component. Therefore, Zhang (2017) argues that there should be used one-period-lagged value in the denominator.

There are also opinions and empirical results that profitability measure should be calculated quarterly, which makes the return on equity (ROE) more practical to use as profitability measure (e.g., Hou et al., 2015; Zhang, 2017; Chen, Sun, Wei & Xie, 2018). However, Novy-Marx (2015) argues against this statement because, as a factor, the quarterly calculated ROE is driven by the PEAD effect. Moreover, quarterly calculated ROE is quite similar to the post loss/profit announcement drift anomaly found by Balakrishnan, Bartov, and Faurel (2010), except that in the anomaly is used total assets instead of book equity as the deflator.

As mentioned above, Ball et al. (2015) have difficulties in agreeing with Novy-Marx's (2013) assumption that gross profitability is the best proxy for firms' true economic profitability. They argue that even though items below the cost of goods sold in income statements could be possibly polluted, these items can still have explanatory power as previous studies have shown, for example, for selling, general and administrative expenses (SG&A) (Eisfeldt & Papanikolaou, 2013). Therefore, they construct a new profitability measure, operating profitability, which they define as total revenue minus cost of goods sold minus SG&A expenses, excluding R&D expenses, divided by book value of total assets. Excluding R&D expenses is consistent with the findings that firms' innovativeness is positively related to future profitability, and thus the future stock returns (e.g., Hirshleifer, Hsu & Li, 2018). Finally, Ball et al. (2015) show that operating profitability earns higher abnormal returns than gross profitability, and it also has more explanatory power to predict future stock returns (Ball et al., 2015).

Later, Ball, Gerakos, Linnainmaa, and Nikolaev (2016) modify their older profitability measure when they exclude accrual components from it, which will make it a better proxy for expected profitability. They name this new measure as cash-based operating profitability, and it outperforms their original operating profitability when measured by explanatory power in the regression analysis or either abnormal or excess returns in the portfolio analysis. Furthermore, cash-based operating profitability subsumes Sloan's (1996) accruals anomaly that has produced enormous challenges for asset pricing models that have included profitability factor. (Hou et al., 2015; Fama & French, 2016; Ball et al., 2016). Fama and French (2018) also find that cash-based profitability might be a better choice as the profitability factor in asset pricing models rather than their profitability measure, operating profitability.

Akbas, Jiang, and Koch (2017) agree with Novy-Marx (2013) that gross profit represents firms' true economic profitability, and thus it is the right proxy for the firm's current profitability. However, they argue that current profitability cannot completely reflect expected profitability, and thus stock returns, because firms' operative environment is unstable. Therefore, gross profitability cannot solely be the best proxy for the expected profitability. They argue that profitability trend offers together with static profitability a better proxy for expected profitability. They also show that it improve explanatory power to, and it predicts future stock returns up to two years ahead. Furthermore, static profitability measures, PEAD, or momentum do not subsume this profitability trend effect. (Akbas et al., 2017).

There have also been presented results that show that a combination of diversified forecasts can outperform some profitability measures that are based on prior profitability data, as a proxy for expected profitability (Detzel, Schaberl & Strauss, 2019). These results are consistent with the interpretation of Akbas et al. (2017) about the insufficiency of static profitability measures. Moreover, Yin and Yang (2022) have also confirmed a similar effect in the Chinese stock market. First, they show that first-order dynamic profitability growth has higher pricing power among profitability proxies tested in their paper. In addition to the above-mentioned finding, they find that utilizing both, dynamic and static profitability measures together generates higher excess returns than utilizing one only. All of these results are consistent with the findings of Detzel et al. (2019) and Akbas et al. (2017).

There have been made a few studies that concern the persistence of the profitability premium. For example, Wahal (2019) studies both profitability and investment premiums with data from 1940 to 1963. He finds that profitability premium measured by Fama and French's (2015) operating profitability or gross profitability exists in the period. However, he does not find any proves about investment premium in his period. Moreover, Linnainmaa and Roberts (2018) study both profitability (RMW) and investment premiums (CMA). In contrast to the findings of Wahal (2019), they find that these premiums are insignificant in their pre-history sample from 1926 to 1963. However, the profitability premium has significant abnormal returns at a ten percent level when measured by Fama and French's (1993) three-factor model. However, it is most likely due to negative loadings of profitability to the value factor (Linnainmaa & Roberts, 2018). Furthermore, Linnainmaa and Roberts (2018) also examine gross profitability, ROA, and ROE, which all have even more significant three-factor alphas, but their average returns remain insignificant in this pre-period.

In his paper, Novy-Marx (2013) also offers international evidence about the gross profitability premium. The results show that gross profitability is significant outside the US market. However, he examines this premium only in developed markets. In addition to Novy-Marx (2013), there are a few studies regarding the profitability premium in the international stock markets. Chen et al. (2018) study profitability premium in 33 different markets, which includes both developed and developing markets. Their results are consistent with Novy-Marx's (2013) when they show that the premium also exists outside the US market. However, they argue that the choice of profitability measure has a significant impact on the magnitude of profitability effect. Moreover, their study reveals that profitability premium is stronger in developed markets than in developing markets.

Sun, Wei, and Xie (2014) have also examined the profitability premium with data from 41 different countries. Their conclusion is similar to the results of Chen et al. (2018).

The profitability premium exists outside the US market, and it is stronger in developed markets. They also offer a rational explanation for this premium, which is introduced later on this thesis. However, the above-mentioned studies have not examined how profitability premium behaves in different size groups or from the perspective of asset pricing (Fama & French, 2017). Therefore, Fama and French (2017) study their five-factor model's performance in four different regions: North America, Europe, Japan, and Asia Pacific. They find that average stock returns increase with profitability except in Japan, where the relationship between profitability and stock returns is weak. Moreover, they find that the profitability premium is stronger for small stocks than big stocks (Fama & French, 2017).

3.2 Behavioral explanations suggested for profitability premium

As mentioned earlier in this thesis, there are two main elements in mispricing explanations. The one element is that there are investors whose irrational beliefs affect stock prices. The other is that arbitrage is not riskless, which causes that mispricing cannot possibly be eliminated. There have been studied the profitability anomaly from both of these two perspectives. However, some results of these studies are inconsistent with each other. Moreover, there have also been presented results regarding risk-based explanations that are entirely inconsistent with these results (see Chapter 3.3). However, there is plenty of studies which have suggested that profitability premium is due to expectations errors in profitability where the underreaction plays a big part (e.g., Wang & Yu, 2013; Lam et al., 2015; Akbas et al., 2017; Bouchaud, Krüger, Landier & Thesmar, 2019). Therefore, this thesis focuses more on finding concrete reasons that cause investors' underreaction when it introduces these studies.

Wang and Yu (2013) argue that profitability premium is due to mispricing because the profitability premium is stronger among stocks with higher limits to arbitrage and higher uncertainty. Moreover, they find that anomaly's profit comes primarily from the short-leg, which is consistent with the argument above because overpricing is more challenging to remove because of the short sale limitations (e.g., Miller, 1977; Jones & Lamont, 2002). Wang and Yu (2013) also find that mispricing is more likely due to underreaction than overreaction. Therefore, they try to find explanations for investors' underreaction with behavioral models. They conclude, in the spirit of Hong and Stein's (1999) model, that underreaction is rather due to the habit of some investors to ignore new information than behavioral biases such as overconfidence or conservatism.

The findings of Stambaugh, Yu, and Yuan (2012) are consistent with the results of Wang and Yu (2013). Stambaugh et al. (2012) examine how investor sentiment explains anomalies (*including Novy-Marx's gross profitability anomaly*) that have generated difficulties for asset pricing models. They find that anomalies' abnormal returns are more likely due to mispricing because these anomalies are more profitable after the investor sentiment has been high. They argue that this mispricing is more probably due to overpricing than underpricing because of the short sale limitations. They prove this argument by showing that anomalies' short-leg portfolios have lower excess returns after high sentiment periods (*i.e., means that the strategies are then more profitable*), which supports the argument of overpricing. Furthermore, they show that the returns of anomalies' long-leg portfolios do not significantly differ between high and low sentiment periods, which indicates that the short sale restrictions have an enormous role in the profitability of these anomalies.

Lam et al. (2015) examine if the profitability premium is due to macroeconomic risks or mispricing. They agree with Stambaugh et al. (2012) when they show that the premium mainly exists because of expectation errors that are explained by overpricing when investor sentiment is high. However, they also find that some macroeconomic risk factors explain a part of the premium, which is discussed more in Chapter 3.3. Lam et al. (2015) take a little different angle than Stambaugh et al. (2012) to explain these expectations errors when they argue that premium exists mainly in firms whose valuation and profitability are discordant. This argument has similarities to the findings of Piotroski and So (2012), who have shown that expectation errors are more probable in stocks like mentioned above. Furthermore, Baker and Wurgler (2006) have argued that mispricing is more probable in stocks whose valuation is hard to do objectively, which is also consistent with the argument of Lam et al. (2015). Lam et al. (2015) also prove their argument by showing that stocks that have an inconsistency between their profitability and valuation generate higher abnormal returns. Moreover, these stocks also have more analysts' forecast errors.

Akbas et al. (2017) also try to find reasons for the profitability premium. They lean rather on mispricing explanations than risk-based explanations. However, it is good to notice that their study takes only account of Fama and French's (1993, 2015) risk factors. When they examine mispricing explanations more closely, they do not find any proves behalf of investors' overreaction. Hence, they focus on examining investors' underreaction, as several studies above have done. They find that there is short-term underreaction to the profit trend of firms in the market. Moreover, they show that analysts have a habit of underreacting annual profitability data, which can indicate conservatism among analysts. Furthermore, they show that there is also a positive relationship between the limits to arbitrage and the magnitude of profitability premium. Finally, they examine whether this underreaction is due to overpricing in the high investor sentiment period or investors' overconfidence. Surprisingly, the results from these tests are inconsistent with the results of Stambaugh et al. (2012) because they cannot find evidence on behalf of either one.

Bouchaud, Krüger, Landier, and Thesmar (2019) have perhaps done the most remarkable study regarding mispricing and the profitability premium. As mentioned above, some studies have recognized analysts' tendency to underreact profitability data (e.g. Akbas et al., 2017; Lam et al., 2015). Moreover, analysts' underreaction to earnings was recognized a long time ago (e.g., Abarbanell & Bernard, 1992). Hence, Bouchaud et al. (2019) decide to examine analysts' forecast errors more closely from the perspective of profitability premium. Firstly, they show that future stock returns can be mainly forecasted by past profitability and profitability trend, which is consistent with the interpretation of Akbas et al. (2017). Secondly, they show that analysts underreact information on firms' past profitability, especially if the firm has high profitability. Therefore, the profitability premium is stronger in firms that are followed by analysts who tend to anchor into their forecast. Moreover, they find that the persistence of profitability affects the magnitude of the profitability premium. Naturally, in firms with a high persistence of profitability, anchoring can easily lead to more substantial expectation errors.

According to Bouchaud et al. (2019), some variables can explain the anchoring of analysts. For example, the number of industries the analyst follows increases anchoring. Whereas, the other variable is the experience of analysts that reduces anchoring. These findings can be interpreted to be partly similar to the conclusion of Wang and Yu (2013). However, the main point from the paper of Bouchaud et al. (2019) is that profitability premium is likely due to investors' anchoring if it is assumed that the forecasts of analysts represent the beliefs of market participants.

Yin and Yang (2022) have done a similar study to the study done in the paper of Akbas (2017) et al. Their study focuses on the dynamic profitability and the mispricing as the source of the profitability effect. Their paper finds evidence that profitability premium is driven by mispricing. In other words, they show that investors tend to underreact profitability data, which is a consistent finding with the findings of Bouchaud et al. (2019), Akbas et al. (2017), and Wang and Yu (2013).

Moreover, Yin and Yang (2022) argue that mispricing factors can substantially explain the abnormal returns of the profitability premium. In their paper, they utilize two different mispricing factor models. One factor model is the model of Daniel, Hirshleifer, and Sun (2020) that includes the following factors: market, PEAD, and FIN, which is a composition of 1-year net share issuance and 5-year composite share issuance. The other model is the model of Stambaugh and Yuan (2017). The model includes four factors: market, size, and two mispricing factors constructed by combining stocks' rankings of 11 major anomalies. Even though these models could help explain the profitability premium, it is good to notice that both models include profitability in some form.

As partly mentioned in the previous Chapter , Sloan and Erhard (2019) argue that profitability premium mainly exists in stocks that have a high potentiality to growth. They show that there is indeed a positive relationship between analyst expectation errors and profitability, especially in the group of growth stocks, which confirms findings of Bouchaud et al. (2019), Lam et al. (2015), and Akbas et al. (2017). However, their explanation for these expectation errors differs from the explanation of Bouchaud et al.

(2019), even though it is not either inconsistent with the interpretation of Bouchaud et al. (2019).

Sloan and Erhard (2019) base their explanation on surveys that have revealed analysts' tendency to use most often market multiples, for example, P/E-ratio when determining the firm's value (Pinto, Robinson & Stowe, 2019). Moreover, these surveys have revealed that analysts utilize mostly growth potential to determine acceptable market multiples (Block, 1999). Because of these findings, a concern arises regarding analyst evaluating firms with the same growth potential by the same market multiples. (Sloan & Erhard, 2019). Therefore, Sloan and Erhard (2019) argue that the profitability premium is due to analysts' underestimation of how firms' profitability affects financing their future growth. Firms with high profitability can more easily finance their growth by internal funds when unprofitable firms must probably organize a new share issue to finance their growth. These new share issues of unprofitable firms can lead to larger stock dilution from the perspective of current owners in the future. They prove this by showing that there exists a negative relationship between profitability and growth in the number of shares. The results mentioned above can be interpreted in the way that analysts' underestimation can be partly caused by availability heuristic because the information of the future dilution is not so in understandable form than, for example, market multiples are.

The interpretation of Sloan and Erhard (2019) has similarities to findings of previous studies, for example, to the study of Baker and Wurgler (2006), who find that valuation of extreme growth stocks is highly subjective, which leads more commonly to mispricing. Moreover, the studies of Lam et al. (2015) and Piotroski and So (2012) have also revealed that stocks' inconsistencies between valuation and profitability are associated with expectation errors, which is the finding that can be interpreted to be consistent with the findings of Sloan and Erhard (2019). Furthermore, the results of Sloan and Erhard (2019) can explain the finding that growth and profitability perform well together (e.g., Mohanram, 2005; Asness et al., 2019). In addition to the above, Sloan and Erhard's findings of investors' underestimation of future dilution can explain why Fama and French's

(2015, 2017) five-factor model has had difficulties in pricing stocks that high growth and low profitability.

3.3 Risk-based explanations suggested for profitability premium

In contrast to mispricing explanations, there have been presented rational explanations for the existence of profitability premium. However, it can generally be hard to approve that the profitability premium is due to risk. For example, Novy-Marx (2013) find it difficult because of rational explanations for the value premium (*e.g., earnings persistence by Fama & French's (1993) and operating leverage by Zhang (2005) and Novy-Marx (2011)*) are inconsistent with the existence of profitability premium. On the other hand, Sloan and Erhard (2019) argue that stocks with high profitability are usually liquid and large, which supports rational explanations more than mispricing explanations. Moreover, Ball et al. (2015, 2016) argue that profitability (*operating profitability and cash-based operating profitability*) can even predict future stock returns for ten years ahead, which leads to their doubts that mispricing does not likely persist so long.

Even though there have been recently added profitability factors in asset pricing models, theories behind these models, for example, q-theory and valuation theory do not take a stand on is this pricing rational or what are the sources of risk behind profitability (Fama & French, 2006, 2015, 2017; Lam et al., 2015; Hou et al., 2015). However, there have been made a couple of studies regarding the profitability premium from the perspective of the risk (e.g., Barinov, 2019; Jiang et al. 2018; Hackbarth & Johnson, 2015; Kogan & Papanikolaou, 2013). Next, this thesis introduces these studies, which gives a contrasting perspective for the mispricing explanations.

Although Lam et al. (2015) conclude that profitability premium is more likely due to mispricing, they also find that the macroeconomic risk factors explain a part of the premium. These macroeconomic risk factors are identified by Chen et al. (1986). They find that especially the industrial production and the default premium in low-grade corporate bonds can explain the profitability premium. However, these macroeconomic risk factors can only explain a third of the premium, which leads to their interpretation on behalf of mispricing as a source of the premium (see Chapter 3.2).

Hackbarth and Johnson (2015) stress the importance of real options in the profitability premium. They try to explain the profitability premium by risks embedded in both operating leverage and real options effects. Operating leverage and real options effects generate opposite forces, which causes the relationship between profitability and stock returns can be as best described with a cubic function. It is also good to notice that the effects of the real option are stronger than the effects of operating leverage, especially in firms with extreme profitability (*i.e., very high or low profitability*). They argue that contraction options become more valuable when profitability declines, which decreases the risk of firms with low profitability. In contrast, expansion options that become more valuable when profitability increases will cause that firms with high profitability have a higher risk.

A recent work by Barinov (2019) concerns aggregate volatility as the source of risk for the profitability premium. He bases his work on Merton's (1974) thought that the firm's equity is like a call option where the exercise price is equal to the firm's debt. Because of low profitable firms are more likely distressed, he argues that these distressed firms will benefit more about increases in volatility than highly profitable firms because their "option-like equity is close to "being in-the-money"" (Barinov, 2019, pp. 24). Barinov (2019) proves this argument by showing that changes in VIX-index can explain the profitability premium (RMW). In high volatility periods, low profitable firms perform better than expected, in contrast to the performance of highly profitable firms that is lower than expected in these high volatility periods. Therefore, Barinov (2019) argues that profitability premium in low volatility periods is due to compensation for the bad performance of the strategy in high volatility periods. Furthermore, he finds that the profitability premium is stronger among distressed and more volatile firms, which is consistent with his interpretation.

Kogan and Papanikolaou (2013) argue that investment-specific technology (IST) shocks can explain the gross profitability premium. They base this argument on their other study where they have shown that firms that are valued rather by their growth potential than the current total assets have a higher exposure to these IST-shocks (Kogan & Papanikolaou, 2014). IST-shocks are shocks that are related to technological development, which leads to increases in productivity (Kogan & Papanikolaou, 2013). Therefore, IST-shocks generate a negative risk premium, and there can be thought that they represent the systematic risk in their way (Kogan & Papanikolaou, 2013). Kogan and Papanikolaou (2013) show with their model that firms with high gross profitability are valued more by their current total assets than the growth potential. Hence, these firms have higher stock returns because they exposure less to the IST-shocks.

As already mentioned in the theoretical framework section, the investment frictions can be negatively related to the magnitude of profitability premium. Sun et al. (2014) have first studied this relationship. They have found that profitability premium is significantly stronger in developed markets that have low investment frictions. Moreover, they do not find evidence of mispricing explanations because the profitability premium is not stronger in markets that have higher limits to arbitrage. Therefore, they argue on behalf of the rational explanations that are based on investment-based asset pricing. However, Fama and French (2017) point out that the results of Sun et al. (2014) are not perfectly comprehensive, which leaves room for the counterarguments.

Furthermore, there is recent work about the role of investment frictions as the source of the profitability premium, which has been done by Jiang et al. (2018). Their study is similar to Sun's (2014), except they delimit their study to the Chinese stock market. Firstly, they show that the profitability premium exists in the Chinese stock market. However, the main finding of their study is that the magnitude of profitability premium is more potent in firms that have lower investment frictions. Moreover, they show that profitability premium is not stronger in firms that exposure to the higher limits to arbitrage. Hence, the study of Jiang et al. (2018) supports the findings of Sun et al. (2014) that there is a negative relationship between the magnitude of investment frictions and the profitability premium. On the contrary, the findings of Jiang et al. (2018) are inconsistent with the findings of Yin and Yang (2022) who do not find evidence of the negative relationship between investment frictions and the magnitude of the profitability premium in the Chinese stock market.

4 Methodology

The main methodology of this thesis is based on portfolio tests. In other words, there will be defined portfolios that are based on the different variable(s) sorts depending on the hypothesis tested. However, one of the sorting variables is always profitability. All portfolios are rebalanced yearly. After portfolio defining, there have been calculated value-weighted monthly returns for each portfolio. Lastly, portfolios' monthly returns are regressed on Fama and French (1993) 3-factor model (*see Eq. 6*), where t is defined as a month, and i represent different portfolio groups. Next, this thesis will construct the hypotheses and present the corresponding methodology to test the specific hypothesis in more detail. Due to the nature of the main methodology of this thesis, there is no one primary test statistic to analyze in order to reject or accept the hypothesis. Thus, the hypotheses of this thesis represent more research questions of this thesis. In other words, the analysis of hypothesis and results are done based on the significance of portfolios' alfa (*abnormal returns*), factor loadings, and excess returns.

4.1 Hypotheses construction and corresponding methodology

There are plenty of studies presented in Chapter 3.1 where different profitability measures are utilized (e.g., Novy-Marx, 2013; Fama & French, 2015, 2018; Ball et al., 2015, 2016; Akbas et al., 2017). The finding regarding the ability of different profitability measures to generate significant excess and abnormal returns supports the robustness of the profitability premium. Hence, it also reduces the probability of data snooping as the source of the profitability premium. Moreover, the profitability premium has also been studied by utilizing different data samples, i.e., the magnitude of profitability premium in different time periods and/or different markets. These studies have almost unanimously shown that the profitability premium is highly significant (e.g., Linnainmaa & Roberts, 2018; Chen et al., 2018; Wahal, 2019). However, this thesis still wants to confirm the profitability premium significance in the data sample. Therefore, the first hypothesis is the following.

$H_{0,0}$*: *Firms with high profitability do not generate significantly higher excess and abnormal returns compared to firms with low profitability.

$H_{0,1}$*: *Firms with high profitability generate significantly higher excess and abnormal returns compared to firms with low profitability.

The definition of profitability is essential for this study. As already can be interpreted in Chapter 3.1, many different definitions for profitability have been used in academic literature. However, as most recent studies have shown, the cash-based operating profitability by Ball et al. (2016) outperforms other profitability measures from both perspectives' anomaly and asset pricing (e.g., Fama & French, 2018). Therefore, it is used as the main profitability measure in this thesis. However, this thesis also includes Novy-Marx's (2013) gross profitability into empirical tests, which is done because it is mainly used in the previous studies. Thus, it helps to compare the results of this thesis to older studies.

The first hypothesis is tested by utilizing portfolios sorted on previous year cash-based operating profitability or gross profitability that are proxies for expected profitability. Regarding the testing of the first hypothesis, there has been constructed profitability decile, quintile, and tertile portfolios. Gross profitability is defined according to Novy-Marx (2013), and Cash-based operating profitability is defined according to Ball et al. (2016). The exact definitions can be seen in Table 1 below.

Table 1. Definitions of profitability proxies

Variable		Definition	Notes
Gross profitability$_{t-1}$	=	$\frac{\text{Revenue}_{t-1} - \text{Cost of goods sold}_{t-1}}{\text{Total assets}_{t-1}}$	If any variable of formula is missing, gross profitability is interpreted as missing.
Cash-based operating profitability$_{t-1}$	=	$\frac{(\text{Revenue}_{t-1} - \text{Cost of goods sold}_{t-1} - (\text{Selling, general and administrative expenses}_{t-1} - \text{R\&D expenses}_{t-1}) - \Delta\text{Accounts receivables}_{t-1} - \Delta\text{Inventory}_{t-1} - \Delta\text{Prepaid expenses}_{t-1} + \Delta\text{Deferred revenue}_{t-1} + \Delta\text{Accounts payables}_{t-1} + \Delta\text{Accrued expenses}_{t-1})}{\text{Total assets}}$	If revenue, Cost of Goods sold or total assets is missing, cash-based operating profitability is interpreted as missing. Other missing values are replaced with zero.

Regarding the testing of the first hypothesis, separate decile, quintile, and tertile portfolios will be constructed on profitability (*gross profitability and cash-based operating* *profitability separately).* Profitability premium is defined as the highest profitability group returns minus the lowest profitability group returns, i.e., zero-hedge portfolio.

As already mentioned earlier, this thesis focuses on behavioral and risk-based perspectives regarding the existence of the profitability premium. Generally, these two explanations are opposite, but academic research has found evidence on behalf of both perspectives as the source of the profitability premium (e.g., Jiang et al., 2018; Bouchaud et al., 2019). Therefore, the interpretation of profitability premium is still challenging when the presented explanations for its existence are highly inconsistent (e.g., Novy-Marx, 2013). This thesis will study both perspectives by utilizing a similar (*but not completely identical*) methodology as used in the study of Jiang et al. (2018).

Regarding the behavioral perspective, there primarily are mixed results on the role of limits to arbitrage in the profitability premium (e.g., Wang & Yu, 2013; Stambaugh et al., 2012; Jiang et al., 2018). Naturally, limits to arbitrage cannot solely be the source of the profitability premium because it rather causes the persistence of profitability premium (*i.e., mispricing in firms with high/low profitability*) than the mispricing itself. Academic research has presented plenty of different reasons for mispricing itself, for example, anchoring or overuse of heuristics. Notwithstanding the source of mispricing, the mispricing should be more substantial among firms with higher limits to arbitrage, according to finance theories (e.g., DeLong et al., 1990). Therefore, this thesis will examine the role of limits to arbitrage in the profitability premium. The second hypothesis is stated below.

$\boldsymbol{H_{1,0}}$: *Profitability premium is not significantly stronger among firms with higher limits to arbitrage.*
$\boldsymbol{H_{1,1}}$: *Profitability premium is significantly stronger among firms with higher limits to arbitrage.*

According to $\boldsymbol{H_{1,1}}$, profitability premium should be stronger, measured by abnormal and excess returns, for high mispricing portfolios compared to low mispricing portfolios. The testing of the second hypothesis is done by utilizing portfolios double-sorted on mispricing proxies and profitability. The sorts are independent, and both sorts are done on tertile groups. This thesis has used four different proxies for mispricing, listed with the exact definitions below in Table 2.

Table 2. Definitions of mispricing proxies

Variable	Definition	Notes
$Illiquidity_t$	Average absolute daily returns divided by the dollar trading volume from January 1 of year t to December 31 of year t.	Presented in the following tables as the unit of 10^{-6}.
$Dollar\ volume_t$	Average of daily share trading volume multiplied by the daily closing price from January 1 of year t to December 31 of year t.	Presented as millions in the following tables.
$Closing\ stock\ price_t$	Closing price at December 31 of year t.	
$Turnover_t$	Daily average of number of shares traded divided by the number of shares ouutstanding from January 1 of year t to December 31 of year t.	Presented as millions in the following tables.

The interpretation of mispricing proxies goes in the following way. Amihud (2002) has shown that higher illiquidity value illustrates higher arbitrage costs for investors. In other words, the stocks with higher Amihud's (2002) illiquidity value are more exposed to liquidity risk, and thus higher limits to arbitrage. On the other hand, the dollar volume of the stock is negatively linked to the price pressure of the stock (Bhushan, 1994). Thus, the stocks with high dollar volume are considered to have lower mispricing. Firms with higher turnover are considered to have higher liquidity (e.g., Baker & Stein, 2004). I.e., turnover is negatively related to the probability of mispricing. The nominal stock price has a negative relationship with the arbitrage costs because it has a reversal relationship with the bid-ask spread (Stoll, 2000). Therefore, stocks with higher nominal stock prices are considered to have a lower probability of mispricing.

There have also been presented different risk-based explanations for the existence of the profitability premium, but these explanations differ even more from each other compared to the mispricing explanations (*see Chapters 3.2 and 3.3*). However, investment-based asset pricing offers the theoretical link between expected profitability and expected stock returns (*see Eq. 16*). The theory does not identify the source of risk itself that causes the riskiness of highly profitable firms (e.g., Lam et al., 2015). However, it identifies the link between investment frictions and profitability premium, which could be the most potential rational explanation for the existence of profitability premium (Sun et al., 2014; Jiang et al., 2018). This explanation could also help understand why profitability premium is stronger in developed markets and among large liquid firms (e.g., Sun et al., 2014; Sloan & Erhard, 2019). However, Fama and French (2017) have noticed that the empirical results regarding the negative link between the magnitude of profitability premium and investment frictions leave room for disagreements. Therefore, this thesis will test this link as the opposite explanation compared to mispricing as the source of profitability premium. Thus, the third hypothesis is the following.

$H_{2,0}$*: Profitability premium is not significantly stronger among firms with lower investment frictions.*
$H_{2,1}$*: Profitability premium is significantly stronger among firms with lower investment frictions.*

In the paper of Jiang et al. (2018), the testing of the third hypothesis is done by first separating firms into investing and disinvesting groups based on the sign of I/A-ratio. After separation, portfolios are constructed based on the independent triple-sorts, where are two groups based on I/A-ratio, three groups based on investment frictions proxies, and three groups based on profitability. I/A-ratio sort is done in order to control the investment rate, which is critical when testing the third hypothesis. According to q-theory and Equation 16, investment frictions have a different effect on the expected stock returns depending on the sign (*and the magnitude*) of the investment-to-assets ratio (*see Chapter 2.3.2*). Lower investment frictions should strengthen the profitability premium only when I/A-ratio is positive. Hence, this thesis mainly focuses on the investing firms' group.

However, the methodology used in Jiang et al.'s (2018) paper is challenging to use in this thesis due to the relatively small data sample (*see next chapter for more details*). In other words, the data sample is not large enough to get all portfolios diversified, and the results of one portfolio group are not even available. However, due to the importance of I/A-ratio controlling and the non-linear relationship of expected stock return and both expected profitability and I/A-ratio, the portfolio test is the best available methodology to use when testing the third hypothesis (Jiang et al., 2018). Therefore, this thesis uses the above-mentioned methodology except that the sorting is done conditionally in order to confirm portfolios' diversification.

Generally, firm-level measures of financial constraints are used as the proxies for the magnitude of investment frictions firms face in the academic literature (e.g., Li & Zhang, 2010). These proxies are linked to restricted access to external financing and/or higher financial costs (e.g., Almeida, Campello & Weisbach, 2004; Jiang et al., 2018) The one used proxy is the payout ratio that is commonly used in academic literature to describe financial constraints. The interpretation of payout ratio is that more constrained firms should have lower payout ratios (e.g., Almeida & Campello, 2007; Fazzari, Hubbards & Peterson, 1988). The other proxy is asset size which is interpreted to be lower for more constrained firms (e.g., Li & Zhang, 2010, Almeida & Campello, 2007; Gilchrist & Himmelberg, 1995). More detailed definitions of these two proxies can be seen below in Table 3.

Table 3. Investment friction proxies

Variable	**Definition**	**Notes**
Payout ratio$_{t-1}$	Dividend per share at year t-1 divided by EBITDA per share at year t-1 . EBITDA defined as Earning before interest, taxes, depreciation, and amortization.	Firms with negative EBITDA are treated as in the paper of Li & Zhang (2010). Firms with negative EBITDA and no dividends are assigned to the lowest payout ratio group. Firms with negative EBITDA and positive dividends are assigned to the highest payout ratio group.
Asset size$_{t-1}$	Total assets in the end of year t -1	
I/A-ratio$_{t-1}$	Total assets in the end of year t -1 divided by Total assets in the end of year t -2 minus one	

5 Data

This thesis will use S&P 500 companies as the data sample when testing the hypotheses mentioned above. The testing is done by utilizing the regression of different portfolios' returns, as mentioned in more detail in the previous chapter. The data sample comprises companies belonging to the S&P 500 index at a specific year. In other words, the composition of the S&P 500 index is refreshed yearly. Regressed returns are from January 1990 to December 2020. Data used to construct the portfolios is from December 1988 to December 2020. Moreover, there are excluded financial firms from the sample, which is standard practice in the major studies of profitability premium (e.g., Novy-Marx, 2013; Ball et al., 2015, 2016). Data for the regression, i.e., factor and risk-free rate data, are from the Kenneth French library. All data used in the thesis is as dollars.

The main reason for choosing S&P 500 companies as the data sample is based on the lack of research done from the perspectives of this thesis in US. stock market. However, this data sample its benefits and challenges. For example, the liquidity risk is controlled when the study is executed with the largest publicly listed firms, which emphasizes the economic significance of the study. On the other hand, the data sample comprises only 500 companies per year, which is a relatively small sample. Over the total data period, there have been 1 243 different companies in the S&P 500 index. There also exist critical missing values in data, which reduces the data sample even more per year, which is discussed more when reviewing summary statistics in the next chapter.

In addition to the challenges of the data sample mentioned above, some mispricing and investment friction proxies are not maybe the best for S&P 500 companies because of the homogeneity of firms. For example, the existence of credit rating is not used because all or at least almost all S&P 500 companies have had it. Overall, these challenges have been taken into consideration when analyzing the results in the empirical part.

5.1 Data description

Summary statistics of the full-sample monthly returns are represented in Table 4, where the statistics have been shown for the full period and each year separately. The full-sample portfolio is defined as firms belonging to the S&P 500 index as a given year where financial firms are excluded. The full-sample portfolio is value-weighted, and it is rebalanced yearly.

Table 4. Descriptive statistics of the full-sample monthly excess returns

This table reports the descriptive statistics of the monthly excess returns of the full-sample portfolio. The monthly excess returns of the full-sample portfolio are value-weighted. The full-sample portfolio comprises firms belonging to the S&P 500 index as a given year where financial companies are excluded. The table reports the average number of companies in the full-sample portfolio, mean, standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum. All statistics are reported for the full period and each year separately. The data period is from Jan 1

Period	Average number of Companies	Mean	Std	Min	P25	Median	P75	Max
Full period	**418**	**0.0111**	**0.0411**	**-0.1457**	**-0.0133**	**0.0133**	**0.0350**	**0.1409**
1990	411	-0.005	0.051	-0.094	-0.032	-0.002	0.023	0.090
1991	413	0.019	0.044	-0.048	-0.008	0.019	0.042	0.109
1992	415	0.003	0.021	-0.027	-0.019	0.006	0.013	0.041
1993	415	0.007	0.018	-0.018	-0.008	0.008	0.020	0.036
1994	412	0.000	0.030	-0.046	-0.025	0.010	0.027	0.039
1995	405	0.023	0.014	-0.011	0.020	0.027	0.032	0.038
1996	404	0.015	0.031	-0.047	0.004	0.018	0.023	0.069
1997	400	0.023	0.045	-0.056	-0.008	0.045	0.061	0.075
1998	401	0.028	0.058	-0.121	0.007	0.048	0.068	0.079
1999	405	0.028	0.044	-0.036	-0.018	0.044	0.057	0.100
2000	404	0.005	0.050	-0.062	-0.027	-0.011	0.045	0.097
2001	406	-0.001	0.060	-0.075	-0.061	-0.002	0.045	0.094
2002	404	-0.013	0.060	-0.100	-0.061	-0.011	0.012	0.100
2003	405	0.023	0.031	-0.026	0.006	0.019	0.051	0.074
2004	409	0.009	0.020	-0.031	-0.004	0.015	0.021	0.037
2005	410	0.004	0.026	-0.027	-0.016	-0.002	0.032	0.045
2006	409	0.010	0.018	-0.030	0.002	0.009	0.023	0.036
2007	411	0.008	0.026	-0.035	-0.016	0.012	0.030	0.042
2008	421	-0.026	0.057	-0.146	-0.066	-0.013	0.019	0.052
2009	429	0.027	0.056	-0.088	0.004	0.034	0.070	0.103
2010	429	0.015	0.055	-0.077	-0.038	0.025	0.058	0.097
2011	429	0.008	0.043	-0.057	-0.012	0.005	0.028	0.110
2012	429	0.013	0.029	-0.052	0.001	0.020	0.032	0.046
2013	430	0.024	0.024	-0.025	0.014	0.026	0.040	0.053
2014	433	0.012	0.023	-0.029	-0.008	0.016	0.027	0.047
2015	433	0.005	0.039	-0.058	-0.017	-0.005	0.016	0.092
2016	436	0.010	0.027	-0.035	-0.002	0.007	0.019	0.068
2017	435	0.018	0.012	-0.004	0.009	0.019	0.026	0.037
2018	438	0.000	0.045	-0.087	-0.028	0.010	0.032	0.063
2019	438	0.024	0.036	-0.062	0.016	0.027	0.034	0.082
2020	438	0.026	0.074	-0.099	-0.026	0.033	0.073	0.141

The average full-sample monthly excess return is 1,1%, and the average standard deviation is 4,1%. The kurtosis of full-sample excess return is 3,807, which means that the distribution of the full-sample returns is close to being normally distributed, i.e., it is only slightly peaked. On the other hand, the skewness of the full-sample excess return is -0,286, which means that the distribution of the full-sample return is slightly left-hand tailed.

Table 5 below reports the descriptive statistics of the variables used in the portfolio construction. The detailed definitions and formats of these variables are presented in Tables 1, 2, and 3.

Table 5. Descriptive statistics of the variables used in the portfolio construction

This table reports the average number of observations in year, mean, standard deviation, and the time-series averages of percentiles for the firms' variables that are used in the portfolio construction. Detailed definitions of these variables are presented in the methodology chapter. The data sample comprises companies belonging to the S&P 500 index as a given year, where financial companies are excluded. The data period for these variables is from Jan 1 1989 to Dec 31 2020. The composition of the S&P 500 index is refreshed yearly.

	Average			Percentiles				
Variables	**Number of Obs.**	**Mean**	**Std**	**1st**	**25th**	**50th**	**75th**	**99th**
Cash-based operating profitability	409	0.193	0.115	-0.012	0.121	0.174	0.247	0.552
Gross profitability	410	0.375	0.228	0.069	0.208	0.327	0.490	1.097
Illiquidity	434	0.0028	0.0389	0.00004	0.0003	0.0007	0.0016	0.0341
Dollar volume	434	151.3	405.9	16.2	47.3	79.2	153.9	1 138.8
Closing stock price	420	136.2	3 629.3	5.4	22.7	37.7	59.2	377.0
Turnover	419	0.009	0.010	0.002	0.005	0.007	0.010	0.039
I/A ratio	419	0.109	0.369	-0.285	-0.006	0.054	0.139	1.274
Payout ratio	414	0.160	0.651	0.000	0.031	0.117	0.204	0.721
Asset size	420	20.68	43.49	1.12	4.29	9.21	21.70	178.85

The average cash-based operating profitability is 19,3%, and the average gross profitability is 37,5% in the data sample. It is good to notice that gross profitability has a higher standard deviation (*22,8%*) than cash-based operating profitability (*11,5%*). Overall, these two proxies for expected profitability are highly different, which is discussed more later.

Table 5 also shows how different mispricing and investment friction proxies variate among S&P 500 companies. Generally, it seems that the distributions of these variables are quite heavily right-hand tailed. The values of the 99th percentile are considerably high compared to the 1st percentile. Therefore, the standard deviations of the presented variables are also relatively large, especially for some variables. For example, the closing stock price has a significantly high standard deviation due to the few stocks with extremely large nominal stock prices.

One of the main challenges of this thesis is the small average of the number of observations. The small average number of observations is partly due to critical missing values in the data sample. I.e., even though excluding financial companies from the data sample negatively affects it, it is not solely the reason why the average number of observations is 70-80 less than five hundred. For some reason, it seems that investment friction proxies generally have a few more missing values in the data sample compared to the mispricing proxies. Small data sample negatively affects the diversification of test portfolios, which is a significant challenge for the thesis's methodology. For example, the third hypothesis is exceptionally challenging to execute with independently sorted portfolios when portfolios are triple-sorted. Thus, the thesis has used conditional sorts when testing the third hypothesis. Overall, this challenge is essential to take into account when analyzing the results.

6 Empirical results

This chapter reports the empirical results of hypotheses testing (*see Chapter 4*). Each hypothesis testing is divided into subsections where are first presented results and then discussed the presented results from the perspective of existing literature regarding profitability premium. First, this thesis will examine the existence of profitability premium in the data sample.

6.1 The magnitude of the profitability premium

As mentioned in Chapter 4.1, the magnitude of the profitability premium in the data sample is analyzed by examining the results of Fama and French (1993) three-factor regression of portfolios sorted on profitability. The results of sorted and regressed portfolios are available in Table 6, where sorts are done on deciles in Panel A, on quintiles in Panel B, and on tertiles in Panel C. In all Panels, sorts are done by utilizing both profitability measures, cash-based operating profitability and gross profitability.

The effect of profitability on the stock returns can easily be seen when examining the differences in portfolios' returns. The excess returns are generally increasing when profitability is increasing. The average monthly return of the portfolios with the highest profitability is 1,27%, which is higher than the full-sample return of 1,11%. However, the average monthly return of the lowest profitability portfolios is 0,79%, which is substantially lower than the full-sample return. The profitability premium is interpreted as the return of the maximum profitability portfolio minus the return of the minimum profitability portfolio. The profitability premium is statistically significant at a 1% confidence level in all sorts except the decile sort done on gross profitability in Panel A, where the profitability premium is statistically significant at a 5% confidence level.

Table 6. Average monthly excess returns of sorted portfolios on the profitability

This table reports the monthly average excess returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) of the profitability portfolios from the regression on Fama and French (1993) three-factor model from Jan 1990 to Dec 2020. Profitability portfolios are constructed by sorting on a firm's one-year-lagged annual cash-based operating profitability and gross profitability. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. Min refers to firms with the lowest profitability and max to firms with the highest profitability. "Max-Min"-portfolio is the difference between max and min portfolio groups, i.e., profitability premium. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model. Sorting is done on deciles in Panel A, on quintiles in Panel B, and on tertiles in Panel C.

Panel A: Deciles

	Cash-based operating profitability					*Gross profitability*				
	Ret	*α*	*β mkt*	*β smb*	*β hml*	*Ret*	*α*	*β mkt*	*β smb*	*β hml*
Min	**0.695**	**-0.099**	**1.101**	**0.012**	**0.131**	**0.839**	**0.080**	**1.034**	**0.018**	**0.362**
	[2.51]	*[-0.83]*	*[39.37]*	*[0.31]*	*[3.3]*	*[3.14]*	*[0.64]*	*[35.43]*	*[0.43]*	*[8.75]*
2	**0.847**	**0.208**	**0.894**	**-0.061**	**0.194**	**0.763**	**0.111**	**0.943**	**-0.190**	**0.083**
	[3.65]	*[1.76]*	*[32.56]*	*[-1.58]*	*[4.97]*	*[3.17]*	*[0.90]*	*[33.16]*	*[-4.71]*	*[2.07]*
3	**1.073**	**0.427**	**0.929**	**-0.186**	**0.155**	**0.756**	**0.121**	**0.904**	**-0.155**	**0.216**
	[4.67]	*[4.08]*	*[38.2]*	*[-5.41]*	*[4.50]*	*[3.28]*	*[1.05]*	*[33.97]*	*[-4.12]*	*[5.71]*
4	**0.782**	**0.137**	**0.918**	**-0.118**	**0.127**	**0.778**	**0.102**	**0.950**	**-0.100**	**0.239**
	[3.42]	*[1.30]*	*[37.7]*	*[-3.43]*	*[3.68]*	*[3.20]*	*[0.85]*	*[34.29]*	*[-2.54]*	*[6.08]*
5	**0.831**	**0.215**	**0.891**	**-0.199**	**0.136**	**0.895**	**0.208**	**0.957**	**0.015**	**0.031**
	[3.73]	*[2.02]*	*[36.1]*	*[-5.70]*	*[3.88]*	*[3.68]*	*[1.90]*	*[37.55]*	*[0.41]*	*[0.87]*
6	**0.85**	**0.221**	**0.900**	**-0.136**	**0.080**	**1.097**	**0.431**	**0.952**	**-0.047**	**-0.168**
	[3.73]	*[1.99]*	*[34.82]*	*[-3.73]*	*[2.19]*	*[4.29]*	*[3.21]*	*[30.57]*	*[-1.07]*	*[-3.80]*
7	**1.025**	**0.353**	**0.955**	**-0.047**	**-0.088**	**1.092**	**0.433**	**0.965**	**-0.169**	**-0.171**
	[4.25]	*[3.33]*	*[38.74]*	*[-1.34]*	*[-2.50]*	*[4.45]*	*[3.81]*	*[36.47]*	*[-4.51]*	*[-4.55]*
8	**1.127**	**0.511**	**0.904**	**-0.172**	**-0.134**	**0.998**	**0.384**	**0.902**	**-0.139**	**-0.243**
	[4.81]	*[4.33]*	*[32.98]*	*[-4.43]*	*[-3.45]*	*[4.32]*	*[3.74]*	*[37.8]*	*[-4.13]*	*[-7.18]*
9	**1.218**	**0.585**	**0.934**	**-0.225**	**-0.085**	**1.348**	**0.792**	**0.847**	**-0.300**	**-0.196**
	[5.31]	*[5.94]*	*[40.82]*	*[-6.96]*	*[-2.61]*	*[5.91]*	*[6.24]*	*[28.72]*	*[-7.19]*	*[-4.69]*
Max	**1.258**	**0.649**	**0.912**	**-0.194**	**-0.368**	**1.308**	**0.707**	**0.870**	**-0.083**	**-0.209**
	[5.19]	*[5.66]*	*[34.21]*	*[-5.15]*	*[-9.71]*	*[5.55]*	*[5.64]*	*[29.86]*	*[-2.03]*	*[-5.05]*
Max - Min	**0.563**	**0.749**	**-0.188**	**-0.206**	**-0.499**	**0.469**	**0.627**	**-0.164**	**-0.101**	**-0.571**
	[2.87]	*[4.23]*	*[-4.58]*	*[-3.54]*	*[-8.53]*	*[2.36]*	*[3.51]*	*[-3.95]*	*[-1.72]*	*[-9.69]*

Panel B: Quintiles

	Cash-based operating profitability					*Gross profitability*				
	Ret	*α*	*β mkt*	*β smb*	*β hml*	*Ret*	*α*	*β mkt*	*β smb*	*β hml*
Min	**0.786**	**0.070**	**0.997**	**-0.018**	**0.127**	**0.787**	**0.079**	**1.001**	**-0.126**	**0.205**
	[3.23]	*[0.75]*	*[46.01]*	*[-0.60]*	*[4.14]*	*[3.23]*	*[0.79]*	*[43.22]*	*[-3.84]*	*[6.23]*
2	**0.942**	**0.297**	**0.926**	**-0.174**	**0.126**	**0.760**	**0.109**	**0.921**	**-0.136**	**0.239**
	[4.25]	*[3.46]*	*[46.35]*	*[-6.15]*	*[4.45]*	*[3.36]*	*[1.13]*	*[41.18]*	*[-4.29]*	*[7.53]*
3	**0.867**	**0.250**	**0.887**	**-0.169**	**0.111**	**1.039**	**0.364**	**0.956**	**-0.023**	**-0.102**
	[4.05]	*[2.88]*	*[43.97]*	*[-5.94]*	*[3.89]*	*[4.29]*	*[3.47]*	*[39.22]*	*[-0.67]*	*[-2.96]*
4	**1.103**	**0.463**	**0.930**	**-0.137**	**-0.134**	**1.059**	**0.423**	**0.937**	**-0.175**	**-0.213**
	[4.86]	*[5.34]*	*[46.13]*	*[-4.80]*	*[-4.67]*	*[4.64]*	*[5.14]*	*[48.93]*	*[-6.46]*	*[-7.84]*
Max	**1.249**	**0.633**	**0.917**	**-0.204**	**-0.256**	**1.351**	**0.781**	**0.853**	**-0.225**	**-0.213**
	[5.55]	*[7.70]*	*[47.97]*	*[-7.57]*	*[-9.43]*	*[6.16]*	*[7.46]*	*[35.02]*	*[-6.54]*	*[-6.15]*
Max - Min	**0.463**	**0.563**	**-0.080**	**-0.186**	**-0.383**	**0.564**	**0.702**	**-0.148**	**-0.099**	**-0.418**
	[3.09]	*[4.10]*	*[-2.50]*	*[-4.12]*	*[-8.44]*	*[3.35]*	*[4.53]*	*[-4.10]*	*[-1.95]*	*[-8.17]*

Panel C: Tertiles

	Cash-based operating profitability					*Gross profitability*				
	Ret	*α*	*β mkt*	*β smb*	*β hml*	*Ret*	*α*	*β mkt*	*β smb*	*β hml*
Min	**0.886**	**0.196**	**0.982**	**-0.127**	**0.127**	**0.760**	**0.076**	**0.969**	**-0.139**	**0.220**
	[3.84]	*[2.60]*	*[56.01]*	*[-5.13]*	*[5.11]*	*[3.29]*	*[0.91]*	*[49.81]*	*[-5.07]*	*[7.96]*
2	**0.902**	**0.273**	**0.897**	**-0.117**	**0.065**	**1.063**	**0.398**	**0.955**	**-0.108**	**-0.062**
	[4.28]	*[3.99]*	*[56.36]*	*[-5.20]*	*[2.88]*	*[4.63]*	*[4.81]*	*[49.52]*	*[-3.96]*	*[-2.28]*
Max	**1.216**	**0.591**	**0.926**	**-0.195**	**-0.233**	**1.217**	**0.622**	**0.885**	**-0.193**	**-0.242**
	[5.5]	*[8.87]*	*[59.75]*	*[-8.92]*	*[-10.61]*	*[5.68]*	*[8.73]*	*[53.44]*	*[-8.22]*	*[-10.29]*
Max - Min	**0.329**	**0.395**	**-0.056**	**-0.068**	**-0.361**	**0.457**	**0.546**	**-0.084**	**-0.053**	**-0.462**
	[2.72]	*[3.62]*	*[-2.21]*	*[-1.90]*	*[-10.01]*	*[3.19]*	*[4.34]*	*[-2.86]*	*[-1.29]*	*[-11.13]*

In addition to excess returns, abnormal returns are also increasing with profitability. The abnormal monthly returns of minimum profitability portfolios are relatively low or even negative and statistically insignificant except for the tertile sorted portfolio on cash-based operating profitability, which has 0,2% monthly abnormal returns significant at a 1 % confidence level. However, the maximum profitability portfolios have substantially higher abnormal returns among all sorts. The abnormal return of these maximum profitability portfolios is approximately 0,66%, which is higher compared to the abnormal return of the full-sample portfolio, 0,46%. Moreover, the abnormal returns of maximum profitability portfolios are statistically significant at a 1% confidence level. Consequently, the zero-hedge portfolio (*i.e., profitability premium*) have also high abnormal returns approx. 0,60% statistically significant at a 1% confidence level.

In addition to abnormal and excess returns, Table 6 also reports the factor loadings of sorted portfolios. It can be seen that the value betas decline when the profitability increases. Thus, the zero-hedge portfolios have highly negative value betas of which have high statistical significance. All zero-hedge portfolios also have negative size beta, which is probably driven by the minimum profitability portfolios' size betas. For example, the minimum profitability portfolios in Panel A have positive factor loadings on the size factor, which is interesting considering the used data sample (*see Chapter 5*).

Even though it is not the main research area of this thesis, the thesis briefly analyzes the differences in different sorts. Profitability premium is relatively stronger, measured by excess returns, in the decile and quintile sorts than in the tertile sort. Surprisingly, the zero-hedge quintile and tertile portfolios sorted on gross profitability outperform the zero-hedge portfolios sorted on cash-based operating profitability. It is also good to notice from Table 6 that the magnitude of profitability premium is weaker among tertile-sorted portfolios when measured by absolute excess returns. However, the statistical significance of profitability premium still remains highly significant among these tertile-sorted portfolios.

Furthermore, the effect of profitability on the stock returns is illustrated in Figure 3. This Figure shows the cumulative returns of maximum and minimum decile profitability portfolios compared to the cumulative return of the full-sample portfolio. These returns are presented as a log scale, which shows the percentage changes in the performance of portfolios.

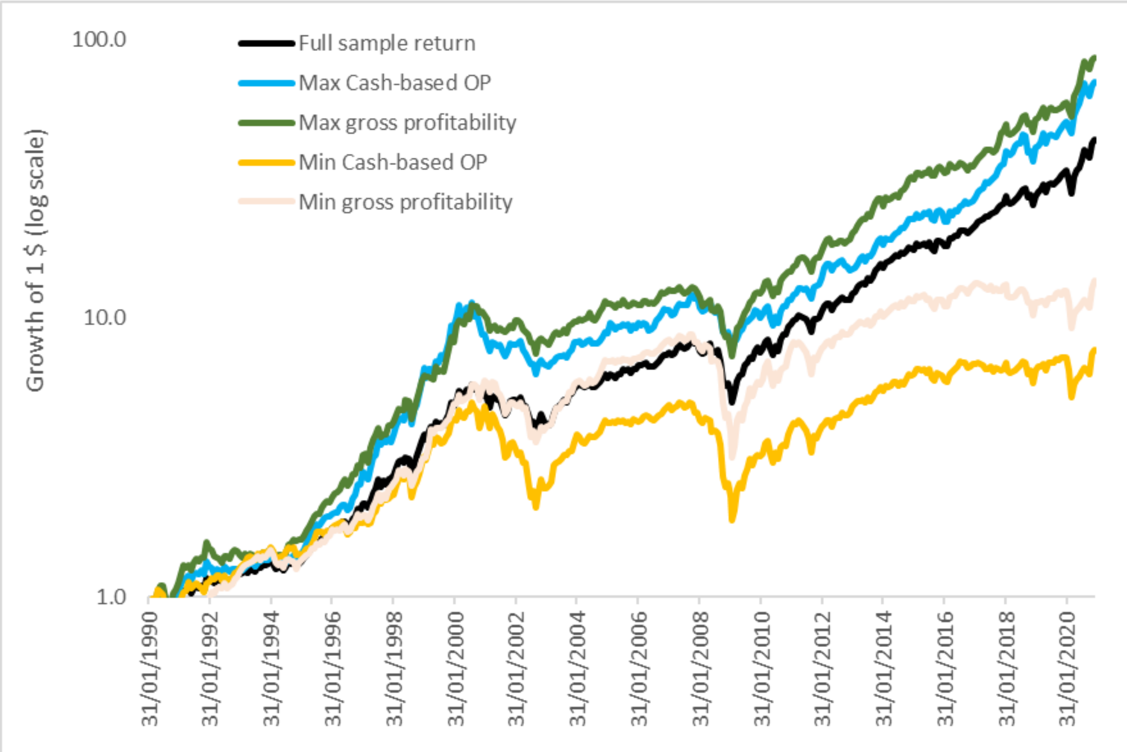

Figure 3. Cumulative returns of max and min decile profitability portfolios

Figure 3 reveals the considerable differences in the cumulative returns of maximum and minimum profitability portfolios. Both maximum profitability portfolios, sorted either on cash-based operating profitability or gross profitability, have outperformed the full-sample portfolio during the sample period. However, the above-mentioned difference in cumulative returns is relatively smaller than the difference between minimum profitability and the full-sample portfolio. In other words, both minimum profitability portfolios have performed poorly during the sample period compared to the full-sample portfolio. Particularly, the decile profitability portfolio sorted on cash-based operating profitability has underperformed compared to the other portfolios.

Figure 3 also shows that minimum portfolios have suffered relatively more during challenging economic times (*i.e., during the dot-com bubble and 2008 financial crisis*) compared to full-sample or maximum profitability portfolios. In fact, the cumulative returns of these minimum profitability portfolios have been extremely low past 20 years compared to the cumulative return of the full-sample portfolio. The observation mentioned above indicates that the profitability premium could perform well during difficult economic times. The interpretation of Figure 4 supports the argument mentioned above when it presents the cumulative returns of zero-hedge portfolios, constructed by decile sorts on cash-based operating profitability or gross profitability.

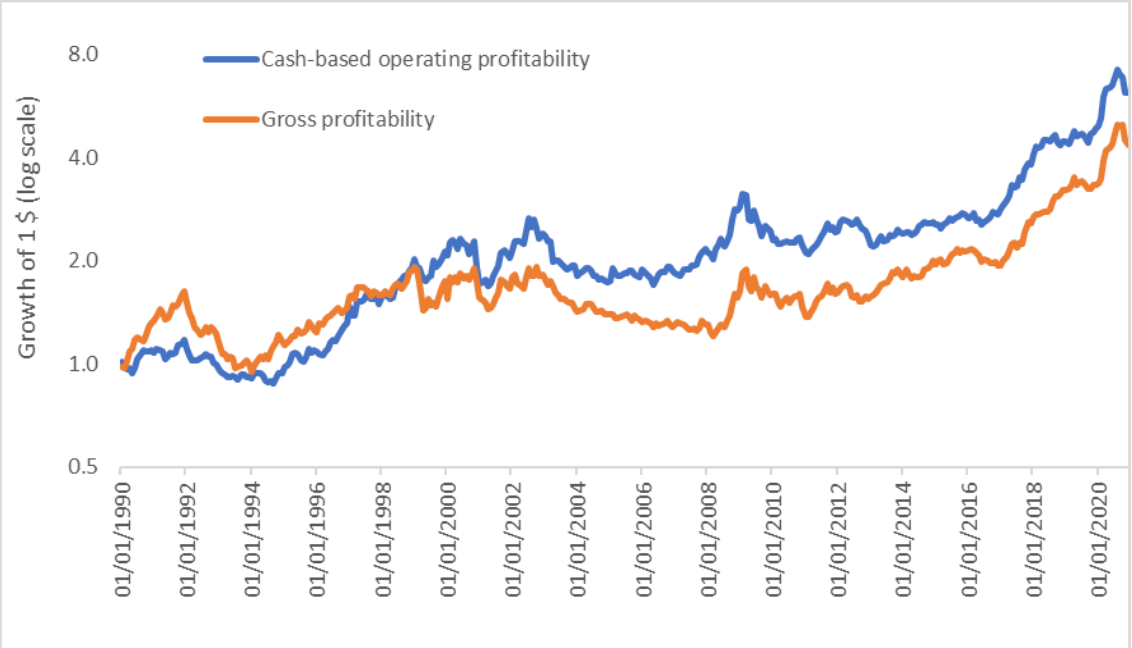

Figure 4. Cumulative return of profitability premium

It can be seen that the cash-based operating profitability zero-hedge portfolio has out-performed the zero-hedge portfolio constructed on gross profitability, which is driven by the short-leg of cash-based operating profitability premium. Overall, there are no significant differences in these two portfolios, and their performances are basically identical except the poor performance of gross profitability premium in 1999. Both zero-hedge portfolios have had a negative performance during the dot-com bubble, but relatively speaking, the performance has been well compared to the portfolios presented in Figure 3. Moreover, the performance in the 2008 financial crisis has been even better. In other words, there have not been any crashes in the cumulative returns, according to Figure 4.

6.1.1 Discussion

The results presented in the chapter above confirm that the profitability premium exists in the data sample. The premium is statistically significant using either cash-based operating or gross profitability as the proxy for the expected profitability. Moreover, it retains its significance in all sorts tested, i.e., decile, quintile, and tertile profitability sorts. Furthermore, the robustness of the profitability premium is even more confirmed in Appendix 1, where the premium retains its high statistical significance when Fama and French (1993) 3-factor model plus momentum factor is used as the regression model. This test has been done in order to confirm that the profitability premium is not driven by the momentum factor, which has also been shown by previous literature (e.g., Novy-Marx, 2013; Akbas et al., 2017). Overall, the existence of the premium was expected, and thus, the results are consistent with the previous academic research. Profitability premium (measured by gross profitability or cash-based operating profitability) is highly significant in the US. stock market (e.g., Novy-Marx, 2013; Ball et al., 2016). Hence, $\boldsymbol{H_{0,1}}$ is accepted and $\boldsymbol{H_0}$ null hypothesis is rejected.

The results presented in Table 6 indicate that the profitability effect in the data sample is more likely driven by the short-leg of the strategy, which is consistent with the findings of Stambaugh et al. (2012). The difference between the returns of minimum profitability and full-sample portfolios is substantially higher than the difference between the returns of maximum profitability portfolios and full-sample portfolios. Figure 3 supports the argument presented when the results regarding the cumulative returns of maximum and minimum profitability portfolios are consistent with the finding mentioned above. This result also indicates that the premium could be more likely due to overpricing than underpricing. Overall, this finding is consistent with the many studies done from the perspective of mispricing (e.g., Wang & Yu, 2013; Stambaugh et al., 2012; Lam et al., 2015; Akbas et al., 2017; Bouchaud et al., 2019).

Factor loadings presented in Table 6 confirm the previous results of academic literature regarding profitability premium representing “the good growth”, because the profitability premium has a negative correlation (*i.e., negative factor loadings on the value factor*) with the value factor (e.g., Novy-Marx, 2013). Moreover, the thesis has found that profitability zero-hedge portfolios have negative size betas, which is consistent with the previous findings that the most profitable firms are the largest firms, and that there exists a negative relationship between profitability and size factors (e.g., Sloan & Erhard, 2019; Jiang et al., 2018).

Even though this thesis uses two profitability proxies, it does not focus on comparing the performance of these two proxies. It is not the research are of this thesis, and the methodology used in the thesis is not suitable for it. As previous research has shown, portfolios tests are not the best methodology to compare the superiority of different proxies (e.g., Fama & French, 2018). However, it is good to understand that these two proxies do not necessarily measure the same profitability. Even though gross profitability is argued to be the cleanest profitability proxy, it can be challenged to be a too pure proxy for the true profitability (e.g., Novy-Marx, 2013; Ball et al., 2015, 2016). When the most recent academic research has indicated the superiority of cash-based operating profitability, this thesis also emphasizes its result more.

As already mentioned, Figures 3 and 4 indicate that profitability premium would perform relatively well during difficult economic times. However, there is a lack of studies that would have examined this phenomenon. Even though the graphs presented in this study are not sufficient evidence to prove the argument, they give a noteworthy direction to future research to study the phenomenon in more detail.

6.2 Profitability and mispricing

Next, this thesis studies the second hypothesis, i.e., is the profitability premium stronger among firms with higher limits to arbitrage. As mentioned in Chapter 4.1, the second hypothesis is tested by constructing zero-hedge portfolios based on the profitability of firms with either low mispricing or high mispricing proxies. Returns of these portfolios are regressed on the Fama and French 3-factor model. The results of these portfolios can be seen below in Table 7.

Table 7. Average monthly returns of double-sorted mispricing portfolios

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the long-short profitability spread tertile portfolios (independently) double-sorted on the profitability and mispricing proxies from the regression on Fama and French (1993) three-factor model from Jan 1990 to Dec 2020. There are used cash-based operating profitability in Panel A and gross profitability in Panel B as the proxy for the expected profitability. Mispricing proxies are Amihud's (2002) Illiquidity, dollar volume, turnover, and nominal share price. Definitions of these variables are described in Data and Methodology Chapter. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model.

Panel A: Cash-based operating profitability

Mispricing	Proxies	*Ret*	*α*	*B mkt*	*B smb*	*B hml*
Low	*ILLIQ*	**0.323**	**0.373**	**-0.048**	**-0.020**	**-0.285**
		[2.49]	*[3.02]*	*[-1.66]*	*[-0.50]*	*[-6.99]*
High		**0.200**	**0.304**	**-0.123**	**-0.012**	**-0.314**
		[1.35]	*[2.18]*	*[-3.78]*	*[-0.25]*	*[-6.82]*
Low	*RMB*	**0.300**	**0.406**	**-0.119**	**-0.045**	**-0.313**
		[2.15]	*[3.10]*	*[-3.91]*	*[-1.05]*	*[-7.25]*
High		**0.182**	**0.200**	**-0.014**	**-0.035**	**-0.059**
		[1.61]	*[1.75]*	*[-0.54]*	*[-0.93]*	*[-1.56]*
Low	*Turnover*	**0.956**	**1.115**	**-0.117**	**-0.247**	**-0.902**
		[3.52]	*[4.74]*	*[-2.14]*	*[-3.2]*	*[-11.62]*
High		**0.048**	**0.108**	**-0.073**	**-0.076**	**0.051**
		[0.34]	*[0.77]*	*[-2.23]*	*[-1.640]*	*[1.08]*
Low	*Share price*	**0.174**	**0.329**	**-0.206**	**0.018**	**-0.216**
		[1.21]	*[2.43]*	*[-6.54]*	*[0.40]*	*[-4.83]*
High		**0.490**	**0.443**	**0.135**	**-0.173**	**-0.563**
		[2.03]	*[1.96]*	*[2.57]*	*[-2.33]*	*[-7.56]*

Panel B: Gross profitability

Mispricing	Proxies	*Ret*	*α*	*B mkt*	*B smb*	*B hml*
Low	*ILLIQ*	**0.464**	**0.563**	**-0.101**	**-0.042**	**-0.427**
		[3.13]	*[4.20]*	*[-3.26]*	*[-0.95]*	*[-9.67]*
High		**0.227**	**0.352**	**-0.148**	**-0.008**	**-0.388**
		[1.27]	*[2.09]*	*[-3.78]*	*[-0.15]*	*[-7.00]*
Low	*RMB*	**0.418**	**0.573**	**-0.172**	**-0.072**	**-0.491**
		[2.56]	*[4.01]*	*[-5.18]*	*[-1.54]*	*[-10.43]*
High		**0.283**	**0.236**	**0.067**	**0.026**	**-0.091**
		[2.06]	*[1.71]*	*[2.1]*	*[0.58]*	*[-2.00]*
Low	*Turnover*	**0.716**	**0.946**	**-0.205**	**-0.295**	**-0.928**
		[2.37]	*[3.55]*	*[-3.30]*	*[-3.37]*	*[-10.55]*
High		**0.356**	**0.421**	**-0.075**	**-0.053**	**-0.102**
		[2.55]	*[3.01]*	*[-2.29]*	*[-1.15]*	*[-2.2]*
Low	*Share price*	**0.277**	**0.411**	**-0.172**	**0.037**	**-0.345**
		[1.80]	*[2.88]*	*[-5.19]*	*[0.79]*	*[-7.33]*
High		**0.582**	**0.615**	**0.017**	**-0.158**	**-0.511**
		[2.67]	*[2.98]*	*[0.35]*	*[-2.32]*	*[-7.51]*

Above in Table 7, it can be seen that profitability premium, constructed either by means of cash-based operating profitability or gross profitability, has higher excess returns among all low mispricing groups except when the nominal share price is used as the proxy for the limits to arbitrage. Moreover, the excess returns among these low mispricing groups are also statistically significant at a 5% confidence level. Furthermore, when share price portfolios are excluded, the profitability premium is insignificant among high mispricing portfolios at a 5% confidence level when cash-based operating profitability is used as the proxy for the profitability.

In addition to excess returns, the abnormal returns of low mispricing portfolios are higher than those of high mispricing portfolios except for the share price portfolios. Moreover, the abnormal returns are significant at a 5% confidence level among all low mispricing portfolios, which is not the case for the high mispricing portfolios. For example, the abnormal returns of high mispricing portfolios are not significant at a 5% confidence level when RMB is used as the proxy for the probability of mispricing.

Table 8. Average monthly returns of high minus low mispricing portfolios

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the portfolios that represent the difference between high and low mispricing long-short profitability spread tertile portfolios (presented in Table 7). Portfolios are regressed on Fama and French (1993) three-factor model from Jan 1990 to Dec 2020. There are used cash-based operating profitability in Panel A and gross profitability in Panel B as the proxy for the expected profitability. Mispricing proxies are Amihud's (2002) Illiquidity, dollar volume, turnover, and nominal share price. Definitions of these variables are described in Data and Methodology Chapter. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model.

Panel A: Cash-based operating profitability

Mispricing	Proxies	*Ret*	*α*	*B mkt*	*B smb*	*B hml*
High - Low	***ILLIQ***	**-0.123**	**-0.069**	**-0.075**	**0.009**	**-0.029**
		[-0.72]	*[-0.40]*	*[-1.86]*	*[0.15]*	*[-0.51]*
High - Low	***RMB***	**-0.118**	**-0.206**	**0.104**	**0.010**	**0.254**
		[-0.68]	*[-1.20]*	*[2.62]*	*[0.19]*	*[4.49]*
High - Low	***Turnover***	**-0.908**	**-1.007**	**0.044**	**0.171**	**0.953**
		[-3.01]	*[-3.76]*	*[0.71]*	*[1.94]*	*[10.78]*
High - Low	***Share price***	**0.316**	**0.114**	**0.341**	**-0.191**	**-0.347**
		[1.21]	*[0.46]*	*[5.90]*	*[-2.34]*	*[-4.23]*

Panel B: Gross profitability

Mispricing	Proxies	*Ret*	*α*	*B mkt*	*B smb*	*B hml*
High - Low	***ILLIQ***	**-0.238**	**-0.211**	**-0.046**	**0.034**	**0.039**
		[-1.36]	*[-1.19]*	*[-1.12]*	*[0.57]*	*[0.66]*
High - Low	***RMB***	**-0.135**	**-0.337**	**0.239**	**0.099**	**0.400**
		[-0.69]	*[-1.88]*	*[5.72]*	*[1.67]*	*[6.74]*
High - Low	***Turnover***	**-0.361**	**-0.525**	**0.130**	**0.242**	**0.827**
		[-1.16]	*[-1.83]*	*[1.95]*	*[2.57]*	*[8.75]*
High - Low	***Share price***	**0.305**	**0.204**	**0.189**	**-0.195**	**-0.166**
		[1.34]	*[0.91]*	*[3.61]*	*[-2.63]*	*[-2.24]*

The average monthly returns of high minus low mispricing profitability spread portfolios are presented above in Table 8. According to $\boldsymbol{H_{1,1}}$, the excess and abnormal returns of these portfolios should be positive and statistically significant. However, as Table 7 already indicated, these excess and abnormal returns are not even positive. The excess and abnormal returns are only positive for share price portfolios, but both returns are statistically insignificant at a 5% confidence level.

6.2.1 Discussion

The evidence above argues that the profitability premium would not be due to mispricing. Hence, this thesis rejects $\boldsymbol{H_{1,1}}$ and accepts the null hypothesis. This result is inconsistent with the results of Wang and Yu (2013), Lam et al. (2015), Stambaugh et al. (2012), and Bouchaud et al. (2018). Particularly, the result is inconsistent with the study of Wang and Yu (2013), who have found opposite evidence from a similar test.

Overall, it is interesting that this thesis finds evidence regarding the short-leg of the strategy as the source of the premium, but not evidence regarding the positive relationship between limits to arbitrage and profitability premium. According to many previous studies, the first-mentioned finding has usually indicated that the premium is driven by irrational overpricing (e.g., Akbas et al., 2017; Lam et al., 2015). Thus, the profitability premium should be stronger among stocks with higher limits to arbitrage because overpricing is always more challenging to clear by arbitrageurs (e.g., Stambaugh et al., 2012). However, this thesis does not find evidence regarding this relationship. On the contrary, the profitability premium seems to be stronger among low mispricing stocks, i.e., stocks with low limits to arbitrage.

On the other hand, rejecting $\boldsymbol{H_{1,1}}$ and accepting the $\boldsymbol{H_1}$ null hypothesis is consistent with the studies of Sun et al. (2014) and Jiang et al. (2018). Neither of these studies have found a positive relationship between profitability premium and limits to arbitrage. Moreover, the result of this thesis is consistent with the arguments of Ball et al. (2015, 2016), who first found that profitability premium is highly persistent and secondly doubt that the mispricing could persist as long. Significantly, Ball et al.'s (2016) study is one of the few that have used cash-based operating profitability as the profitability proxy.

6.3 Profitability and investment frictions

Lastly, this thesis studies the third hypothesis concerning the effect of investment frictions on the magnitude of the profitability premium. According to Eq. (16), investment frictions should negatively affect the magnitude of the profitability premium if firms' I/A-ratio is positive. Therefore, examining the third hypothesis focuses on the firms with a positive I/A-ratio. Table 9 below shows the returns of long-short profitability spread portfolios, constructed by conditional triple-sorts, where the sample is the firms with the positive I/A-ratio. The sort on I/A-ratio is done in order to control the effect of I/A-ratio on the relationship between the investment frictions and the magnitude of the profitability premium.

Table 9. Returns of triple-sorted portfolios among firms with positive I/A-ratio

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the long-short profitability spread portfolios of the triple sorts. Portfolios are regressed on Fama & French 3-factor model from Jan 1990 to Dec 2020. In this table, the used sample is the firms with a positive I/A-ratio. Triple-sorts are done conditionally by classifying firms first into two I/A-ratio groups, then into three investment friction groups, and lastly into three profitability groups. The payout ratio and asset size are used as the proxies for investment frictions, which are defined in more detail in Chapter 4.1. In this table, there is only used cash-based operating profitability as the proxy for the expected profitability. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model. Panel B reports the results of low minus high investment friction portfolios.

Panel A: Cash-based operating profitability

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	Low	Payout-ratio	**0.391** [1.99]	**0.489** [2.57]	**-0.084** [-1.89]	**-0.158** [-2.52]	**-0.359** [-5.70]
Low	High		**0.149** [0.64]	**0.190** [0.83]	**-0.044** [-0.82]	**0.041** [0.54]	**-0.332** [-4.37]
High	Low		**0.466** [2.10]	**0.495** [2.28]	**0.041** [0.80]	**-0.371** [-5.20]	**-0.178** [-2.48]
High	High		**0.865** [3.08]	**0.882** [3.19]	**0.012** [0.19]	**-0.039** [-0.43]	**-0.452** [-4.96]
Low	Low	Asset size	**0.211** [1.16]	**0.342** [1.94]	**-0.138** [-3.38]	**-0.138** [-2.38]	**-0.296** [-5.09]
Low	High		**0.232** [1.18]	**0.337** [1.73]	**-0.137** [-3.02]	**0.030** [0.48]	**-0.231** [-3.60]
High	Low		**0.573** [2.73]	**0.604** [2.96]	**0.030** [0.64]	**-0.282** [-4.20]	**-0.330** [-4.89]
High	High		**0.684** [2.98]	**0.688** [3.11]	**0.040** [0.77]	**-0.085** [-1.17]	**-0.466** [-6.37]

Panel B: Gross profitability

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	Low	Payout-ratio	**0.459** [2.08]	**0.558** [2.57]	**-0.103** [-2.04]	**-0.061** [-0.86]	**-0.355** [-4.97]
Low	High		**0.283** [1.22]	**0.358** [1.54]	**-0.089** [-1.64]	**-0.021** 0.280]	**-0.191** [-2.48]
High	Low		**0.443** [2.07]	**0.483** [2.24]	**-0.025** [-0.5]	**-0.137** [-1.93]	**-0.079** [-1.10]
High	High		**1.069** [3.51]	**1.132** [3.77]	**-0.049** [-0.71]	**-0.047** [-0.47]	**-0.476** [-4.80]
Low	Low	Asset size	**0.236** [1.34]	**0.378** [2.26]	**-0.159** [-4.11]	**-0.081** [-1.47]	**-0.361** [-6.55]
Low	High		**0.386** [1.85]	**0.507** [2.44]	**-0.126** [-2.61]	**-0.182** [-2.67]	**-0.133** [-1.94]
High	Low		**0.493** [2.39]	**0.493** [2.45]	**0.063** [1.35]	**-0.220** [-3.33]	**-0.339** [-5.10]
High	High		**0.735** [2.91]	**0.802** [3.15]	**-0.062** [-1.05]	**-0.164** [-1.96]	**-0.015** [-0.18]

According to q-theory, the profitability premium should be stronger for the low investment friction portfolios than high investment friction portfolios among the same I/A-ratio group (e.g., Jiang et al., 2018). However, the results presented in Table 9 indicate that the theory does not hold. For example, when cash-based operating profitability is used as the proxy, there generally are no differences in high and low friction asset size portfolios. When the payout ratio is used as the proxy for the investment friction, the excess and abnormal returns of the low friction portfolio are higher than the high friction portfolio for the low I/A-ratio group, but the results are vice versa among the high I/A-ratio group.

In Panel A of Table 9, the profitability premium is statistically significant at a 5% confidence level among three low friction portfolios when the premium is only significant for two high friction portfolios, measured either by excess or abnormal returns. Interestingly, the profitability premium does not exist in the portfolio groups of low I/A-ratio when asset size is used as the proxy for the investment frictions. Another interesting finding is that the returns of high positive I/A-ratio portfolios are relatively higher than the returns of low positive I/A-ratio portfolios.

Overall, the results presented in Panel B of Table 9 are very similar to the results presented in Panel A. The premium is statistically significant at a 5% confidence level in three low friction portfolios, while it is only significant in two portfolios among high friction portfolios. However, high friction portfolios have higher excess or abnormal returns among three of four portfolio groups. Again, the profitability premium is not statistically significant at a 5% confidence level in the portfolios of low I/A-ratio and either high or low asset size.

In Table 10 below, this thesis has examined the relationship between stock returns and firms' profitability, investments, and investment frictions among firms with negative investments. In other words, there have been constructed triple-sorted investment friction portfolios (*identical to the portfolios presented in Table 9*) by utilizing the sample where firms have negative I/A-ratio. According to Eq. (16), the effect of investment friction on the profitability premium should be the opposite when firms have a negative I/A-ratio (e.g., Jiang et al., 2018).

Table 10. Returns of triple-sorted portfolios among firms with negative I/A-ratio

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the long-short profitability spread portfolios of the triple sorts. Portfolios are regressed on Fama & French 3-factor model from Jan 1990 to Dec 2020. In this table, the used sample is the firms with a negative I/A-ratio. Triple-sorts are done conditionally by classifying firms first into two I/A-ratio groups, then into three investment friction groups, and lastly into three profitability groups. The payout ratio and asset size are used as the proxies for investment frictions, which are defined in more detail in Chapter 4.1. In this table, there is only used cash-based operating profitability as the proxy for the expected profitability. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model. Panel B reports the results of low minus high investment friction portfolios.

Panel A: Cash-based operating profitability

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	Low	Payout-ratio	**0.209** [0.59]	**0.446** [1.29]	**-0.240** [-2.97]	**-0.306** [-2.69]	**-0.517** [-4.52]
Low	High		***0.280*** [0.58]	***0.385*** [0.79]	***-0.123*** [-1.09]	***0.051*** [0.32]	***-0.514*** [-3.20]
High	Low		**0.096** [0.34]	**0.248** [0.88]	**-0.143** [-2.19]	**-0.282** [-3.06]	**-0.252** [-2.72]
High	High		**0.105** [0.26]	**0.173** [0.43]	**-0.163** [-1.73]	**0.396** [2.97]	**-0.089** [-0.66]
Low	Low	Asset size	**-0.039** [-0.12]	**0.196** [0.59]	**-0.265** [-3.45]	**-0.295** [-2.71]	**-0.135** [-1.24]
Low	High		***0.110*** [0.28]	***0.256*** [0.67]	***-0.143*** [-1.61]	***-0.054*** [-0.43]	***-0.785*** [-6.23]
High	Low		**-0.224** [-0.80]	**-0.090** [-0.32]	**-0.149** [-2.29]	**-0.118** [-1.28]	**-0.249** [-2.70]
High	High		**0.701** [2.14]	**0.721** [2.18]	**-0.025** [-0.33]	**0.048** [0.44]	**-0.187** [-1.71]

In general, it can be seen that the profitability premium is not significant among firms with the negative I/A-ratio. Moreover, even the sign of excess and abnormal returns is negative for part of the portfolios. The only exception is high investment friction portfolio returns when asset size is used as the proxy for the investment frictions. Its excess and abnormal returns are statistically significant at a 5% significance level.

Table 11. Differences in high and low investment friction portfolios

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the portfolios that represent the difference between low and high investment friction portfolios (presented in Table 9 and 10). Portfolios are regressed on Fama & French 3-factor model from Jan 1990 to Dec 2020. In Panel A and B, the used sample is the firms with a positive I/A-ratio when firms with a negative I/A-ratio are used in Panel C. Initially, the portfolios are conditionally triple-sorted on two I/A-ratio groups, then into three investment friction groups, and lastly into three profitability groups. The payout ratio and asset size are used as the proxies for investment frictions, which are defined in more detail in Chapter 4.1. As the proxy for the expected profitability, cash-based operating profitability is used in Panel A and C, and gross profitability in Panel B . All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model.

Panel A: Cash-based operating profitability and positive I/A-ratio sample

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	Low - High	Payout-ratio	**0.242** [0.85]	**0.299** [1.04]	**-0.040** [-0.60]	**-0.199** [-2.11]	**-0.027** [-0.28]
High	Low - High		**-0.398** [-1.13]	**-0.387** [-1.11]	**0.028** [0.35]	**-0.332** [-2.90]	**0.274** [2.38]
Low	Low - High	Asset size	**-0.021** [-0.09]	**0.006** [0.02]	**-0.002** [-0.03]	**-0.168** [-2.20]	**-0.065** [-0.84]
High	Low - High		**-0.111** [-0.39]	**-0.084** [-0.30]	**-0.009** [-0.14]	**-0.197** [-2.10]	**0.136** [1.45]

Panel B: Gross profitability and positive I/A-ratio sample

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	Low - High	Payout-ratio	**0.177** [0.61]	**0.200** [0.68]	**-0.014** [-0.2]	**-0.040** [-0.42]	**-0.165** [-1.71]
High	Low - High		**-0.625** [-1.70]	**-0.649** [-1.76]	**0.024** [0.28]	**-0.091** [-0.75]	**0.398** [3.27]
Low	Low - High	Asset size	**-0.150** [-0.62]	**-0.129** [-0.53]	**-0.034** [-0.59]	**0.101** [1.26]	**-0.228** [-2.82]
High	Low - High		**-0.242** [-0.85]	**-0.309** [-1.09]	**0.126** [1.90]	**-0.056** [-0.60]	**-0.324** [-3.46]

Panel C: Cash-based operating profitability and negative I/A-ratio sample

I/A	FRIC	Proxies	Ret	α	B mkt	B smb	B hml
Low	High - Low	Payout-ratio	**0.071** [0.12]	**-0.060** [-0.10]	**0.117** [0.86]	**0.357** [1.86]	**0.004** [0.02]
High	High - Low		**0.009** [0.02]	**-0.075** [-0.15]	**-0.020** [-0.17]	**0.679** [4.11]	**0.163** [0.99]
Low	High - Low	Asset size	**0.149** [0.29]	**0.060** [0.12]	**0.122** [1.05]	**0.241** [1.47]	**-0.650** [-3.94]
High	High - Low		**0.925** [2.13]	**0.811** [1.85]	**0.124** [1.21]	**0.166** [1.15]	**0.061** [0.42]

Above in Table 11, this thesis has reported the statistical differences between high and low investment friction portfolios. Table 11 supports the results presented above. The high and low investment friction portfolios do not statistically differ at a 5% confidence level. The only exception is in the low I/A-ratio group in Panel C, where asset size is used as the proxy for frictions and the sample comprises firms with negative I/A-ratio. Next, this thesis analyses these results in more detail and reflects the results to the existing literature.

6.3.1 Discussion

In general, the results presented in the previous chapter are quite contradictory. The results show that the profitability premium is not significantly more substantial among firms with lower investment frictions when I/A-ratio is controlled, which supports rejecting $\boldsymbol{H_{2,1}}$. However, the results still partly indicate that there could exist a link between investment frictions and profitability premium. Moreover, this thesis has also constructed individually triple-sorted long-short profitability spread portfolios in Appendix 2, of which results are consistent with the argument stated in the previous sentence. In Appendix 2, profitability premium is stronger among all low investment friction portfolio groups when measured by the excess returns. Nonetheless, it is essential to notice that these portfolios are not necessarily diversified as well as the portfolios presented in Table 9. Therefore, this thesis strongly suggests future research to replicate this study with the larger data sample of the US. stocks in order to confirm the findings of this thesis.

However, according to the results presented in the previous chapter, this thesis rejects $\boldsymbol{H_{2,1}}$, and thus, accepts $\boldsymbol{H_2}$ null hypothesis. This result is inconsistent with the papers of Jiang et al. (2018 and Sun et al. (2014). These papers have found evidence regarding the role of investment frictions on the magnitude of the profitability premium. However, as Fama and French (2017) have stated, the results of Sun et al. (2014) leave room for disagreement. On the contrary, rejecting $\boldsymbol{H_{2,1}}$ is consistent with the finding of Yin and Yang (2022), who do not find a significant relationship between investment frictions and profitability premium in the Chinese stock market. However, any of the above-mentioned studies have not examined the effect of investment frictions on the profitability premium in the US. stock market. In other words, there still is a lack of studies examining the role of investment frictions, or even the risk-based explanations, in the profitability premium.

The results presented in Table 10 and in Panel C of Table 11 are quite similar to the results presented in the paper of Jiang et al. (2018). In general, the performance of the profitability premium is worse among firms with negative I/A-ratio, which is consistent with the results of Jiang et al. (2018). The poor performance of profitability premium among the negative investment firms is an interesting finding since I/A-ratio is considered to have a negative relationship with the stock returns (e.g., Titman et al., 2004). Thus, these results indicate that merging the investment factor into a profitability premium strategy could significantly weaken the strategy. The effect of investment frictions on the profitability premium is also consistent with the q-theory (*see Eq. 16*) when the premium is stronger in high friction portfolio groups among firms with negative I/A-ratio.

Lastly, this thesis wants to discuss the methodology used to test the third hypothesis. Testing the hypothesis is challenging due to the nature of q-theory regarding the effect of profitability on the stock returns. According to the q-theory, the investment frictions should only affect the magnitude of the premium, as demonstrated in Eq. (16). In other words, the premium could exist in all portfolio groups or firms because investment frictions are not the reason why the higher profitability is linked to the higher expected stock returns. As Lam et al. (2015) have argued, q-theory offers the theoretical link between expected profitability and the expected stock returns, but it does not take a stand on the risk that causes the systematic risk of firms with higher profitability.

7 Conclusion

The main purpose of this thesis is to offer a better understanding of the profitability premium. Academic research has found contradictory results regarding the source of the profitability premium, which have been introduced in Chapter 3. Inspired by these inconsistent results, this thesis has studied the profitability premium from both mispricing and rational theory-based perspectives in the US. stock market. To be more precise, the profitability premium has been studied from the perspective of both the limits to arbitrage and investment frictions.

First, this thesis has confirmed the existence of the profitability premium in the data sample. The profitability premium is statistically significant using either cash-based operating or gross profitability as the proxy for the expected profitability. Moreover, it retains its significance in all sorts tested, i.e., decile, quintile, and tertile profitability sorts. Furthermore, the results presented in Appendix 1 support the robustness of the profitability premium. Since the profitability portfolios are value-weighted, the data sample comprises the large US. companies and portfolios are only rebalanced yearly; it can be interpreted that the profitability premium also has high economic significance, in addition to the statistical significance (e.g., Novy-Marx & Velikov, 2016). In addition to the above-mentioned, the thesis has found an interesting finding that the profitability premium has performed relatively well during difficult economic times, driven by the extremely poor performance of minimum profitability portfolios. This thesis suggests that the performance of profitability premium during crises could be studied more by future academic research.

This thesis has also found indications that the return of profitability premium primarily is due to the short-leg of the strategy (*see Figure 3*), which is consistent with the many papers done from the perspective of mispricing as the source of the profitability premium (e.g., Stambaugh et al., 2012; Lam et al., 2015; Wang & Yu, 2013; Bouchaud et al., 2018). On the contrary, the thesis has not found evidence regarding mispricing as the source of the profitability premium. According to the results of this thesis, profitability premium even seems to be stronger among firms with low limits to arbitrage. Thus, this thesis argues that the profitability premium is not driven by mispricing.

Lastly, the thesis has studied if the investment frictions affect the magnitude of the profitability premium. According to q-theory and Equation 16, the investment frictions a firm faces should negatively affect the relationship between a firm's profitability and stock return. However, this thesis does not find strong evidence regarding the above-mentioned link. The returns of low friction portfolios are not generally higher than the returns of high friction portfolios when sorting has been done conditionally. On the other hand, there still are some indications that the investment frictions could affect the profitability premium (*see Appendix 2*). Therefore, this thesis encourages future research to examine the relationship between investment friction and profitability premium more with a larger data sample in the US. stock market.

Overall, this thesis fails to explain the existence of the profitability premium. Under the results of this thesis, the mispricing explanation does not hold. On the other hand, the evidence regarding the role of investment frictions on the profitability premium is also weak or even non-existent. Therefore, this thesis concludes that the profitability premium must be driven by the undiscovered risk. Thus, the thesis also suggests considering and examining the explanations presented in Chapter 3.3 as the potential sources of the premium.

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Appendices

Appendix 1 The regression of profitability portfolios on 4-factor model

This table reports the monthly average excess returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) of the profitability portfolios from the regression on Fama and French (1993) three-factor model plus momentum factor from Jan 1990 to Dec 2020. Profitability portfolios are constructed by sorting on a firm's one-year-lagged annual cash-based operating profitability and gross profitability. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. Min refers to firms with the lowest profitability and max to firms with the highest profitability. "Max-Min"-portfolio is the difference between max and min portfolio groups, i.e., profitability premium. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model. Sorting is done on deciles in Panel A, on quintiles in Panel B, and on tertiles in Panel C.

Panel A: Deciles

	Cash-based operating profitability						*Gross profitability*					
	Ret	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*	*Ret*	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*
Min	**0.70**	**-0.01**	**1.06**	**0.02**	**0.09**	**-0.11**	**0.84**	**0.12**	**1.01**	**0.02**	**0.34**	**-0.06**
	[2.51]	*[-0.12]*	*[36.96]*	*[0.41]*	*[2.14]*	*[-4.32]*	*[3.14]*	*[0.98]*	*[33.18]*	*[0.48]*	*[7.94]*	*[-2.11]*
2	**0.85**	**0.32**	**0.84**	**-0.06**	**0.13**	**-0.15**	**0.76**	**0.17**	**0.92**	**-0.19**	**0.05**	**-0.08**
	[3.65]	*[2.81]*	*[30.51]*	*[-1.53]*	*[3.46]*	*[-6.03]*	*[3.17]*	*[1.380]*	*[30.93]*	*[-4.7]*	*[1.26]*	*[-2.92]*
3	**1.07**	**0.45**	**0.92**	**-0.18**	**0.14**	**-0.03**	**0.76**	**0.16**	**0.89**	**-0.15**	**0.20**	**-0.05**
	[4.67]	*[4.27]*	*[35.93]*	*[-5.39]*	*[3.99]*	*[-1.40]*	*[3.28]*	*[1.36]*	*[31.81]*	*[-4.1]*	*[5.04]*	*[-1.89]*
4	**0.78**	**0.19**	**0.89**	**-0.12**	**0.10**	**-0.07**	**0.78**	**0.15**	**0.93**	**-0.10**	**0.21**	**-0.07**
	[3.42]	*[1.840]*	*[35.28]*	*[-3.41]*	*[2.76]*	*[-3.22]*	*[3.20]*	*[1.29]*	*[32.03]*	*[-2.51]*	*[5.23]*	*[-2.66]*
5	**0.83**	**0.25**	**0.87**	**-0.20**	**0.12**	**-0.05**	**0.90**	**0.26**	**0.93**	**0.02**	**0.00**	**-0.08**
	[3.73]	*[2.37]*	*[33.81]*	*[-5.69]*	*[3.2]*	*[-2.16]*	*[3.68]*	*[2.410]*	*[35.15]*	*[0.48]*	*[0.04]*	*[-3.11]*
6	**0.85**	**0.24**	**0.89**	**-0.14**	**0.07**	**-0.03**	**1.10**	**0.53**	**0.90**	**-0.04**	**-0.22**	**-0.14**
	[3.73]	*[2.16]*	*[32.76]*	*[-3.71]*	*[1.81]*	*[-1.16]*	*[4.29]*	*[4.06]*	*[28.41]*	*[-1]*	*[-5.03]*	*[-4.79]*
7	**1.03**	**0.45**	**0.91**	**-0.04**	**-0.14**	**-0.14**	**1.09**	**0.49**	**0.94**	**-0.17**	**-0.20**	**-0.08**
	[4.25]	*[4.42]*	*[36.65]*	*[-1.27]*	*[-4.090]*	*[-5.980]*	*[4.45]*	*[4.35]*	*[34.1]*	*[-4.51]*	*[-5.31]*	*[-3.26]*
8	**1.13**	**0.56**	**0.88**	**-0.17**	**-0.16**	**-0.07**	**1.00**	**0.38**	**0.90**	**-0.14**	**-0.24**	**0.01**
	[4.81]	*[4.77]*	*[30.77]*	*[-4.41]*	*[-4.07]*	*[-2.73]*	*[4.32]*	*[3.64]*	*[35.99]*	*[-4.14]*	*[-6.86]*	*[0.29]*
9	**1.22**	**0.58**	**0.93**	**-0.23**	**-0.08**	**0.00**	**1.35**	**0.70**	**0.89**	**-0.30**	**-0.15**	**0.12**
	[5.31]	*[5.86]*	*[38.77]*	*[-6.96]*	*[-2.52]*	*[0.03]*	*[5.91]*	*[5.6]*	*[29.32]*	*[-7.46]*	*[-3.51]*	*[4.34]*
Max	**1.26**	**0.53**	**0.97**	**-0.20**	**-0.31**	**0.16**	**1.31**	**0.61**	**0.92**	**-0.09**	**-0.16**	**0.13**
	[5.19]	*[4.83]*	*[36.25]*	*[-5.57]*	*[-8.21]*	*[6.41]*	*[5.55]*	*[4.94]*	*[30.73]*	*[-2.19]*	*[-3.77]*	*[4.81]*
Max - Min	**0.56**	**0.55**	**-0.10**	**-0.21**	**-0.39**	**0.27**	**0.47**	**0.48**	**-0.10**	**-0.11**	**-0.50**	**0.19**
	[2.87]	*[3.26]*	*[-2.37]*	*[-3.95]*	*[-6.91]*	*[7.27]*	*[2.36]*	*[2.76]*	*[-2.33]*	*[-1.88]*	*[-8.37]*	*[4.9]*

Panel B: Quintiles

	Cash-based operating profitability						*Gross profitability*					
	Ret	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*	*Ret*	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*
Min	**0.79**	**0.16**	**0.95**	**-0.01**	**0.08**	**-0.12**	**0.79**	**0.13**	**0.98**	**-0.12**	**0.18**	**-0.07**
	[3.23]	*[1.82]*	*[44]*	*[-0.50]*	*[2.56]*	*[-6.29]*	*[3.23]*	*[1.29]*	*[40.59]*	*[-3.820]*	*[5.31]*	*[-2.99]*
2	**0.94**	**0.32**	**0.91**	**-0.17**	**0.11**	**-0.04**	**0.76**	**0.15**	**0.90**	**-0.13**	**0.22**	**-0.05**
	[4.25]	*[3.74]*	*[43.63]*	*[-6.13]*	*[3.83]*	*[-1.87]*	*[3.36]*	*[1.54]*	*[38.64]*	*[-4.27]*	*[6.67]*	*[-2.54]*
3	**4.05**	**0.27**	**0.88**	**-0.17**	**0.10**	**-0.03**	**4.29**	**0.45**	**0.92**	**-0.02**	**-0.15**	**-0.12**
	[0.87]	*[3.1]*	*[41.41]*	*[-5.92]*	*[3.38]*	*[-1.47]*	*[1.04]*	*[4.41]*	*[36.95]*	*[-0.58]*	*[-4.32]*	*[-5.2]*
4	**1.10**	**0.53**	**0.90**	**-0.13**	**-0.17**	**-0.09**	**1.06**	**0.45**	**0.93**	**-0.17**	**-0.23**	**-0.03**
	[4.86]	*[6.23]*	*[43.66]*	*[-4.840]*	*[-5.91]*	*[-4.84]*	*[4.64]*	*[5.39]*	*[46.1]*	*[-6.450]*	*[-8.07]*	*[-1.82]*
Max	**1.25**	**0.56**	**0.95**	**-0.21**	**-0.22**	**0.09**	**1.35**	**0.68**	**0.90**	**-0.23**	**-0.16**	**0.13**
	[5.55]	*[7.010]*	*[48.87]*	*[-7.96]*	*[-8.07]*	*[5.26]*	*[6.16]*	*[6.720]*	*[36.63]*	*[-6.96]*	*[-4.68]*	*[5.89]*
Max - Min	**0.46**	**0.40**	**-0.01**	**-0.19**	**-0.30**	**0.22**	**0.56**	**0.55**	**-0.08**	**-0.11**	**-0.34**	**0.20**
	[3.09]	*[3.090]*	*[-0.170]*	*[-4.59]*	*[-6.78]*	*[7.62]*	*[3.35]*	*[3.690]*	*[-2.20]*	*[-2.17]*	*[-6.7]*	*[5.98]*

Panel C: Tertiles

	Cash-based operating profitability						*Gross profitability*					
	Ret	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*	*Ret*	*α*	*βmkt*	*βsmb*	*βhml*	*βmom*
Min	**0.89**	**0.26**	**0.95**	**-0.12**	**0.09**	**-0.09**	**0.76**	**0.13**	**0.94**	**-0.14**	**0.19**	**-0.07**
	[3.84]	*[3.60]*	*[53.67]*	*[-5.22]*	*[3.67]*	*[-5.64]*	*[3.29]*	*[1.57]*	*[47.04]*	*[-5.09]*	*[6.81]*	*[-3.94]*
2	**0.90**	**0.31**	**0.88**	**-0.12**	**0.05**	**-0.05**	**1.06**	**0.48**	**0.92**	**-0.10**	**-0.10**	**-0.10**
	[4.28]	*[4.52]*	*[53.25]*	*[-5.210]*	*[1.99]*	*[-3.19]*	*[4.63]*	*[5.93]*	*[47.33]*	*[-4.02]*	*[-3.83]*	*[-5.86]*
Max	**1.22**	**0.56**	**0.94**	**-0.20**	**-0.22**	**0.04**	**1.22**	**0.57**	**0.91**	**-0.19**	**-0.21**	**0.07**
	[5.5]	*[8.38]*	*[58.22]*	*[-9.07]*	*[-9.62]*	*[2.8]*	*[5.68]*	*[8.09]*	*[53.65]*	*[-8.56]*	*[-9.01]*	*[4.63]*
Max - Min	**0.33**	**0.30**	**-0.01**	**-0.07**	**-0.31**	**0.13**	**0.46**	**0.44**	**-0.03**	**-0.06**	**-0.40**	**0.14**
	[2.72]	*[2.79]*	*[-0.41]*	*[-2.110]*	*[-8.6]*	*[5.66]*	*[3.19]*	*[3.57]*	*[-1.15]*	*[-1.45]*	*[-9.76]*	*[5.31]*

Appendix 2 Individually triple-sorted investment friction portfolios

This table reports the monthly average returns (as %), alfa (as %), factor loadings, and corresponding t-statistics (in brackets) for the long-short profitability spread portfolios of the triple sorts. In this table, the used sample is the firms with a positive I/A-ratio. Triple-sorts are done independently by classifying firms on two I/A-ratio groups, three investment friction groups, and three profitability groups. The payout ratio and asset size are used as the proxies for investment frictions, which are defined in more detail in Chapter 4.1. In this table, there is only used cash-based operating profitability as the proxy for the expected profitability. All portfolios are value-weighted. Returns are calculated monthly, and portfolios are rebalanced yearly. MKT, SMB, and HML are the market, size, and value factors in Fama and French (1993) 3-factor model. Panel B reports the results of low minus high investment friction portfolios.

Panel A: Triple-sorted investment frictions portfolios

I/A	FRIC	Proxies	Ret		α		B mkt		B smb		B hml	
Low	Low	Payout-ratio	0.432	[2.31]	0.539	[2.94]	-0.110	[-2.58]	-0.121	[-2.01]	-0.271	[-4.48]
Low	High		0.141	[0.48]	0.192	[0.65]	-0.080	[-1.16]	0.106	[1.09]	-0.163	[-1.66]
High	Low		0.668	[2.88]	0.722	[3.13]	-0.014	[-0.26]	-0.299	[-3.94]	-0.087	[-1.15]
High	High		0.623	[2.29]	0.658	[2.46]	-0.022	[-0.35]	0.022	[0.25]	-0.456	[-5.17]
Low	Low	Asset size	0.107	[0.59]	0.256	[1.49]	-0.162	[-4.04]	-0.141	[-2.50]	-0.311	[-5.47]
Low	High		0.041	[0.17]	0.168	[0.70]	-0.175	[-3.12]	0.087	[1.10]	-0.307	[-3.87]
High	Low		0.492	[2.40]	0.462	[2.33]	0.075	[1.62]	-0.042	[-0.64]	-0.386	[-5.89]
High	High		0.479	[1.89]	0.523	[2.15]	-0.020	[-0.35]	-0.026	[-0.32]	-0.546	[-6.80]

Panel B: Low minus high investment friction portfolios

I/A	FRIC	Proxies	Ret		α		B mkt		B smb		B hml	
Low	Low - High	Payout-ratio	0.291	[0.91]	0.347	[1.08]	-0.030	[-0.39]	-0.227	[-2.15]	-0.109	[-1.02]
High	Low - High		0.045	[0.13]	0.065	[0.18]	0.008	[0.10]	-0.321	[-2.76]	0.369	[3.16]
Low	Low - High	Asset size	0.066	[0.25]	0.088	[0.33]	0.013	[0.21]	-0.228	[-2.60]	-0.004	[-0.05]
High	Low - High		0.013	[0.04]	-0.061	[-0.20]	0.095	[1.32]	-0.016	[-0.16]	0.160	[1.56]