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# IMPLIED COST OF CAPITAL BASED INVESTMENT STRATEGIES: EVIDENCE FROM WESTERN-EUROPE

Master's Thesis
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Aalto University School of Business
Master's Programme in Finance
Spring 2023

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**Title of thesis** IMPLIED COST OF CAPITAL BASED INVESTMENT STRATEGIES: EVIDENCE FROM WESTERN-EUROPE

**Programme** Master of Science in Economics and Business Administration

**Major** Finance

**Thesis supervisor** Prof. Vesa Puttonen

**Date** 20.03.2023 **Number of pages** 53 + 12 **Language** English

**Abstract**

Due to the limitations of traditional approaches to estimating expected returns, there have been attempts to generate alternative ways to estimate expected stock returns, such as an implied cost of capital (ICC). The term ICC was initially coined by Gebhardt et al. (2001), and it is defined as the internal rate of return that equates a firm's share price to the firm's expected cash flows.

The objective of this thesis is firstly to assess the connection between the average of ICC estimates of stocks included in a portfolio and the future realised returns of a portfolio. Secondly, this thesis aims to evaluate whether the ICC estimates can be used to generate trading strategies that yield positive abnormal returns before and after transaction costs. Besides these main objectives, this thesis analyses the factor loadings of the ICC-based portfolios.

The methodology used to achieve the objectives of this thesis consists of three main sets of methods: Firstly, to calculate stocks' ICC estimates, I follow the approaches introduced in earlier literature and especially the methodologies used by Gebhardt et al. (2001) and Claus and Thomas (2001). Secondly, to construct the ICC-based portfolios and to calculate the absolute and risk-adjusted returns of these portfolios, I follow the methodology used by Esterer and Schröder (2014). Thirdly, to calculate the returns of ICC-based portfolios after transaction costs, I estimate the transaction costs following the methodology of Barber et al. (2001).

The results regarding my main hypotheses imply that investing in monthly rebalanced portfolios comprising stocks with very high ICC estimates generates statistically significant four-factor alphas both before and after transaction costs. On the other hand, observing the returns of portfolios that include stocks with ICC estimates closer to the sample average implies that there is no clear relation between the ICC estimates and the absolute or risk-adjusted returns of the portfolios. The reason for this seems to be that the so-called ICC effect documented by Esterer and Schröder (2014) is strongest for stocks with ICC estimates clearly deviating from the sample average.

My thesis contributes to the existing literature in three main ways: It assesses whether investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns, both before and after the transaction costs. In addition, this thesis contributes to the literature examining the association between ICC estimates and future realised returns by investigating the association between portfolio-level returns and the average of ICC estimates of stocks included in portfolios. Furthermore, this thesis contributes to the existing literature by analysing the factor loadings of the ICC-based portfolios.

**Keywords** implied cost of capital, asset pricing, expected return, investment strategy, quantitative investing

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**Tekijä** Jaakko Henriksson

**Työn nimi** IMPLISIITTISEEN PÄÄOMAKUSTANNUKSEEN PERUSTUVAT SIJOITUSSTRATEGIAT: HAVAINTOJA LÄNSI-EUROOPASTA

**Koulutusohjelma** Kauppatieteiden maisterin tutkinto

**Pääaine** Rahoitus

**Vastuuopettaja/valvoja** Professori Vesa Puttonen

**Päivämäärä** 20.03.2023 **Sivumäärä** 53 + 12 **Kieli** Englanti

**Tiivistelmä**

Perinteisten odotetun tuoton arvioinnissa käytettyjen menetelmien rajoitteiden vuoksi odotettujen tuottojen arviointiin on yritetty kehittää vaihtoehtoisia menetelmiä, kuten implisiittinen pääomakustannus (ICC). Termiä ICC käyttivät ensimmäisenä Gebhardt et al. (2001), ja se määritellään sisäiseksi korkokannaksi, jolla yrityksen odotetut kassavirrat vastaavat yrityksen osakkeen nykyhintaa.

Tämän tutkielman tavoitteena on ensinnäkin arvioida salkkuun sisältyvien osakkeiden ICC-estimaattien keskiarvon ja salkun tulevien toteutuneiden tuottojen välistä yhteyttä. Toiseksi tämän tutkielman tavoitteena on arvioida, voidaanko ICC-estimaatteja käyttää sellaisten kaupankäyntistrategioiden kehittämisessä, jotka tuottavat positiivista epänormaalia tuottoa ilman transaktiokustannuksia sekä transaktiokustannukset huomioiden. Näiden päätavoitteiden lisäksi tässä tutkielmassa analysoidaan ICC-pohjaisten portfolioiden faktoripainotuksia.

Tämän tutkielman tavoitteiden saavuttamiseksi käytettävä metodologia koostuu kolmesta pääosasta: Ensinnäkin, laskettaessa osakkeiden ICC-estimaatteja hyödynnän aiemmassa kirjallisuudessa esiteltyjä sekä erityisesti Gebhardtin et al. (2001) sekä Clausin ja Thomasin (2001) käyttämiä menetelmiä. Toiseksi muodostaakseni ICC-pohjaiset salkut sekä laskeakseni näiden salkkujen absoluuttiset ja riskikorjatut tuotot hyödynnän Estererin ja Schröderin (2014) käyttämiä menetelmiä. Kolmanneksi laskeakseni ICC-pohjaisten salkkujen transaktiokustannusten jälkeisen tuoton, käytän transaktiokustannusten arviointiin Barberin et al. (2001) metodologiaa.

Tulokset koskien päähypoteesejani osoittavat, että sijoittaminen kuukausittain uudelleenpainotettaviin portfolioihin, jotka koostuvat osakkeista, joilla on erittäin korkea ICC-estimaatti, tuottaa sekä ennen transaktiokuluja että niiden jälkeen tilastollisesti merkitseviä neljän faktorin alfakertoimia. Toisaalta havainnot salkkujen tuotoista, jotka sisältävät osakkeita, joiden ICC-estimaatit ovat lähempänä otoksen keskiarvoa, viittaavat siihen, ettei ICC-estimaattien ja salkkujen absoluuttisten tai riskikorjattujen tuottojen välillä ole selvää yhteyttä. Syynä tähän vaikuttaa olevan se, että Estererin ja Schröderin (2014) dokumentoima niin kutsuttu ICC-efekti on voimakkain sellaisille osakkeille, joiden ICC-estimaatit poikkeavat selvästi otoksen keskiarvosta.

Tutkielmani kontribuoi olemassa olevaan kirjallisuuteen kolmella pääasiallisella tavalla: Siinä arvioidaan, voivatko osakkeiden ICC-estimaattien hyödyntämiseen pyrkivät sijoitusstrategiat tuottaa positiivisia epänormaaleja tuottoja sekä ennen transaktiokuluja että niiden jälkeen. Lisäksi tämä tutkielma täydentää ICC-ennusteiden ja tulevien toteutuneiden tuottojen välistä yhteyttä koskevaa kirjallisuutta tutkimalla portfoliotason tuottojen sekä portfoliossa mukana olevien osakkeiden ICC-estimaattien keskiarvon yhteyttä. Tämä tutkielma kontribuoi olemassa olevaan kirjallisuuteen myös analysoimalla ICC-pohjaisten salkkujen faktoripainotuksia.

**Keywords** implisiittinen pääomakustannus, arvopaperien hinnoittelu, odotettu tuotto, sijoitusstrategia, kvantitatiivinen sijoittaminen

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# 1 Introduction

## 1.1 Background and motivation

The expected return is an essential concept in theory and practice. Despite its importance for firms and investors, as Ilmanen (2011) points out, the expected return is an unobservable figure. Due to the unobservability of expected returns, numerous methods attempting to estimate the expected returns have been generated by academics. These methods include several long-standing classical asset pricing models and approaches based on a simple firm or portfolio-level time-series average of realised returns. However, approaches based on the classical asset pricing models and realised returns have theoretical limitations; also, the empirical evidence implies that expected return estimates based on these approaches are unreliable.

Due to the limitations of these traditional approaches to estimating expected returns, there have been efforts to generate alternative ways to estimate expected stock returns, such as an implied cost of capital (ICC). The term ICC was initially coined by Gebhardt et al. (2001), and as defined by Esterer and Schröder (2014), it is *"the internal rate of return that equates share prices to discounted analysts' cash flow forecasts*" (p. 171). Similarly to bond yield, the ICC aims to capture the market's view about a share's risk based on the assumption that analysts' cash flow forecasts accurately reflect the market's opinion on the share's expected cash flows.

There is a vast existing literature examining the validity and accuracy of the expected return estimates calculated based on the ICC approaches. The reliability of these ICC estimates is usually tested by 1) assessing the relation between ICC estimates and risk characteristics or 2) examining the association between ICC estimates and future realised returns. The study of Esterer and Schröder (2014) builds on this existing literature by testing ICC-based investment strategies. They document that in the U.S. equity markets, portfolios including stocks with high ICC estimates, overperform those with low ICC estimates. Furthermore, Esterer and Schröder (2014) report that this outperformance of high ICC stocks remains statistically significant when controlling for commonly known variables.

## 1.2 Research questions and testable hypotheses

The objective of this thesis is firstly to assess the connection between the average of ICC estimates of stocks included in a portfolio and the future realised returns of a portfolio. Secondly, this thesis aims to evaluate whether the ICC estimates can be used to generate trading strategies that yield positive abnormal returns. Regarding these objectives, I have the following two main hypotheses in my thesis:

$\mathrm{H_1}$: *There is a positive association between the average of ICC estimates of stocks included in portfolios and the future realised returns of portfolios*

My first main hypothesis ($\mathrm{H_1}$) is based on the findings of Botosan et al. (2011) and Pastor et al. (2008). Firstly, Botosan et al. (2011) find that there is a strong positive association between various ICC proxies and future realised returns. Secondly, Pastor et al. (2008) conclude that ICC outperforms realised returns as a proxy for expected returns. If there is a positive relation between stocks' ICC estimates and future realised returns, as indicated by the mentioned authors, it is logical to assume that there is also a strong positive association between portfolio-level returns and average ICC estimates of the firms in a portfolio in line with the first main hypothesis ($\mathrm{H_1}$). The hypothesis is tested by measuring the absolute returns of ICC-based portfolios formed by ranking all stocks in the sample according to their ICC estimate and grouping these stocks into five equally-weighted portfolios. In line with the first main hypothesis ($\mathrm{H_1}$), I expect that there is a strong positive relation between the total portfolio returns and average ICC estimates of the firms in a portfolio, i.e., the portfolios including stocks with higher ICC estimates yield higher total portfolio returns than portfolios including stocks with lower ICC estimates. The first hypothesis is evaluated in subsection 5.1.1. My second main hypothesis is indirectly related to ($\mathrm{H_1}$), and the second hypothesis is as follows:

$\mathrm{H_2}$: *Investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns, both before and after the transaction costs*

I test the second main hypothesis by adapting the methodology of Esterer and Schröder (2014), who documented that ICC-based investment strategies can yield positive abnormal returns when the transaction costs are not considered[1]. Esterer and Schröder (2014) documented the existence of a so-called ICC effect, meaning that portfolios including stocks with high ICC estimates, overperform those with low ICC estimates. However, if this effect exists and ICC estimates can be used to detect pricing errors since the stocks with very high ICC estimates are underpriced, and vice versa, stocks with more extreme ICC estimates should be especially mispriced. Thus, my initial supposition is that the best way to detect the possible existence of the so-called ICC effect is to observe stocks with especially low or high ICC estimates, as the ICC effect should be strongest for stocks with ICC estimates clearly deviating from the sample average. Therefore, to assess whether ICC estimates can be used to generate profitable trading strategies by being long in portfolios that include stocks with high ICC estimates or being simultaneously long in high ICC portfolios and short in low ICC portfolios: I focus on measuring the returns of portfolios that comprise only stocks with very high or low ICC estimates[2]. Similarly, as Esterer and Schröder (2014), to evaluate the risk-adjusted returns of these portfolios, I use the Capital Asset Pricing Model developed by Sharpe (1964) and Lintner (1965) and the four-factor model introduced by Carhart (1997).

As implied by the wording of hypothesis two, the hypothesis can be further split into two subhypotheses. The first subhypothesis ($\mathrm{H}_{2.1}$) is that the ICC-based investment strategies yield positive abnormal returns gross of transaction costs, whereas the second subhypothesis ($\mathrm{H}_{2.2}$) is that these investment strategies yield positive abnormal returns even net of transaction costs. The first subhypothesis ($\mathrm{H}_{2.1}$) is evaluated in subsection 5.2.1, and the second subhypothesis ($\mathrm{H}_{2.2}$) is evaluated in subsection 5.2.2.

[1] However, as reported by Esterer and Schröder (2014), the statistical significance of these abnormal returns disappears when transaction costs are taken into account.
[2] It should be noted that if the possible existence of the so-called ICC effect can be detected only by observing stocks with especially low or high ICC estimates because the ICC effect is practically non-existent for stocks with ICC estimates close to the average, this might mean that being long in portfolios that include stocks with high ICC estimates or being simultaneously long in high ICC portfolios and short in low ICC portfolios generate positive abnormal returns even though, in contrast to my first main hypothesis ($\mathrm{H}_1$), observing the portfolios including stocks in the sample whose ICC estimate is between the 20th percentile and the 80th percentile would imply that there is no positive association between various ICC proxies and future realised returns.

## 1.3 Main findings and contributions

### 1.3.1 Main findings

The results reported in this thesis show that monthly rebalanced portfolios comprising stocks with the highest ICC estimates outperform other portfolios, especially those with the lowest ICC estimates. However, when observing the portfolios that include stocks in the sample whose ICC estimate is between the 20th and 80th percentile, the results indicate no clear relation between the average ICC estimates of the firms included in portfolios and the absolute or risk-adjusted returns of the portfolios. Thus, the results related to the first main hypothesis ($\mathrm{H}_1$) that there should be a strong positive association between portfolio returns and average ICC estimates of the firms included in each portfolio are conflicting. Despite the notable differences in monthly returns between high and lower ICC portfolios, the returns of other portfolios do not support the hypothesis.

Regarding my second main hypothesis ($\mathrm{H}_2$): I find strong evidence that investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns. Unlike Esterer and Schröder (2014) or any previous study, my results imply that these ICC-based investment strategies yield positive abnormal returns even after transaction costs. Therefore, my results indicate that these strategies generate positive abnormal returns when implemented in practice. However, it seems that besides investing in high ICC portfolios that are monthly rebalanced, no other ICC-based investment strategies, such as being simultaneously long in high ICC portfolios and short in low ICC portfolios, do not generally yield positive abnormal returns.

Furthermore, the above-discussed results regarding my main hypotheses ($\mathrm{H}_1$) and ($\mathrm{H}_2$) imply that the so-called ICC effect can be detected only by observing stocks with especially low or high ICC estimates. The reason for this seems to be that the ICC effect is strongest for stocks whose ICC estimates clearly deviate from the sample average. However, the effect is practically non-existent for stocks with ICC estimates close to the average, as in contrast to my first main hypothesis ($\mathrm{H}_1$), there is no clear relation between the average ICC estimates of the firms included in portfolios and the absolute or risk-adjusted returns of the portfolios when observing the portfolios that include stocks in the sample whose ICC estimate is between the 20th and the 80th percentile.

Besides testing the hypotheses presented above, this thesis analyses the factor loadings of the ICC-based portfolios. Among other things, the factor loadings of these portfolios reveal that the ICC estimates are strongly related to book-to-market ratios, as the higher ICC portfolios are clearly more tilted towards value stocks with a high book-to-market ratio than the lower ICC portfolios. As further discussed in subsection 5.1.2, this finding relates to the discussion on what has been driving the so-called "value premium". The relation between value tilt and implied cost of capital supports the risk-based explanations for value premium as it implies that value stocks are riskier than growth stocks as ICC aims to capture the market's view about a share's risk.

### 1.3.2 Main contributions

The reliability of ICC estimates is usually tested in the literature by 1) assessing the relation between ICC estimates and common risk characteristics or 2) examining the association between ICC estimates and future realised returns. However, although these tests are closely related to the relation between ICC estimates and the risk-adjusted returns, the tests usually focus on measuring the correlation between ICC estimates and the realised returns or between ICC estimates and various risk characteristics. Thus, these tests do not directly provide clarity on whether ICC estimates can be used to generate trading strategies that yield positive abnormal returns. Consequently, despite the vast array of literature related to the ICC, based on my comprehensive literature review, only one study by Esterer and Schröder (2014) has explicitly studied whether investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns.

My thesis contributes to the existing literature as it further examines the profitability of ICC-based investment strategies by building on and selectively combining the approaches used by Esterer and Schröder (2014) and those presented in other ICC-related literature. As previously explained, ICC is an alternative method to classical asset pricing models and approaches based on historical realised returns to estimate expected returns. Numerous studies have backtested whether investment strategies based on realised returns or traditional asset pricing models generate abnormal returns. Consequently, further testing investment strategies based on ICC is essential as this might reveal whether ICC estimates can be used for generating positive abnormal returns by detecting mispriced assets. In addition, if ICC-based investment strategies generate positive abnormal returns measured by classical asset pricing models, this indicates that ICC estimates can generate insights on expected returns that traditional asset pricing models do not fully capture.

My thesis also contributes to the literature examining the association between ICC estimates and future realised returns (see, e.g., Easton and Monahan, 2005; Guay et al., 2005; Botosan and Plumlee, 2011) by investigating the association between portfolio returns and the average of ICC estimates of stocks included in portfolios. Furthermore, this thesis contributes to the existing literature by analysing the factor loadings of the ICC-based portfolios.

## 1.4 Structure of the thesis

The remainder of this thesis is organised as follows: Section 2 describes the literature relevant to this study. Section 3 presents the data used in this thesis and discusses why I have decided to make certain choices regarding the data selection. The methodology used in this thesis is presented in section 4, and the main results of this thesis are in section 5. Finally, section 6 concludes this thesis.

# 2 Literature review

The literature review begins by briefly describing the literature regarding the concept of expected return and selected traditional methods to measure the expected return in section 2.1 to provide some background and context for a better understanding of the ICC. Then, I review the literature on the ICC in section 2.2, which is further split into seven subsections. First, subsection 2.2.1 provides an introduction to the ICC. Then, in subsections 2.2.2-2.2.4, I give an overview of the valuation models most commonly used to estimate the ICC; subsection 2.2.2 describes the dividend discount model, subsection 2.2.3 presents the abnormal earnings growth model, and subsection 2.2.4 introduces the residual income model. Next, in subsection 2.2.5, I provide an overview of the literature analysing the validity of the valuation models presented in subsections 2.2.2-2.2.4. Then, in subsection 2.2.6, I review research on the reliability of different approaches to estimate the ICC. Finally, subsection 2.2.7 shortly describes the limited literature on ICC-based investment strategies. As a general note regarding this section, it should be noted that due to the vast array of literature related to the expected return and the ICC, the literature review examines this literature selectively.

## 2.1 Expected return

The expected return is an essential concept in theory and practice. The expected return can be viewed from the investors' or the firms' perspective.[3] From an investor's perspective, the expected return on an investment is the expected value of its return. Given that the markets are efficient, the expected return on financial investment is higher for more risky issues than less risky ones (see, e.g., Vasicek & McQuown, 1972). From the firm's perspective, the expected return measures the cost of raising money from investors through equity financing as the expected return equals the firm's cost of capital, as shown, for example, by Schlegel (2015). Despite its importance for firms and investors, the expected return is unobservable. As Ilmanen (2011) points out, unlike realised returns that can be observed ex-post, the expected return is unobservable, both ex-post and ex-ante, since the realised returns do not reveal the return expected by investors.

[3] In this thesis, the term "expected return" refers to the expected return on equity and "cost of capital" refers to the cost of equity.

Since expected returns are unobservable, numerous methods attempting to estimate the expected returns have been generated by academics. Various traditional asset pricing models are a common way to estimate the expected returns. These asset pricing models include, among others, the Capital Asset Pricing Model (CAPM) based on the work by Sharpe (1964) and Lintner (1965), the arbitrage model of capital asset pricing developed by Ross (1976), and various factor-based models such as the three-factor model of Fama and French (1993), the four-factor model proposed by Carhart (1997) and the five-factor model introduced by Fama and French (2015). Along with these classical asset pricing models, the models based on a simple firm or portfolio-level time-series average of realised returns are among the most commonly used methods to measure the expected return.

However, approaches based on the classical asset pricing models and realised returns have theoretical limitations, and the empirical evidence implies that expected return estimates based on these approaches are unreliable. As stated by Fama and French (2004), the CAPM fails empirically to explain the expected returns, and the CAPM's empirical failures might reflect the model's theoretical weaknesses related to the model's oversimplifying assumptions. Also, the various multifactor models have not been an empirical success, and for example, Fama and French (1997) have shown that over 3% standard errors per year are typical when estimating the costs of equity for industries based on the three-factor model. The authors argue that these significant standard errors are caused by uncertainty about the factor risk premiums and imprecise estimates of factor risk loadings.

Furthermore, the approaches using realised returns for approximation of expected returns are subject to severe theoretical issues as these are based on the assumption that the so-called information surprises after the formation of expectations average away within a portfolio or over the measurement period. Elton (1999) has pointed out that there is clear evidence that the assumption is invalid. As also shown by Botosan et al. (2011), the realised returns seem to be an unreliable proxy for expected returns.

## 2.2 Implied cost of capital

### 2.2.1 Introduction

Due to the limitations of these traditional approaches to estimating expected returns discussed above, there have been attempts to generate alternative ways to estimate expected stock returns, such as an implied cost of capital. The term ICC was initially coined by Gebhardt et al. (2001). The implied cost of capital is a proxy for expected returns, and it is defined as the discount rate that equates a firm's share price to the firm's expected cash flows. Pursuant to Lee et al. (2009), the formal expression of the implied cost of capital in infinite horizon form is as follows:

$$P_t = \sum_{k=1}^{\infty} \frac{E_t(FCFE_{t+k})}{(1+r_e)^k} \tag{1}$$

where $P_t$ is the current stock price, $E_t(FCFE_{t+k})$, is the expected free cash flow to equity for period $t+k$ conditional on information available at time $t$ and $r_e$ is the cost of equity capital, i.e., the implied cost of capital.

Similarly to the equation above, a clear majority of approaches estimating the ICC are based on an equity value instead of an enterprise value. As stated by Echterling et al. (2015), almost all implied cost of capital methods are based on equity valuation since the availability of forecasts of earnings and dividends due to equity holders is better than the forecasts of cash flows available to all investors. Furthermore, as pointed out by Echterling et al. (2015), most ICC approaches use a constant deterministic discount rate. Referring to Kruschwitz & Löffler (2006), Fama and French (1996) and Laitenberger & Löffler (2006), Echterling et al. (2015) point out that the main reason for using non-time-varying constant deterministic discount rate is that it makes the estimation of ICC more "straightforward".

As indicated by the ICC models discussed in subsections 2.2.2-2.2.6, most ICC approaches rely on analysts' forecasts, usually obtained from I/B/E/S or Value Line Investment Survey (Value Line), to estimate future earnings and book values. Hou et al. (2012) have generated an alternative to this well-established approach to estimating the ICC. Instead of analysts' forecasts, they use earnings forecasts from a cross-sectional model they created to estimate the

ICC. However, as the ICC estimates in this paper are estimated using the established approach utilising analysts' forecasts, the cross-sectional earnings model introduced by Hou et al. (2012) will not be discussed in further detail in this thesis.

The methods to estimate the ICC are usually based either on the dividend discount model, the abnormal earnings growth model or the residual income model. These three models and their use in ICC approaches are described in further detail below in subsections 2.2.2-2.2.5.

### 2.2.2 Dividend discount model

The dividend discount model is a valuation method based on the assumption that the current price of a stock equals the present value of a company's future dividends. Following Gebhardt et al. (2001), the formal expression of the dividend discount model is as follows:

$$P_t = \sum_{i=1}^{\infty} \frac{E_t(D_{t+i})}{(1 + r_e)^i} \tag{2}$$

where $P_t$ is the current stock price, $E_t(D_{t+i})$ is the expected value of the future dividends and $r_e$ is the expected return or implied cost of capital.

Malkiel (1979) was the first to use an accounting-based valuation technique to estimate the expected return, and the valuation method was based on the dividend discount model. Malkiel (1979) estimated the cost of capital by constructing an equation where the current stock price equals dividends (earnings) over the 20-year explicit forecast period plus the terminal value. Malkiel (1979) assumed that the growth rate of earnings for the next five years equals to estimated growth rates obtained from Value Line, and since these estimates are made to cover only a five-year period, Malkiel (1979) assumed that after year five and until year 20, the long-term growth rate obtained from Value Line, decays to the economy's long-term growth rate.

Also, Gordon and Gordon (1997) use an approach based on the dividend discount model to estimate the expected return. The authors introduced a finite horizon expected return model that assumes that dividends have a limited horizon for growth. In other words, Gordon and Gordon (1997) assumed that after the forecast horizon, a return on equity equals the required rate of return on equity, and thus, there are no excess returns after the forecast horizon. Most of the results provided by Gordon and Gordon (1997) are calculated by assuming that the explicit forecast period is seven years. However, they also calculated results using 0 years, 5 years, 10 years, 20 years, and an infinite-horizon forecasting period. The earnings forecasts used in the model introduced by Gordon and Gordon (1997) are based on the analysts' forecasts obtained from I/B/E/S.

Similarly to Gordon and Gordon (1997), the finite horizon model was also used by Botosan (1997), who estimated the expected rate of return using a limited four years horizon. However, instead of using the dividend discount model per se to estimate the cost of capital, Botosan (1997) used an accounting-based EBO valuation formula derived from the dividend discount model[4]. She used earnings forecasts, stock prices, book values and P/E ratios obtained from Value Line as variables in her model. The model employed by Botosan and Plumlee (2002) is quite similar to the earlier model by Botosan (1997). However, in the model introduced by Botosan and Plumlee (2002), the terminal value is substituted with an equation shown below:

$$(1+r)^{-4}P_4 \tag{3}$$

where $r$ is the cost of equity capital and $P_4$ is the forecasted price in year 4, which equals the mean of the minimum and maximum long-run price forecasts obtained from Value Line. Botosan (1997) calculated the price forecast in year four using the price implied by the long-run P/E ratio forecast instead of the minimum and maximum long-run price forecasts obtained from Value Line. However, as Botosan and Plumlee (2002) noted, these approaches provide practically identical results.

### 2.2.3 Abnormal earnings growth model

As stated by Gode and Mohanram (2003), the abnormal earnings growth model can be expressed following Ohlson and Juettner-Nauroth (2003) as follows:

$$P_t = \frac{EPS_1}{r_e} + \frac{(EPS_2 - EPS_1 - r_e(EPS_1 - DPS_1))}{r_e(r_e - g_p)} \tag{4}$$

where $P_t$ is the share price at time $t$, $EPS_1$ is the expected earnings per share at time $t+1$, and $EPS_2$ is the expected earnings per share at time $t + 2$, $DPS_1$ equals the expected dividends per

[4] As stated by Botosan (1997), the EBO valuation formula was developed by Edwards and Bell (1961), Ohlson (1995) and Feltham and Ohlson (1995).

share at time $t + 1$, $r_e$ is the required return for equity and $g_p$ is the perpetuity growth rate. A variety of researchers have employed the abnormal earnings growth model. For example, Easton (2004) has developed a method for simultaneously estimating the required rate of return for equity and the long-run change in an abnormal growth in earnings for 1,499 portfolios consisting of 20 stocks. Pursuant to the model, the cost of equity and long-run change in an abnormal growth in earnings are calculated based on prices and analysts' earnings forecasts provided by I/B/E/S. Furthermore, according to Easton (2004), comparing the required rate of return estimates computed in line with the model with the estimates implied by other commonly used heuristics, the model yields less biased results than these heuristics.

### 2.2.4 Residual income model

Gebhardt et al. (2001) show that given the forecasts of earnings and book values are pursuant to "clean surplus" accounting[5], equation (2) can be rewritten as follows:

$$P_t = B_t \sum_{i=1}^{\infty} \frac{E_t[NI_{t+i} - r_e B_{t+i-1}]}{(1+r_e)^i}$$

$$= B_t \sum_{i=1}^{\infty} \frac{E_t[(ROE_{t+i} - r_e) B_{t+i-1}]}{(1+r_e)^i} \tag{5}$$

where, $P_t$ = share price at time $t$, $B_t$ = book value at time $t$, $E_t[.]$ = expectation based on information available at time $t$, $NI_{t+i}$ = net income for period $t+i$, $r_e$ = cost of equity capital and $ROE_{t+i}$ = the after-tax return on book equity for period $t+i$.

As equation (5) is a rewritten version of the formal expression of the dividend discount model shown in equation (2), the residual income valuation model pursuant to equation (5) is subject to the same limitations as the dividend discount model. Perhaps the most widely used approaches to estimate the ICC based on the residual income model are developed by Gebhardt et al. (2001) and Claus and Thomas (2001). However, the model I use in this thesis to estimate

[5] The clean surplus relation is satisfied if the change in book value per share from period to period is equal to earnings per share minus net dividends per share ($B_t = B_{t-1+} EPS_t - DPS_t$).

the ICC is based on the residual income valuation model and the approaches introduced by the said authors. Thus, the residual income model, as well as the models of Gebhardt et al. (2001) and Claus and Thomas (2001), will be discussed in more detail in section 4, which covers the methodology used in this thesis.

### 2.2.5 Comparison of different valuation models used to estimate the ICC

As shown in the previous section, the residual income model is derived from the dividend discount model. Further, Easton (2004) shows that the residual income model and abnormal earnings growth model are theoretically similar. Therefore, since the valuation methods described in subsections 2.2.2-2.2.4 are theoretically similar, these models should, in theory, yield identical results, given that the clean surplus relation applies, as Lundholm & O'Keefe (2001) shows.

However, the residual income valuation model provides similar results to the other two models only if the clean surplus relation is not violated. The clean surplus assumption does not hold if all items, excluding transactions with shareholders such as dividends or share repurchases, impacting the shareholder's equity are not shown in the income statement and vice versa. In practice, the clean surplus assumption is often violated. As summarised by Echterling (2015), Ohlson (2005) has pointed out three reasons why the clean surplus relation only rarely holds: 1) the changes in the number of shares outstanding violate the clean surplus accounting assumption on a share basis if modifications to the book value per share or earnings per share are not made, 2) on a total equity basis, the clean surplus assumption does not hold if all the issuances/buy-backs of shares do not have a net present value of zero from the point of view of new shareholders, 3) many accounting rules violate the clean surplus accounting.

Regarding the abovementioned point three, clean surplus accounting requires that all items, excluding transactions with shareholders such as dividends or share repurchases, impacting the shareholder's equity are shown in the income statement and vice versa. Nevertheless, most accounting rules do not align with clean surplus accounting (see, e.g., Ohlson, 2005; Easton, 2004 and Bhattacharya et al., 2003). However, despite the accounting rules not aligning with clean surplus accounting in practice, Frankel and Lee (1996) point out that these dirty surplus adjustments are a potential source of bias only if the clean surplus violations do not cancel each other out. Furthermore, Van Cauwenberge and De Beelde (2007) have argued that the residual income model is valid even though the accounting would not be in line with clean surplus accounting.

Despite the theoretical limitations of the residual income valuation model discussed above, the model yields more accurate results than the dividend discount model or the discounted cash flow model measured in terms of prediction errors (see, e.g., Courteau et al., 2001; Francis et al., 2000; Penman and Sougiannis, 1998). Furthermore, Jorgensen et al. (2011) have compared the valuation accuracy of the equity value estimates based on the residual income model with the equity value estimates inferred from the abnormal earnings growth model introduced by Ohlson and Juettner-Nauroth (2005), and they conclude that in terms of valuation accuracy, the abnormal earnings growth model underperforms residual income valuation model.

To summarise the comparison between the valuation models used to estimate the ICC, despite the issues related to the clean surplus assumption, the empirical evidence implies that the residual income model outperforms both the abnormal earnings growth model and the dividend discount model. Thus, as discussed in section 4 in further detail, the ICC estimates presented in this paper are calculated using the residual income valuation model.

#### 2.2.6 Reliability of ICC estimates

As discussed before, it can be argued that the ICC approaches were developed in response to the concerns over the reliability of the expected return measures based on the classical asset pricing models or realised returns. Thus, examining the validity and accuracy of the expected return estimates calculated based on these approaches is crucial to assess whether the ICC approaches generate reliable measures of expected return. As stated by Botosan et al. (2011), in the previous literature, ICC estimates' reliability is usually tested by 1) assessing the relation between ICC estimates and common risk characteristics or 2) examining the association between ICC estimates and future realised returns. This section will briefly and selectively discuss this literature regarding testing the reliability of ICC estimates.

In the tests assessing the connection between ICC estimates and risk characteristics, the general approach is to test the relation between ICC estimates and the commonly used risk characteristics. The underlying hypothesis in these tests is that if ICC estimates are valid, there should be a positive correlation between the ICC estimates and risk characteristics. This hypothesis is based on the idea that the firm-specific risk is associated with generally accepted risk characteristics, and ICC should capture the market's view about a share's risk. Thus, stocks with higher risk exposures should have, in general, higher ICC estimates than the stocks with more limited risk exposures.

Gode and Mohanram (2003) compare the relation between the risk exposures and the risk premiums calculated using the models introduced by Ohlson and Juettner-Nauroth (2005). Gode and Mohanram (2003) test this relation by regressing the risk factors (beta, unsystematic risk, earnings volatility, leverage, size, long-term growth in expected earnings, book-to-market ratio and industry risk premium) against the risk premia. Furthermore, Gode and Mohanram (2003) run similar regressions by using risk premiums inferred from valuation models that are similar but not identical to models introduced by Gebhardt et al. (2001) and Liu et al. (2002) as a dependent variable. Based on the results of these regressions, Gode and Mohanram (2003) conclude that risk premiums computed based on Gebhardt et al. (2001) are more correlated with the risk factors than the risk premiums calculated by using the other two models. Further, Gode and Mohanram (2003) show that risk premiums computed based on Gebhardt et al. (2001) outperform the risk premiums calculated following Ohlson and Juettner-Nauroth (2005) in predicting one-year ahead risk premia[6]. However, the results presented by Gode and Mohanram (2003) imply that even though the results seem to vary depending on the model used to compute ICC estimates, there is generally a clear association between risk exposures and ICC estimates.

In line with Gode and Mohanram (2003), also Botosan and Plumlee (2005) as well as Botosan et al. (2011) document that the risk characteristics are consistently and predictably associated with the ICC estimates computed following different approaches, albeit the results vary slightly depending on the model used to estimate the ICC. Further, Pastor et al. (2008) conclude that the market-level estimates of ICC are associated with stock market volatility.

As discussed above, besides observing the relation between ICC estimates and risk characteristics, examining the association between ICC estimates and future realised returns is another common way used in literature to assess the reliability of ICC estimates. Both Easton and

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[6] Gode and Mohanram (2003) have not tested how accurately the model that is similar but not identical to the model introduced by Liu et al. (2002) predicts one-year ahead risk-premia.

Monahan (2005) and Guay et al. (2005) conclude that the explanatory power of ICC estimates based on various ICC approaches concerning future realised returns is limited, implying that the ICC estimates are not a reliable proxy for expected return.

In contrast to Easton and Monahan (2005) and Guay et al. (2005), Botosan et al. (2011) conclude that there is a positive association between ICC estimates and future realised returns. Botosan et al. (2011) estimate the expected return based on 12 different proxies, of which nine are ICC proxies, one proxy is derived from the four-factor model, and two proxies are based on the average of subsets of various proxies. Botosan et al. (2011) document a positive correlation between almost all examined ICC proxies and future realised returns after controlling for cash flow and expected return news. However, despite the similar theoretical premises, results differ significantly from Guay et al. (2005) and Easton and Monahan (2005). Botosan et al. (2011) argue that these differences are due to "empirical misspecification" in the models developed by Guay et al. (2005) and Easton and Monahan (2005). Further, in line with Botosan et al. (2011), Pastor et al. (2008) document that ICC outperforms realised return as a proxy for expected return.

To summarise the previous research studying the reliability of ICC estimates: despite the results slightly varying depending on the model used to compute ICC estimates, there seems to be a strong positive association between the ICC estimates and firm-level risk characteristics. However, tests assessing the association between ICC estimates and future realised returns have provided more mixed results, as these seem to depend on the controlling variables used and how the ICC proxies are calculated. In conclusion, considering the limitations of the traditional approaches discussed in section 2.1, the previous literature implies that despite the deficiencies of the ICC approaches, the ICC estimates are a relatively reliable and valid proxy for expected returns.

#### 2.2.7 ICC-based trading strategies

Already at the beginning of the 2000s, Gebhardt et al. (2001) stated that the ICC estimates could be utilised in creating a trading strategy and that their "*research plans include testing such a strategy*" (p. 172). As previously explained, a vast array of literature examines the relationship between ICC estimates and common risk characteristics and the association between ICC estimates and future realised returns. However, based on my comprehensive literature review, only one study by Esterer and Schröder (2014) has explicitly studied whether investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns. Esterer and Schröder (2014) document that in the U.S. equity markets, portfolios comprising stocks with high ICC estimates overperform those with low ICC estimates, and this outperformance remains statistically significant when controlling for commonly known variables. However, Esterer and Schröder (2014) report that the statistical significance of abnormal returns generated by strategies designed to take advantage of stocks' ICC estimates disappears when transaction costs are taken into account. Since most of my analyses behind the results reported in section 5 partially replicate the analyses conducted by Esterer and Schröder (2014), the methodology used and conclusions presented by Esterer and Schröder (2014) will be further discussed in sections 4 and 5.

# 3 Data

This section presents the data used in this thesis and the sources from which the data is obtained. Furthermore, this section discusses why I have decided to make certain choices regarding the data selection.

## 3.1 Data description

The sample period in this thesis is from January 2000 to the end of 2022. The sample includes companies that meet the criteria set out below:

- A company has its stock listed in WBAH or WBDM (Austria), ALXB, MLXB, VPXB, or XBRU (Belgium), ALXP, XMLI or XPAR (France), XBER, XDUS, XETR, XFRA, XHAM, XHAN, XMUN or XSTU (Germany), XDUB (Ireland), EMTF or XLUX (Luxembourg), XAMS (Netherlands), XBRN or XSWX (Switzerland) or AQSG, AQST or XLON (United Kingdom)[7]. Hereinafter, all these listed stock exchanges are being referred to as "Western European Stock Exchanges".
- A firm's one-year-ahead and two-year-ahead earnings forecasts and a five-year earnings growth forecast can be obtained from I/B/E/S.
- Data on the current share price and the prior year's book value, earnings and dividends are available.

As discussed in section 4, my data covers monthly observations from January 2000 to the end of 2022. Using the above-listed criteria yields 144,720 firm-month observations (i.e., the number of calculated ICC estimates) from 1,278 companies. Further information on sample sizes is presented in Appendix 1, which shows the number of stocks included in the portfolios after each rebalancing event.

The main reason why I have chosen to include in my sample only companies that are listed in Western European Stock Exchanges is that most of the previous studies related to the ICC have focused on non-European markets (see, e.g., Claus & Thomas, 2001; Gebhardt et al., 2001; Gordon and Gordon, 1997; Botosan and Plumlee, 2002; Easton, 2004; Gode and Mohanram, 2003) or have used data obtained only from individual European countries (see, e.g., Daske et

[7] Abbreviations used here refer to the Market Identifier Codes (MIC).

al., 2006 and Esterer and Schröder, 2014). Furthermore, I have excluded companies that are listed on stock exchanges outside Western Europe since, as Farooq (2016) shows, Western European firms have, on average, higher analyst coverage than companies located in other parts of Europe. Thus, the availability of analysts' consensus forecasts for companies listed in Western European Stock Exchanges is significantly better than for other European companies. Furthermore, as shown by the number of firm-month observations (144,720), my sample size is larger than necessary even though companies listed in Northern Europe, Eastern Europe or Southern Europe are excluded.

Like Esterer and Schröder (2014), this study uses the median earnings forecasts of all contributing sell-side equity analysts instead of individual forecasts, and these consensus forecasts are obtained from I/B/E/S. Share prices, sector classifications, and data on total stock returns, dividends and accounting variables referred to in this thesis are obtained from Datastream. Further, the long-term Harmonised Index of Consumer Prices (HICP) inflation forecasts used to estimate the growth rates of residual income after the explicit forecast period, as described in section 4, are obtained from Eurostat.

This paper will control the results with several combinations for exposure to common risk factors. I estimate the risk-adjusted returns of the ICC-based portfolios with the CAPM developed by Sharpe (1964) and Lintner (1965) and the four-factor model introduced by Carhart (1997). European data on these risk factors are obtained from the website of Kenneth French.

# 4 Methodology

This section presents the primary empirical methods used in this thesis. In section 4.1, I present the methodology used to estimate the ICC, whereas section 4.2 presents the methods used to construct the ICC-based portfolios and analyse the profitability of investment strategies designed to take advantage of stocks' ICC estimates.

## 4.1 Calculating the implied cost of capital

### 4.1.1 Valuation model

In this thesis, the implied cost of capital for each firm included in the sample is calculated as the cost of equity that equates the present value of expected cash flows to the current stock price. The ICC for each firm is estimated using the residual income model, following the approaches used in earlier literature and especially the methodologies used by Gebhardt et al. (2001) and Claus and Thomas (2001)[8]. However, unlike the dividend discount model, the residual income model is not based on forecasted dividends. Instead, it considers firms' accounting values – book value and expected residual income – based on the so-called "clean surplus" accounting rule.

As discussed in subsections 2.2.2 and 2.2.4, the formal expression of a dividend discount model shown in equation (2) can be rewritten in the form that expresses the stock price in terms of the firm's book value and an infinite sum of its discounted residual income as shown by equation (5). Gebhardt et al. (2001) point out that equations (2) and (5) are identical, and the only difference between them is that the latter expresses the firm's value in terms of accounting numbers of the firm. However, it should be noted that, as Gebhardt et al. (2001) point out, equation (5) expressing the residual income model assumes that the book value and earnings forecasts are consistent with the "clean surplus" accounting. As stated by Claus and Thomas (2001), the alignment with the clean surplus accounting requires that all items, excluding transactions with shareholders such as dividends or share repurchases, impacting the shareholder's equity are shown in the income statement and vice versa.

[8] Esterer and Schröder (2014) estimate stocks‘ ICC estimates using an approach that is identical to model introduced by Claus and Thomas (2001).

Similarly to Gebhardt et al. (2001) and Claus and Thomas (2001), in this thesis, the future book values are constructed in accordance with the surplus accounting rule by assuming that the changes in book values from the previous period equal earnings minus dividends. Thus, the clean surplus is maintained, given that the analysts' earnings forecasts align with the clean surplus accounting. As discussed in subsection 2.2.5, the clean surplus assumption does not always hold in practice. However, despite the theoretical limitations related to the clean surplus assumption, the model yields more accurate results than alternative valuation models measured in terms of prediction errors (see, e.g., Courteau et al., 2001; Francis et al., 2000; Penman & Sougiannis, 1998; Jorgensen et al., 2011).

### 4.1.2 Forecast horizons and terminal values

Equation (5) expresses the residual income model as an infinite time series. However, this thesis uses an explicit forecast period to calculate the implied cost of capital for each firm in the sample. The results in this paper have been calculated in line with Gebhardt et al. (2001) and Claus and Thomas (2001) by using the two-stage approach forecasting earnings for up to 5 future years and estimating a terminal value for cash flows after year 5. Thus, equation (5) is adapted as follows:

$$P_t = B_t + \frac{FEPS_{t+1} - r_{eB_t}}{(1+r_e)} + \frac{FEPS_{t+2} - r_{eB_{t+1}}}{(1+r_e)^2} + \frac{FEPS_{t+3} - r_e B_{t+2}}{(1+r_e)^3} + \frac{FEPS_{t+4} - r_e B_{t+3}}{(1+r_e)^4} + \frac{FEPS_{t+5} - r_e B_{t+4}}{(1+r_e)^5} + \left[\frac{(FEPS_{t+5} - r_e B_{t+4})(1+g)}{(r-g)(1+r_e)^5}\right] \tag{6}$$

where:

$P_t$ = Share price at time $t$.

$B_t$ = Book value of equity from the most recent financial statement divided by the number of shares outstanding in the current month.

$R_e$ = The cost of equity.

$FEPS_{t+i}$ = Forecasted earnings per share for period *t+i*. For the first two years, this variable equals analysts' one-year-ahead and two-year-ahead EPS forecasts obtained from I/B/E/S ($FEPS_{t+1}$ = one-year-ahead EPS forecast & $FEPS_{t+2}$ = two-year-ahead EPS forecast). For years three, four and five, the EPS is forecasted by using the two-year-ahead earnings forecast ($FEPS_{t+2}$) and a five-year earnings growth forecast (Ltg) obtained from I/B/E/S: $FEPS_{t+3} = FEPS_{t+2}(1 + Ltg)$, $FEPS_{t+4} = FEPS_{t+2}(1 + Ltg)^2$ and $FEPS_{t+5} = FEPS_{t+2}(1 + Ltg)^3$.

$B_{t+i} = B_{t+i-1} + FEPS_{t+i} - FDPS_{t+i}$, where $FDPS_{t+i}$ The forecasted dividend per share for year t+i is calculated using the dividend payout ratio (k), estimated as further described in subsection 4.1.3. Precisely, the amount of dividends is calculated by assuming that $FDPS_{t+i} = FEPS_{t+i} * k$.

$\left[\frac{(FEPS_{t+5} - r_e B_{t+4})(1+g)}{(r-g)(1+r_e)^5}\right]$ = Terminal value of residual income after the explicit forecast period.

g = Constant growth rate of residual income after the explicit forecast period. This growth rate is estimated as further described in subsection 4.1.4.

Similarly to Claus and Thomas (2001), I use a five years explicit forecast period as I/B/E/S does not provide analysts' consensus earnings forecasts beyond year five. I estimate earnings for the next five years based on analysts' one-year-ahead, two-year-ahead, and five-year earnings growth forecasts. The chosen approach deviates notably from the method adopted by Gebhardt et al. (2001) as they use a 12-year explicit forecast period. In addition, instead of using the five-year earnings forecast, Gebhardt et al. (2001) implicitly forecast earnings beyond year three by *"mean reverting the period t+3 ROE to the median industry ROE"* (p. 141). This median industry return on equity (ROE) is a moving median of past ROEs from all firms in the same industry. Gebhardt et al. (2001) calculate the median industry ROE using data varying from the past five years up to the past ten years.

I use a shorter explicit forecast period, and a different approach to estimating earnings compared to Gebhardt et al. (2001) since the validity of the approach adopted by Gebhardt et al. (2001) is subject to the validity of one additional assumption that the companies' ROE reverts to past industry mean ROE during the explicit forecast period. There are two reasons why I find this assumption questionable. Firstly, profitabilities between industries vary significantly over time. However, estimating earnings up to twelve years based on historical earnings relies on an implicit assumption that profitability across industries remains stable over the explicit forecast period. For example, pursuant to the methodology used by Gebhardt et al. (2001), in a case where they estimate the ICC in 2000 for a company by using 12 years explicit forecast period and used the past ten years to calculate the median industry ROE, they have forecasted earnings for the year 2011 by using past median ROE of the company's industry from 1990 to 2000. Secondly, profitabilities between companies operating in the same industry vary significantly for many reasons. For example, companies may have notable differences regarding their competitive position and operational efficiency. Furthermore, Gebhardt et al. (2001) calculate median industry ROEs by grouping stocks into groups based on companies' SIC codes. However, this approach might yield inaccurate estimates because companies with the same industry SIC codes might have notably different operating models and product/services offering.

### 4.1.3 Dividend payout ratios

In this thesis, the future book values are constructed in accordance with the surplus accounting rule by assuming that the changes in book values from the previous period equal earnings minus dividends. Therefore, the model requires estimating the dividend payout ratio to estimate the future book values. I estimate the payout ratio similarly to Gebhardt et al. (2001) by assuming it equals the dividend payout ratio from the last fiscal year. In other words, the estimated payout ratio is computed by dividing dividends from the most recent fiscal year by the earnings over the same fiscal year. However, I assign a value of 1.0 for companies with a dividend payout ratio above 1.0 since, for most companies, it is not reasonable to assume that the amount of paid dividends would exceed the earnings in the longer term.

For firms with negative earnings, the payout ratio is negative, so I assume that the dividend payout ratio for these firms is 0.17, as this is the average payout ratio in my sample during the sample period. Assuming a payout ratio of 0.17 for firms with negative earnings is a rather robust assumption. However, a clear majority of earnings from the most recent fiscal year in my sample has a positive value, and thus varying the ratio assigned for firms with negative has little impact on the estimated rates of ICC.

### 4.1.4 The growth rate of residual income after the explicit forecast period

Calculating ICC requires estimating the growth rate of residual income beyond the explicit forecast period. I have followed the approach used by Claus and Thomas (2001) and Gode and Mohanram (2003), who have assumed that the residual income grows at the expected inflation rate after the explicit forecast period for all firms in their sample. The mentioned authors have calculated the estimated inflation rate by subtracting 3 per cent from the risk-free rate. However, using the same approach would often lead to results implying that the expected inflation rate is negative as euro area risk-free rates have been under 3 per cent over long times during my sample period. Therefore, I have used a modification of the approach of Claus and Thomas (2001) and Gode and Mohanram (2003) by assuming that the expected inflation rate is equal to the longer-term (five years ahead) HICP inflation forecast published by Eurostat.

HICP inflation forecasts are published quarterly, usually in the quarter's first month, and the ICC estimates are calculated using the most recently published inflation forecast. Since the portfolios constructed in this thesis based on the implied cost of capital estimates are rebalanced at the beginning of each month (monthly rebalanced portfolios) or at the beginning of each year (yearly rebalanced portfolios), the inflation forecasts used to calculate the implied cost of capital for each company on November, December and January is the Q4 forecast published in last September[9]. These forecasted longer-term inflation rates have been stable during the sample period as the rates have varied between 1.6 and 2.2 per cent.

Claus and Thomas (2001) acknowledge that estimating the growth rate beyond the explicit forecast period by subtracting 3 per cent from the risk-free rate is higher than usually used in the literature. As a comparison, Gebhardt et al. (2001) calculate the terminal value by assuming that the growth rate of residual income is zero after the explicit forecast period. Assigning a zero growth rate might seem to be a pessimistic assumption, but as Gebhardt et al. (2001) point out, this does not imply that cash flows do not grow after the explicit forecast period but assumes that any incremental economic profits after the explicit forecast period are zero.

As Easton et al. (2002) point out, the expected return estimates can be sensitive to assumptions about the growth rate of residual income. Therefore, due to the importance of the assumed growth rate, I have also calculated some results by assuming that the growth rate of residual income beyond the explicit forecast period is zero to check the robustness of my results further. Results calculated using this alternative specification are reported in the Appendices.

[9] The inflation forecast used to calculate the implied cost of capital for each company in February-April is the Q1 forecast published the last January. The inflation forecast used to calculate the implied cost of capital for each company in May-July is the Q2 forecast published the last April, and the inflation forecast used to calculate the implied cost of capital in August-October is the Q3 forecast published in July.

## 4.2 Analysing the profitability of ICC-based investment strategies

### 4.2.1 Calculating risk-adjusted returns of ICC-based portfolios

I follow a similar approach to Esterer and Schröder (2014) to construct implied cost of capital-based portfolios, and the portfolios are constructed, as further explained in section 5, as follows: First, at the beginning of each month (monthly rebalanced portfolios) or year (yearly re-balanced portfolios), all stocks in my sample are ranked according to their ICC estimates and grouped into five equally-weighted portfolios. Second, I measure the subsequent total portfolio returns for these portfolios and for a portfolio that is simultaneously long in a portfolio consisting of stocks with the highest ICC estimates and short in a portfolio comprised of stocks with low ICC estimates.

To examine whether the ICC-based portfolios yield abnormal returns, similar to Esterer and Schröder (2014), I use the CAPM developed by Sharpe (1964) and Lintner (1965) and the Four-Factor Model introduced by Carhart (1997)[10]. The CAPM regression coefficients are obtained from the following time-series regression:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + e_{pt} \tag{7}$$

where $R_{pt}$ is the return for portfolio $p$ on period[11] $t$, $R_{ft}$ is the period $t$ risk-free rate obtained from the website of Kenneth French, $\alpha_p$ is the estimated CAPM intercept (CAPM alpha), $\beta_p$ is the estimated beta, $R_{mt}$ is the period $t$ return on the value-weighted market portfolio comprising all stocks listed in Western European Stock Exchanges and $e_{pt}$ is the regression error term.

The four-factor alpha is calculated by using the four-factor model developed by Carhart (1997), and the four-factor model is obtained from the following time series regression:

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[10] Despite using a similar methodology to Esterer and Schröder (2014), the methods described in this subsection 4.2.1 to estimate the beta coefficients differ notably from the approach used by the said authors, who calculate the betas by regressing a company's five-year price return sensitivity on the market portfolio.

[11] The period refers to a month or year, depending on whether the portfolio is rebalanced monthly (period = month) or annually (period = year).

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + m_p MOM_t + e_{pt} \tag{8}$$

where $SMB_t$ is the return of size factor, $HML_t$ is the return of a value factor and $MOM_t$ is the return of the momentum factor[12]. The regression yields estimates of $\alpha_p$, $\beta_p$, $s_p$, $h_p$ and $m_p$.

### 4.2.2 Transaction costs

My second main hypothesis ($H_2$) is that the ICC estimates can be used to generate investment strategies that yield positive abnormal returns. These abnormal returns are measured before transaction costs in subsection 5.2.1 and after transaction costs in subsection 5.2.2.

However, as stated by Esterer and Schröder (2014), "*Actual investors that try to exploit the ICC effect in stock markets face transaction costs every time they rebalance their equity portfolio, which reduces the risk-adjusted returns*." (p.184). Therefore, to estimate whether the ICC-based strategies generate positive abnormal returns in practice, the transaction costs of these strategies should be estimated. My approach to estimating transaction costs is based on the methods developed by Barber et al. (2001), Keim and Madhavan (1998) and Esterer and Schröder (2014). I estimate the transaction costs by first calculating the turnover for each portfolio at each rebalancing date. Then the transaction costs are computed by assuming round-trip transaction costs of 1.0 per cent. The procedure to calculate the portfolio turnovers and the assumed round-trip transaction costs are described in more detail below.

Similarly to Barber et al. (2001), in this thesis, the turnover for portfolio *p* during rebalancing day *t* is defined as the percentage of a portfolio that has been turned over at rebalancing day *t*. Following Barber et al. (2001), the turnover for portfolio *p* at rebalancing date *t* is calculated by first computing the fraction each stock would have comprised of portfolio *p* at the end of rebalancing date *t* if there were no rebalancing, and as shown by Barber et al. (2001), this fraction $G_{it}$, can be expressed as follows:

[12] The estimation of $SMB_t$ and $HML_t$ is further described in Fama and French (1993) and Carhart (1997). The calculation of the $MOM_t$ is discussed in more detail in Carhart (1997).

$$G_{it} = \frac{x_{it-1} * (1 + R_{it})}{\sum_{i=1}^{n_{pt-1}} x_{it-1} * (1 + R_{it})} \tag{9}$$

where $R_{it}$ is the return on the common stock of a company $i$ on date $t$, $x_{it-1}$ is the market capitalisation for a company $i$ as of the close of trading on $t-1$ ($t-1$ = last trading day before the rebalancing date $t$) divided by the aggregate market values of all firms in portfolio $p$ as of the close of trading on $t-1$ and $n_{pt-1}$ is the number of firms in portfolio p at the close of trading on date $t-1$. Then, $G_{it}$ is compared to the fraction the firm *i* has in portfolio $p$ at the end of rebalancing date *t* after the portfolio has been rebalanced based on stocks' ICC estimates (this fraction is denoted by $F_{it}$). The final step in calculating a turnover for portfolio $p$ at the rebalancing date *t* is to sum the decreases in the percentage holding (from the close of the trading on date $t-1$ to the end of trading on rebalancing date $t$) of each security included in portfolio $p$ on date $t-1$. As shown by Barber et al. (2001), the turnover for portfolio $p$, denoted by $U_{it}$, is calculated as follows:

$$U_{it} = \sum_{\mathrm{i}=1}^{p_t} \mathrm{MAX}\{G_{it} - F_{it}, 0\} \tag{10}$$

After calculating the turnover for each portfolio at each rebalancing date, I estimate transaction costs at date *t* by assuming a round-trip transaction cost of 1.0 per cent, i.e., the cost of replacing existing shares in a portfolio with new shares amounts to 1.0 per cent of the share value traded. Together with the estimated turnover for each portfolio on each rebalancing date, the assumed round-trip transaction costs can be used to estimate transaction costs for each portfolio on each rebalancing date[13]. Considering that the assumed level of transaction costs has usually been higher in previous literature, I will also compute the results net of transaction costs assuming that round-trip transaction costs equal 0.5 and 1.5 per cent to check the robustness of my results further. However, as discussed further in subsection 5.2.2, I find it justifiable to assume lower transaction costs than usually assumed in the literature since technological developments have substantially decreased the costs associated with trading.

[13] My methodology to estimate the transaction costs differ from the methodology used by Esterer and Schröder (2014) in two main ways. Firstly, instead of calculating the turnover for each portfolio at each rebalancing date, Esterer and Schröder (2014) assume that the turnover for a portfolio remains constant and equals the average turnover rate at each rebalancing date of a portfolio. Secondly, they assume 2.0 per cent round-trip transaction costs.

### 4.2.3 Limitations

Several limitations are affecting my study. Most of these limitations are related to the valuation model used in this thesis since, as Gebhardt et al. (2001) pointed out, finite time horizon versions of the cash flow-based valuation models require simplifying assumptions.

First, I have assumed the same growth rate for all firms in my sample beyond the five-year explicit forecast period. Thus, as acknowledged in the existing literature (see, e.g., Gebhardt et al., 2001), the ICC estimates may be too low (high) for firms with high (low) growth expectations after the explicit forecast period. Second, the future dividends in my model are estimated based on the dividends paid in the last fiscal year, and these estimates may contain measurement errors. Third, the residual income model used in this thesis to estimate the ICC relies on the clean surplus assumption, which does not always hold in practice. However, despite the theoretical limitations related to the clean surplus assumption, the model yields more accurate results than alternative valuation models measured in terms of prediction errors (see, e.g., Courteau et al., 2001; Francis et al., 2000; Penman & Sougiannis, 1998; Jorgensen et al. 2011). Fourth, similarly, as all methods to estimate the ICC that rely on analysts' forecasts, my approach is based on the implicit assumption, which does not always hold in practice, that analysts' cash flow forecasts accurately reflect the market's opinion on the share's expected cash flows.

To summarise these abovementioned limitations, like all methods used to estimate the cost of capital, the approach used in this thesis to compute the ICC estimates might yield results containing measurement errors, and thus these ICC estimates may deviate from the true theoretical cost of capital. Furthermore, the ICC-based portfolios are constructed by ranking all stocks in the sample according to their ICC estimate and grouping them into portfolios based on these estimates. Thus, these measurement errors might impact which stocks are included in each portfolio, affecting the measured portfolio returns. These measurement errors and the methods used to mitigate them are described in more detail in subsections 4.1.1-4.1.4.

# 5 Results

The results from my analyses are split into two sections. Section 5.1 reports the absolute and risk-adjusted returns before transaction costs and the characteristics of the five portfolios constructed based on stocks' ICC estimates, evaluating the first main hypothesis ($\mathrm{H_1}$). Section 5.2 presents the results of the ICC-based investment strategies after transaction costs evaluating hypothesis two ($\mathrm{H_2}$). The methodology used to obtain most of the results reported in sections 5.1 and 5.2 partially replicates the methodology used by Esterer and Schröder (2014).

## 5.1 Returns and characteristics of ICC-based portfolios

Section 5.1 is split into two subsections. Firstly, subsection 5.1.1 reports absolute and risk-adjusted returns before transaction costs of the portfolios constructed based on stocks' ICC estimates evaluating hypothesis one ($\mathrm{H_1}$). Secondly, subsection 5.1.2 analyses the characteristics of these portfolios. Subsection 5.1.2 is not directly related to my main hypotheses, but analysing portfolio characteristics provides insights into the reasons behind the observed differences in absolute and risk-adjusted returns.

### 5.1.1 Absolute and risk-adjusted returns of ICC-based portfolios

To obtain the absolute and risk-adjusted returns of ICC-based portfolios, I follow the methodology used by Esterer and Schröder (2014). First, the monthly rebalanced ICC-based portfolios are constructed using the following procedure: At the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios[14]. I also report returns for yearly rebalanced portfolios, which are constructed otherwise similarly to monthly rebalanced portfolios but rebalanced only once a year at the beginning of each year. After the portfolios are formed, I calculate the absolute returns of portfolios by measuring the subsequent total portfolio returns, including capital gains and dividend yield over the sample period from January 2000 to the end of 2022. The final step is to calculate the risk-adjusted returns of the portfolios: I calculate alphas for portfolios using the CAPM based

[14] The portfolio with the lowest ICC estimates (P1) includes all stocks in the sample whose ICC estimate is below or equal to the 20th percentile, (P2) includes all stocks in the sample whose ICC estimate is above the 20th percentile and below or equal to the 40th percentile, (P3) includes all stocks in the sample whose ICC estimate is above the 40th percentile and below or equal to the 60th percentile, (P4) includes all stocks in the sample whose ICC estimate is above the 60th percentile and below or equal to 80th percentile and (P5) includes all stocks in the sample whose ICC estimate is above the 80th and below or equal to the 100th percentile.

on the work by Sharpe (1964) and Lintner (1965), as shown in equation (7). The four-factor alphas are calculated by regressing the returns of portfolios against the factors in Carhart's (1997) four-factor model, as shown in equation (8).

Table 1 presents the absolute returns of portfolios constructed based on stocks' ICC estimates and the average of ICC estimates of the firms included in each portfolio. In contrast, Table 2 reports the risk-adjusted returns of these portfolios[15]. As shown in Table 2, the monthly returns of a portfolio, including stocks with the highest ICC estimates, are statistically significant when measured by using CAPM or the four-factor model. In addition, the high ICC portfolio generates notably higher monthly absolute and risk-adjusted returns than portfolios that include stocks with lower ICC estimates. However, despite these notable differences in monthly returns between high and lower ICC portfolios, returns of other portfolios that include stocks with ICC estimates close to the average (P2, P3 and P4) indicate no positive association between the ICC estimates and the absolute or risk-adjusted returns.

**Table 1: Portfolio returns 2000-2022 gross of transaction costs**

This Table reports the monthly and annual geometric mean returns of the five portfolios constructed according to the firms' ICC estimate. Column "Monthly returns" reports the monthly returns of portfolios in which, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Column "Annual returns" reports the return of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. P1 comprises the stocks with the lowest ICC, and P5 comprises the stocks with the highest ICC. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, the Table reports the average ICC estimates of the firms included in each portfolio. The *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The sample period is from January 2000 to the end of the year 2022.

| | ICC (%) | Monthly returns | Annual returns |
|---|---|---|---|
| P1 (low ICC) | 5.72% | 0.36% | 6.71% |
| P2 | 8.31% | 0.64% | 7.39% |
| P3 | 10.02% | 0.56% | 6.82% |
| P4 | 12.14% | 0.58% | 7.36% |
| P5 (high ICC) | 18.56% | 0.66% | 8.68% |
| P5-P1 | 12.78% | 0.33% | 2.48% |

[15] Results reported in Tables 1 and 2 have also been calculated using an alternative specification by assuming that the growth rate of residual income beyond the explicit forecast period is zero. The results using this alternative specification are reported in Appendix 2 and 3, and these results are in all material aspects highly similar to those reported in Tables 1 and 2. The similarity of these results implies that estimates of expected return are less sensitive to growth rate assumptions as could have been expected.

Furthermore, as reported in Table 1 above, the relative difference in absolute returns between monthly rebalanced high and low ICC portfolios is higher than the difference between annually rebalanced high and low ICC portfolios. This implies that ICC estimates' impact on expected returns erodes over a more extended holding period.

To summarise the results regarding my first main hypothesis ($H_1$) that there is a relation between ICC estimates and future realised returns, and thus there should be a strong positive association between portfolio returns and average ICC estimates of the firms included in each portfolio: The results are conflicting as despite the notable differences in monthly returns between high and lower ICC portfolios, the returns of other portfolios do not support the hypothesis. Therefore, it appears that there is no clear relation between ICC estimates and absolute or risk-adjusted returns of the portfolios. Nevertheless, results show that monthly rebalanced portfolios comprising stocks with the highest ICC estimates outperform other portfolios, especially those with the lowest ICC estimates (results of the ICC-based investment strategies are reported in section 5.2).

### 5.1.2 Characteristics of ICC-based portfolios

Table 2 strongly indicates that ICC-based portfolios have differing characteristics[16]. A first notable observation regarding the portfolio characteristics is that, as shown in Table 2 below, the differences between betas of portfolios P1, P2, P3 and P4 are surprisingly small. However, the betas of the monthly and annually rebalanced portfolios consisting of stocks with the highest ICC estimates are significantly higher than those of other portfolios, indicating that the high ICC portfolios are especially exposed to risk arising from changes in overall stock markets. Moreover, the portfolios long in the high ICC portfolios and short in the low ICC portfolios have notably high betas for long-short portfolios, considering that long-short portfolios are, in principle, at least almost market neutral. Finally, it is also notable that the average beta of ICC-

[16] Results reported in Table 2 are calculated for portfolios constructed without paying attention to companies' sectors. However, as the average ICC estimates vary between industries, these industry-agnostic portfolios have different sector weightings, as reported in Appendix 4. Therefore, I have calculated the results reported in Table 2 also by using an alternative specification constructing portfolios by first sorting all stocks into eleven sector portfolios based on companies' GICS sector classification and then sorting all stocks in these sector portfolios again into five portfolios according to their ICC estimate, and these results are reported in Appendix 5. Due to this method used to construct portfolios, these portfolios have similar sector loading. However, the results shown in Appendix 5 are materially similar to those shown in Table 2, which strongly indicates that the differences in industry performances have a very limited impact on the returns of ICC-based portfolios. Therefore, this thesis does not report any additional results than those reported in Appendix 5 calculated using this alternative specification.

based portfolios is above 1.0, but the reason for this likely is that all ICC-based portfolios consist of fewer assets than the market portfolio and are thus, on average, more volatile than the market portfolio.

Observing the monthly rebalanced portfolios reveals that the SMB coefficient of the high ICC portfolio is higher than the SMB coefficient of the low ICC portfolio, and the said coefficient of portfolio P5-P1 is positive and statistically significant. However, despite the abovementioned, there is no clear relation between the SMB coefficients and the average ICC estimates of the firms included in each portfolio. Further, almost all portfolios seem weighted towards stocks with smaller market capitalisations. The likely explanation for this unexpected result is that all portfolios are equally weighted, and thus the stocks with small market capitalisation have larger weight in these portfolios compared to market value-weighted portfolios.

As shown in Table 2, all monthly rebalanced portfolios seem to be negatively exposed to the momentum factor. The most potential explanation for this is that ICC-based portfolios that I have constructed are equally weighted, and due to the monthly rebalancing, the weight of well-performing stocks in these portfolios increases less than in value-weighted portfolios rebalanced less frequently. Despite the negative exposure to the momentum factor being strongest for the monthly rebalanced high ICC portfolio, the MOM coefficients of the monthly rebalanced portfolios P2, P3 and P4 indicate that portfolios comprising stocks with higher ICC estimates are not systematically more exposed to the momentum factor. Further, the MOM coefficients of annually rebalanced portfolios strongly support this interpretation. The finding that there is no relation between the exposure to the momentum factor and the ICC estimates is not in line with the findings made by Esterer and Schröder (2014), who argue that stocks with high ICC estimates tend to be stocks that have underperformed recently. Furthermore, the finding is surprising considering that value and momentum returns are negatively correlated (see, e.g., Asness et al., 2013), and as further discussed below, the higher ICC portfolios are systematically more weighted towards value stocks than the lower ICC portfolios.

## Table 2: Risk-adjusted portfolio returns 2000-2022 gross of transaction costs

This Table reports the risk-adjusted returns gross of transaction costs of the five portfolios constructed according to the firms' ICC estimate. Panel A reports the monthly risk-adjusted returns of portfolios in which, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Panel B reports the annual risk-adjusted returns of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. P1 comprises the stocks with the lowest ICC, and P5 comprises the stocks with the highest ICC. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, the Table reports the CAPM and four-factor model regression coefficients. The CAPM regression coefficients are obtained from the regression model described by equation (7), and the four-factor regression coefficients are obtained from the regression model shown by equation (8). The *,** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The sample period is from January 2000 to the end of the year 2022.

| *Panel A: Monthly returns* | | | | | |
|---|---|---|---|---|---|
| | α | Beta | SMB | HML | MOM |
| P1 | 0.08 | 1.08*** | | | |
| t-stat | (0.53) | (32.49) | | | |
| P2 | 0.18* | 0.98*** | | | |
| t-stat | (1.66) | (41.72) | | | |
| P3 | 0.06 | 1.02*** | | | |
| t-stat | (0.49) | (41.32) | | | |
| P4 | 0.07 | 1.12*** | | | |
| t-stat | (0.56) | (40.22) | | | |
| P5 | 0.39** | 1.38*** | | | |
| t-stat | (2.11) | (34.19) | | | |
| P5-P1 | 0.31 | 0.30*** | | | |
| t-stat | (1.58) | (6.99) | | | |
| P1 | 0.20 | 1.05*** | 0.55*** | -0.20*** | -0.16*** |
| t-stat | (1.49) | (32.27) | (8.63) | (-4.28) | (-4.25) |
| P2 | 0.23** | 0.95*** | 0.37*** | -0.08** | -0.09*** |
| t-stat | (2.29) | (40.32) | (8.12) | (-2.30) | (-3.37) |
| P3 | 0.11 | 0.99*** | 0.51*** | -0.01 | -0.12*** |
| t-stat | (1.11) | (42.79) | (11.29) | (-0.41) | (-4.57) |
| P4 | 0.07 | 1.07*** | 0.55*** | 0.20*** | -0.14*** |
| t-stat | (0.64) | (42.31) | (11.16) | (5.32) | (-4.88) |
| P5 | 0.50*** | 1.23*** | 0.75*** | 0.27*** | -0.35*** |
| t-stat | (3.59) | (36.68) | (11.41) | (5.64) | (-9.36) |
| P5-P1 | 0.30* | 0.17*** | 0.19** | 0.48*** | -0.20*** |
| t-stat | (1.72) | (4.15) | (2.40) | (7.91) | (-4.19) |
| *Panel B: Annual returns* | | | | | |
| | α | Beta | SMB | HML | MOM |
| P1 | 2.53 | 1.13*** | | | |
| t-stat | (1.06) | (9.45) | | | |
| P2 | 3.13* | 0.99*** | | | |
| t-stat | (1.77) | (11.26) | | | |
| P3 | 2.38 | 1.10*** | | | |
| t-stat | (1.58) | (14.64) | | | |
| P4 | 3.31 | 1.10*** | | | |
| t-stat | (1.39) | (9.32) | | | |
| P5 | 4.59* | 1.36*** | | | |
| t-stat | (1.65) | (9.80) | | | |

| | | | | | |
|---|---|---|---|---|---|
| P5-P1 | 2.06 | 0.24* | | | |
| t-stat | (0.79) | (1.83) | | | |
| P1 | 2.98 | 0.89*** | 1.09*** | -0.24** | -0.16* |
| t-stat | (1.51) | (9.60) | (5.04) | (-2.27) | (-1.72) |
| P2 | 1.89 | 0.92*** | 0.55** | -0.09 | 0.04 |
| t-stat | (0.92) | (9.59) | (2.44) | (-0.83) | (0.42) |
| P3 | 1.27 | 1.01*** | 0.57*** | -0.03 | 0.00 |
| t-stat | (0.76) | (12.95) | (3.12) | (-0.30) | (0.00) |
| P4 | -0.09 | 0.97*** | 1.02*** | 0.25** | 0.02 |
| t-stat | (-0.04) | (9.06) | (4.06) | (1.99) | (0.19) |
| P5 | 2.08 | 1.14*** | 1.24*** | 0.31** | -0.12 |
| t-stat | (0.84) | (9.82) | (4.57) | (2.30) | (-1.07) |
| P5-P1 | -0.90 | 0.25** | 0.15 | 0.56*** | 0.03 |
| t-stat | (-0.34) | (2.03) | (0.52) | (3.81) | (0.28) |

Besides the abovementioned differences in portfolio characteristics, the HML coefficients shown in Table 2 above indicate that ICC estimates are strongly related to book-to-market ratios as the higher ICC portfolios are clearly more tilted towards value stocks with a high book-to-market ratio than the lower ICC portfolios. These results regarding the portfolios' HML coefficients are related to the discussion on what has been driving the so-called "value premium", which generally refers to the well-established findings that firms with higher book-to-market ratios generate higher returns than companies with lower such ratios. The theories attempting to explain the value premium can be roughly split into behavioural-based and risk-based explanations. Behavioural-based explanations claim that investors systematically under-price value stocks due to their behavioural biases. For example, Lakonishok et al. (1994) argue that behavioural biases cause the value premium and that investors are willing to pay too much for growth stocks as they extrapolate past growth too far into the future. Also, Titman and Daniel (1997) attribute the value stock overperformance to behavioural biases, and they argue that, among other possible explanations linked to behavioural finance, the value premium might be caused by investors who have attached higher discount rates to value stocks as they have mistakenly assumed that value stocks bear higher systematic risk. In contrast to these behavioural explanations, many previous studies suggest that value stocks are associated with higher risk and that the “value premium” is compensation for the higher risks induced by the characteristics of value stocks (see Fama and French, 1993; Fama and French, 1996; and Petkova and Zhang, 2005).

HML coefficients reported in Table 2 indicate that value stocks tend to have a higher implied cost of capital than growth stocks, which implies that value stocks are riskier than growth stocks as ICC aims to capture the market's view about a share's risk. Thus, these findings related to HML coefficients shown in Table 2 seem to support the risk-based explanations for the value premium. However, as the interesting relationship between book-to-market ratio and ICC values is not directly related to my main hypotheses, the association between book-to-market ratios and ICC values is not discussed further.

### 5.2 ICC-based investment strategies

As mentioned in the introduction of this thesis, my second main hypothesis ($\mathrm{H}_2$) is that the ICC estimates can be used to generate profitable trading strategies by either 1) being long in portfolios that include stocks with high ICC estimates or 2) being simultaneously long in high ICC portfolios and short in low ICC portfolios. My initial supposition is that the best way to detect the possible existence of the so-called ICC effect is to observe stocks with especially low or high ICC estimates, as the ICC effect should be strongest for stocks with ICC estimates clearly deviating from the sample average. Therefore, to assess whether ICC estimates can be used to generate profitable trading strategies by being long in portfolios that include stocks with high ICC estimates or being simultaneously long in high ICC portfolios and short in low ICC portfolios, I focus on measuring the returns of portfolios that comprise only stocks with very high or low ICC estimates.

The second main hypothesis ($\mathrm{H}_2$) is evaluated in this section 5.2, which is further split into two subsections: subsection 5.2.1 analyses the profitability of these trading strategies before transaction costs evaluating the subhypothesis ($\mathrm{H}_{2.1}$). Finally, subsection 5.2.2 measures the profitability of these strategies when the transaction costs are considered evaluating the subhypothesis ($\mathrm{H}_{2.2}$).

#### 5.2.1 Returns of ICC-based investment strategies before transaction costs

Portfolios analysed in section 5.1 are quite widely diversified as the number of stocks included in the portfolios is, on average, quite large. As well known, increasing the number of stocks in a portfolio generally decreases a portfolio's unsystematic risk and volatility. However, as stated by Esterer and Schröder (2014), if ICC estimates can be used to detect pricing errors since the stocks with very high ICC estimates are underpriced, and vice versa, the stocks with more extreme ICC estimates should be especially mispriced. Thus, investing in more extreme ICC quintiles should generate higher returns. Therefore, to assess whether ICC estimates can be used to generate profitable trading strategies by being long in portfolios that include stocks with high ICC estimates or being simultaneously long in high ICC portfolios and short in low ICC portfolios, I also measure the returns of portfolios that comprise only stocks with extremely high or low ICC estimates.

Table 3 below reports the absolute and risk-adjusted returns of the portfolios consisting only of stocks with extremely high or low ICC estimates and the returns of portfolios P1, P5 and P5-P1, which are also reported in tables 1 and 2[17]. The procedure followed to construct the portfolios P1, P5 and P5-P1 referred to in tables 1 and 2 is further explained in subsection 5.1.1. The portfolios comprising only stocks with extremely high or low ICC estimates are constructed quite similarly using the following procedure: Firstly, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate. Then low ICC portfolio is formed by grouping the stocks with ICC estimates below a certain percentile into an equally-weighted low ICC portfolio. Accordingly, the high ICC portfolio is formed by grouping the stocks with ICC estimates above a certain percentile into an equally-weighted high ICC portfolio. After the portfolios are formed, I calculate the absolute returns of these portfolios by measuring the subsequent total portfolio returns, including capital gains and dividend yield over the sample period from January 2000 to the end of 2022. The final step is to calculate the risk-adjusted returns of the portfolios: I calculate alphas for portfolios using the CAPM based on the work by Sharpe (1964) and Lintner (1965), as shown in equation (7). The four-factor alphas are calculated by regressing the returns of portfolios against the factors in Carhart's (1997) four-factor model, as shown in equation (8).

[17] The columns of Table 3 below indicate the returns of portfolios comprising only stocks with ICC estimates below/above the 20th/80th,10th/90th, 5th/95th and 2nd/98th percentile. Returns of low ICC portfolios reported in the table include only stocks with ICC estimates below the lower percentile (20th, 10th, 5th, or 2nd). In contrast, returns of high ICC portfolios reported in the table include only stocks with ICC estimates above the higher percentile (80th, 90th, 95th, or 98th). Long-short portfolios are long in these high ICC portfolios and short in these low ICC portfolios.

## Table 3: Raw and risk-adjusted returns for low and high ICC portfolios gross of transaction costs

This Table reports the absolute and risk-adjusted returns before transaction costs of the low and high ICC portfolios. The low ICC portfolio contains only stocks below a given ICC percentile, and the high ICC portfolio contains only stocks above a given ICC percentile (for example, in the 5th/95th specification, the low ICC portfolio includes stocks with ICC estimates lower than the 5th percentile and high ICC portfolio includes stocks with ICC estimate higher than the 95th percentile). The long-short portfolio is long in the high ICC portfolio, which includes stocks with ICC estimate above the given percentile, and short in the low ICC portfolio, which includes stocks with ICC estimate below the given percentile. Panel A reports the monthly returns of portfolios rebalanced at the beginning of every month, and panel B reports the yearly returns of portfolios rebalanced at the beginning of each year. The CAPM alphas are obtained from the regression model described by equation (7), and the four-factor alphas are obtained from the regression model shown by equation (8).

*Panel A: Monthly portfolio returns*

| ICC percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
|---|---|---|---|---|
| **Geometric mean return** | | | | |
| Low ICC portfolio | 0.36% | 0.25% | 0.27% | -0.21% |
| High ICC portfolio | 0.66% | 0.62% | 0.54% | 0.72% |
| Long-short portfolio | 0.33% | 0.39% | 0.31% | 0.94% |
| **CAPM alphas:** | | | | |
| Low ICC portfolio | 0.08 | -0.01 | 0.03 | -0.42 |
| t-statistics | (0.53) | (-0.04) | (0.11) | (-1.58) |
| High ICC portfolio | 0.39** | 0.38* | 0.33 | 0.59 |
| t-statistics | (2.11) | (1.72) | (1.59) | (1.57) |
| Long-short portfolio | 0.31 | 0.26 | 0.19 | 0.88** |
| t-statistics | (1.58) | (1.12) | (0.73) | (2.33) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | 0.20 | 0.13 | 0.28 | -0.32 |
| t-statistics | (1.49) | (0.73) | (1.22) | (-1.25) |
| High ICC portfolio | 0.50*** | 0.58*** | 0.61*** | 0.95*** |
| t-statistics | (3.59) | (3.25) | (2.57) | (2.8) |
| Long-short portfolio | 0.30* | 0.33 | 0.21 | 1.16*** |
| t-statistics | (1.72) | (1.50) | (0.83) | (2.97) |

*Panel B: Annual portfolio returns*

| ICC percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
|---|---|---|---|---|
| **Geometric mean return** | | | | |
| Low ICC portfolio | 6.71% | 9.24% | 7.36% | 2.94% |
| High ICC portfolio | 8.68% | 8.11% | 8.64% | 10.01% |
| Long-short portfolio | 2.48% | 0.85% | 1.98% | 8.01% |
| **CAPM alphas:** | | | | |
| Low ICC portfolio | 2.53 | 6.20* | 4.19 | 0.26 |
| t-statistics | (1.06) | (1.75) | (1.03) | (0.06) |
| High ICC portfolio | 4.59* | 7.00 | 6.76 | 9.20 |
| t-statistics | (1.65) | (1.40) | (1.33) | (1.54) |
| Long-short portfolio | 2.06 | 0.80 | 2.57 | 8.93* |
| t-statistics | (0.79) | (0.28) | (0.81) | (2.00) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | 2.98 | 7.81* | 3.58 | -2.32 |
| t-statistics | (1.51) | (1.88) | (0.75) | (-0.41) |
| High ICC portfolio | 2.08 | 5.75 | 6.33 | 11.52 |
| t-statistics | (0.84) | (0.93) | (1.01) | (1.52) |
| Long-short portfolio | -0.90 | -2.06 | 2.76 | 13.84** |
| t-statistics | (-0.34) | (-0.61) | (0.66) | (2.54) |

Results reported in Table 3 above show that all monthly rebalanced high ICC portfolios have a highly statistically significant four-factor alpha. Further, the four factor-alpha of these portfolios seems to grow when the number of stocks in portfolios is decreased, and generally, the return difference between high and low ICC portfolios tends to increase when decreasing the number of stocks in a portfolio. However, except for the CAPM and four-factor alphas of the long-short portfolio that includes only stocks below/above the 2nd/98th percentile, the statistical significance of the alphas calculated for high ICC and long-short portfolios does not seem to increase when decreasing the number of stocks. The reason for this is likely that, as stated earlier, decreasing the number of stocks in a portfolio increases the returns volatility of a portfolio, which decreases the statistical significance of the portfolio returns.

As shown in Table 3, except for the long-short portfolio that includes only stocks below/above the $2^{nd}/98^{th}$ percentile, other long-short portfolios do not generate highly statistically significant positive abnormal returns. Therefore, in line with the results reported in tables 1 and 2, trading strategies based on being simultaneously long in high ICC portfolios and short in low ICC portfolios do not generally generate statistically significant positive abnormal returns.

To summarise the findings presented in this subsection 5.2.1 and to conclude on the subhypothesis ($H_{2.1}$) that the ICC-based investment strategies yield positive abnormal returns gross of transaction costs: It appears that the ICC estimates can be used to create trading strategies that yield positive abnormal returns before transaction costs since, as reported in Table 3, all monthly rebalanced high ICC portfolios, as well as monthly and annually rebalanced long-short portfolios including only stocks below/above the 2nd/98th percentile, generate four-factor alpha that is highly statistically significant. Whether the ICC-based trading strategies generate abnormal returns after considering the impact of transaction costs, i.e., do these strategies yield abnormal returns when implemented in practice, will be evaluated in the next subsection, 5.2.2.

### 5.2.2 Returns of ICC-based investment strategies after transaction costs

All results presented so far have been calculated by not considering the transaction costs, such as the brokerage commissions, the bid-ask spread and the market impact of trading. However, in this subsection, the returns are reported by considering the transaction costs, such as the bid-ask spread, brokerage commissions, and the market impact of trading. However, these costs must be considered when evaluating whether ICC-based investment strategies yield abnormal returns in practice, and in this subsection, I report the returns of portfolios net of transaction costs[18]. To estimate the transaction costs, I calculate the turnover for each portfolio at each rebalancing date as further described in subsection 4.2.2, and assume that round-trip transaction costs amount to 1.0 per cent of the share value traded.

The level of assumed transaction costs is relatively low compared to the assumptions used conventionally in the literature. For example, Barber et al. (2001) have assumed 1.3% round-trip transaction costs based on the size of the firms in their sample. However, it should be noted that the transaction costs have been sharply declining, and as shown by Stoll (2006), technological developments have substantially decreased the trading costs, and for example, the average round-trip commission in the U.S. decreased from 1.17% in 1980 to 0.21% in 2001. As the transaction costs have decreased significantly over the last decades, it seems reasonable to assume that the transaction costs during my sample period (2000-2022) are notably lower than assumed by Barber et al. (2001), who use a sample period starting from 1985 and ending in 1996. Furthermore, Frazzini et al. (2012) use live trading data from institutional money managers over a 16-year period to estimate the transaction costs faced by real-world arbitrageurs, and they conclude that actual transaction costs are several times smaller than suggested by previous studies. In light of the evidence presented by Frazzini et al. (2012), assuming 1% transaction costs might even overestimate the transaction costs of implementing the ICC-based investment strategies. However, considering that the actual transaction costs depend on various factors, such as trade sizes and vary between investors, I will also compute results by assuming 0.5 and 1.5 per cent round-trip transaction costs to check the robustness of my results further.

Table 4 reports the absolute and risk-adjusted returns of the ICC-based portfolios after considering the transaction costs. The only difference between the results reported in Tables 3 and 4 is that results in Table 3 are gross transaction costs, and results in Table 4 are net transaction costs assuming 1% round-trip transaction costs. Results reported in Table 4 show that the impact of transaction costs on the abnormal returns of high and low ICC portfolios is surprisingly low, and even after transaction costs, almost all monthly rebalanced high ICC portfolios yield four-factor alphas that are statistically significant at the 5% level. However, except for the four-factor alphas of these monthly rebalanced high ICC portfolios and the four-factor alpha of the

[18] Otherwise, the portfolio returns have been calculated similarly as in previous sections.

annually rebalanced long-short portfolio that includes only stocks below/above the 2nd/98th percentile, any other portfolio does not yield statistically significant positive abnormal return measured by CAPM or the four-factor model. The results imply that the ICC estimates can be used to generate profitable trading strategies in practice by being long in stocks with high ICC estimates using a monthly rebalancing period. However, as shown in Table 4, using annual rebalancing or being simultaneously long in high ICC stocks and short in low ICC stocks do not generally generate positive abnormal returns after the transaction costs.

When observing the differences between portfolio returns before and after transaction costs reported in Tables 3 and 4, it is notable that the differences are largest for long-short portfolios since, similarly as reported by Barber et al. (2001), the long-short portfolios have significantly larger turnover rates than the long-only portfolios. Another finding regarding these return differences is that, as implied by these differences, the transaction costs for monthly rebalanced portfolios are rather low despite the frequent rebalancing, showing that the turnover ratios for these portfolios are relatively low.

## Table 4: Raw and risk-adjusted returns for low and high ICC portfolios net of transaction costs (assuming 1.0% round-trip transaction costs)

This Table reports the absolute and risk-adjusted returns after transaction costs of the low and high ICC portfolios. The transaction costs are estimated as further described in subsection 4.2.2 by assuming round-trip transaction costs of 1.0 per cent. The low ICC portfolio contains only stocks below a given ICC percentile, and the high ICC portfolio contains only stocks above a given ICC percentile (for example, in the 5th/95th specification, the low ICC portfolio includes stocks with ICC estimates lower than the 5th percentile and high ICC portfolio includes stocks with ICC estimate higher than the 95th percentile). The long-short portfolio is long in the high ICC portfolio and short in the low ICC portfolio. Panel A reports the returns of monthly rebalanced portfolios, and panel B reports the returns of annually rebalanced portfolios. The CAPM alphas are obtained from the regression model described by equation (7), and the four-factor alphas are obtained from the regression model shown by equation (8).

| *Panel A: Monthly portfolio returns* | | | | |
|---|---|---|---|---|
| ICC percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
| **Geometric mean return** | | | | |
| Low ICC portfolio | 0.19% | 0.05% | 0.02% | -0.52% |
| High ICC portfolio | 0.48% | 0.41% | 0.32% | 0.47% |
| Long-short portfolio | -0.01% | -0.01% | -0.16% | 0.38% |
| **CAPM alphas:** | | | | |
| Low ICC portfolio | -0.08 | -0.20 | -0.22 | -0.73*** |
| t-statistics | (-0.54) | (-1.00) | (-0.94) | (-2.72) |
| High ICC portfolio | 0.21 | 0.29 | 0.11 | 0.34 |
| t-statistics | (1.38) | (1.34) | (0.42) | (0.35) |
| Long-short portfolio | -0.03 | -0.17 | -0.16 | 0.45 |
| t-statistics | (-0.17) | (-0.78) | (-0.63) | (1.20) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | 0.04 | -0.06 | 0.02 | -0.63** |
| t-statistics | (0.27) | (-0.33) | (0.10) | (-2.43) |
| High ICC portfolio | 0.32** | 0.37** | 0.39* | 0.71** |
| t-statistics | (2.31) | (2.08) | (1.65) | (2.07) |
| Long-short portfolio | -0.05 | 0.04 | -0.14 | 0.72* |
| t-statistics | (-0.27) | (0.20) | (-0.55) | (1.86) |
| *Panel B: Annual portfolio returns* | | | | |
| ICC percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
| **Geometric mean return** | | | | |
| Low ICC portfolio | 6.19% | 8.59% | 6.65% | 2.11% |
| High ICC portfolio | 8.11% | 7.39% | 7.85% | 9.12% |
| Long-short portfolio | 1.38% | 0.18% | 1.55% | 7.39% |
| **CAPM alphas:** | | | | |
| Low ICC portfolio | 2.02 | 5.60 | 3.50 | -0.53 |
| t-statistics | (0.85) | (1.56) | (0.86) | (-0.12) |
| High ICC portfolio | 4.05 | 6.34 | 6.03 | 8.38 |
| t-statistics | (1.46) | (1.27) | (1.19) | (1.41) |
| Long-short portfolio | 1.00 | 0.13 | 1.15 | 7.32* |
| t-statistics | (0.38) | (0.05) | (0.36) | (1.65) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | 2.45 | 7.17* | 2.89 | -3.11 |
| t-statistics | (1.25) | (1.72) | (0.60) | (-0.55) |
| High ICC portfolio | 1.52 | 5.08 | 5.58 | 10.70 |
| t-statistics | (0.62) | (0.82) | (0.89) | (1.41) |
| Long-short portfolio | -1.99 | -2.76 | 1.32 | 12.23** |
| t-statistics | (-0.74) | (-0.81) | (0.32) | (2.26) |

The baseline results reported in Table 4 above have been calculated assuming that round-trip transaction costs amount to 1.0 per cent of the share value traded. However, considering that the actual transaction costs depend on various factors and vary between investors, I have also computed portfolio returns after net transaction costs by assuming 0.5 and 1.5 per cent round-trip transaction costs, and these results are reported in Table 5 below.

The results reported in Table 5 show that when assuming 0.5% round-trip transaction costs, the monthly rebalanced high ICC portfolios and the long-short portfolio that include only stocks below/above the 2nd/98th percentile generate statistically significant four-factor alphas. Moreover, the statistical significance of these alphas unexpectedly grows when assuming 0.5% round-trip transaction costs instead of 1.0%. However, any other portfolios do not yield statistically significant positive abnormal returns measured by CAPM or the four-factor model when assuming 0.5% round-trip transaction costs. Results reported in Table 5 also show that any portfolio does not yield statistically significant positive abnormal returns when assuming that the round-trip transaction costs amount to 1.5 per cent of the share value traded.

To summarise the results reported in subsection 5.2.2 and to conclude on the subhypothesis ($\mathrm{H}_{2.2}$) that ICC-based investment strategies yield positive abnormal returns net of transaction costs: Assuming that round-trip transaction costs are less than or equal to 1.0 per cent, unlike Esterer and Schröder (2014), who report that the statistical significance of positive abnormal returns generated by strategies designed to take advantage of stocks' ICC estimates disappears when transaction costs are taken into account, I find strong evidence that investors can generate highly statistically significant four-factor alpha by investing in monthly rebalanced high ICC portfolios. However, it seems that other ICC-based strategies do not yield positive abnormal returns and that investors facing especially high transaction costs cannot generate positive abnormal returns by exploiting ICC-based investment strategies presented in this thesis.

## Table 5: Alphas for low and high ICC portfolios net of transaction costs (assuming 1.0% / 0.5% round-trip transaction costs)

This Table reports alphas for the monthly rebalanced high and low ICC portfolios. The transaction costs are estimated by first calculating the turnover for each portfolio at each rebalancing date, as further described in subsection 4.2.2, and then assuming round-trip transaction costs. Panel A reports the alphas of portfolios when assuming that round-trip transaction costs equal 0.5%, and Panel B reports the alphas of portfolios when assuming 1.5% round-trip transaction costs. The low ICC portfolio contains only stocks below a given ICC percentile, and the high ICC portfolio contains only stocks above a given ICC percentile (for example, in the $5^{th}/95^{th}$ specification, the low ICC portfolio includes stocks with ICC estimates lower than the $5^{th}$ percentile and high ICC portfolio includes stocks with ICC estimate higher than the $95^{th}$ percentile). The long-short portfolio is long in the high ICC portfolio, which includes stocks with ICC estimate above the given percentile, and short in the low ICC portfolio, which includes stocks with ICC estimate below the given percentile. The CAPM alphas are obtained from the regression model described by equation (7), and the four-factor alphas are obtained from the regression model shown by equation (8).

*Panel A: T-Statistics of alphas of monthly rebalanced portfolios (Round-trip transaction cost = 0.5%)*

| ICC percentiles | $20^{th}/80^{th}$ | $10^{th}/90^{th}$ | $5^{th}/95^{th}$ | $2^{nd}/98^{th}$ |
|---|---|---|---|---|
| **CAPM alphas:** | | | | |
| Low ICC portfolio | -0.00 | -0.10 | -0.10 | -0.57** |
| (t-stat) | (-0.00) | (-0.52) | (-0.41) | (-2.15) |
| High ICC portfolio | 0.30 | 0.27 | 0.23 | 0.46 |
| (t-stat) | (1.63) | (1.25) | (0.83) | (1.27) |
| Long-short portfolio | 0.14 | 0.18 | 0.08 | 0.73* |
| (t-stat) | (0.71) | (0.80) | (0.29) | (1.93) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | 0.12 | 0.04 | 0.15 | -0.48* |
| (t-stat) | (0.88) | (0.20) | (0.66) | (-1.84) |
| High ICC portfolio | 0.41*** | 0.47*** | 0.50** | 0.83** |
| (t-stat) | (2.95) | (2.67) | (2.08) | (2.44) |
| Long-short portfolio | 0.13 | 0.24 | 0.10 | 1.00** |
| (t-stat) | (0.73) | (1.13) | (0.38) | (2.57) |

*Panel C: T-Statistics of alphas of monthly rebalanced portfolios (Round-trip transaction cost = 1.5%)*

| ICC percentiles | $20^{th}/80^{th}$ | $10^{th}/90^{th}$ | $5^{th}/95^{th}$ | $2^{nd}/98^{th}$ |
|---|---|---|---|---|
| **CAPM alphas:** | | | | |
| Low ICC portfolio | -0.17 | -0.30 | -0.34 | -0.89*** |
| (t-stat) | (-1.07) | (-1.48) | (-1.46) | (-3.29) |
| High ICC portfolio | 0.12 | 0.07 | 0.00 | 0.21 |
| (t-stat) | (0.67) | (0.31) | (0.02) | (0.59) |
| Long-short portfolio | -0.21 | -0.21 | -0.39 | 0.17 |
| (t-stat) | (-1.06) | (-0.91) | (-1.55) | (0.46) |
| **4-factor alphas:** | | | | |
| Low ICC portfolio | -0.05 | -0.16 | -0.10 | -0.79*** |
| (t-stat) | (-0.33) | (-0.86) | (-0.46) | (-3.00) |
| High ICC portfolio | 0.23* | 0.27 | 0.28 | 0.58* |
| (t-stat) | (1.67) | (1.50) | (1.16) | (1.71) |
| Long-short portfolio | -0.22 | -0.16 | -0.38 | 0.45 |
| (t-stat) | -(1.27) | (-0.74) | (-1.48) | (1.14) |

# 6 Conclusions

The first main hypothesis ($H_1$) in this thesis has been that there is a positive association between the average of ICC estimates of stocks included in portfolios and the future realised returns of portfolios. The second main hypothesis ($H_2$) has been that investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns, both before and after the transaction costs. Besides these main objectives, this thesis has analysed the factor loadings of the ICC-based portfolios.

Regarding the first main hypothesis ($H_1$) in this thesis, my results are conflicting as despite the notable differences in monthly returns between high and lower ICC portfolios, the returns of other portfolios that include stocks between the 20$^{th}$ percentile and the 80$^{th}$ percentile do not support the hypothesis. Therefore, my results imply that there is not a clear relation between the average ICC estimates of the firms included in portfolios and the absolute returns of the portfolios. These results contrast the empirical findings of Botosan et al. (2011) and Pastor et al. (2008), as their results indicate that ICC estimates are a relatively reliable proxy for expected return. Instead, results reported in this thesis are in line with Easton and Monahan (2005) and Guay et al. (2005), who conclude that the explanatory power of ICC estimates based on various ICC approaches in relation to future realised returns is limited and depends heavily on the used controlling variables and how the ICC proxies are calculated.

Regarding my second main hypothesis ($H_2$) – which is the most important one of this thesis – I find strong evidence that investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns. Further, in contrast to Esterer and Schröder (2014), who report that the statistical significance of the abnormal returns of ICC-based investment strategies disappear when transaction costs are taken into account, my results suggest that investing in high ICC portfolios that are monthly rebalanced generates highly statistically significant four-factor alphas, both gross and net of transaction costs (assuming 1.0% round-trip transaction costs). However, it seems that other ICC-based strategies tested in this thesis, such as being simultaneously long in a high ICC portfolio and short in a low ICC portfolio, do not generally yield positive abnormal returns. Therefore, the results reported in this thesis suggest that investors who can implement ICC-based strategies with moderate transaction costs can generate positive abnormal returns by employing these strategies. Thus, the semi-strong form of market efficiency appears to be violated in the sense that investors can generate positive abnormal returns by exploiting analysts' consensus forecasts and other publicly available information.

The above-discussed results regarding my main hypotheses ($H_1$) and ($H_2$) imply that investing in high ICC portfolios that are monthly rebalanced generates highly statistically significant four-factor alphas. On the other hand, observing the returns of portfolios that include stocks between the 20$^{th}$ percentile and the 80$^{th}$ percentile implies no clear relation between the average ICC estimates of the firms included in portfolios and the absolute or risk-adjusted returns of the portfolios. Therefore, the results imply that the so-called ICC effect can be detected only by observing stocks with especially low or high ICC estimates. The reason for this seems to be that, in line with my initial supposition, the ICC effect is strongest for stocks with ICC estimates clearly deviating from the sample average. Furthermore, the ICC effect seems to be practically non-existent for stocks with ICC estimates close to the sample average, as there seems to be no clear relation between the average ICC estimates and the absolute or risk-adjusted returns of the portfolios when observing the portfolios that include stocks whose ICC estimate is between the 20$^{th}$ and the 80$^{th}$ percentile.

Besides testing the hypotheses presented above, this thesis has analysed the factor loadings of the ICC-based portfolios. Among other things, the factor loadings of these portfolios reveal that the ICC estimates are strongly related to book-to-market ratios, as the higher ICC portfolios are clearly more tilted towards value stocks with a high book-to-market ratio than the lower ICC portfolios. The positive association between ICC estimates and book-to-market ratios implies that value stocks tend to have a higher implied cost of capital than growth stocks, which in turn suggests that value stocks are riskier than growth stocks as ICC aims to capture the market's view about a share's risk. Thus, the results documented in this thesis suggest that the so-called "value premium" is compensation for the higher risks induced by the characteristics of value stocks. However, despite the fact the higher ICC portfolios are clearly more associated with the value factor and other risk factors in Carhart's (1997) four-factor model than the lower ICC portfolios, the statistically significant positive four-factor alphas of monthly rebalanced high ICC portfolios clearly indicate that these risk factors cannot explain the positive abnormal returns generated by ICC-based strategies. Consequently, the positive abnormal returns of monthly rebalanced high ICC portfolios imply that ICC estimates can generate insights on expected returns that traditional asset pricing models do not fully capture.

There is a vast array of literature related to the relationship between ICC estimates and common risk characteristics, as well as the association between ICC estimates and future realised returns. However, this literature usually focuses on measuring the correlation between ICC estimates and the realised returns or between ICC estimates and various risk characteristics. Therefore, this literature does not generally directly provide clarity on whether ICC estimates can be used to generate trading strategies that yield positive abnormal returns. Based on my comprehensive literature review, only one study by Esterer and Schröder (2014) has explicitly studied whether investment strategies designed to take advantage of stocks' ICC estimates can yield positive abnormal returns. My thesis contributes to the existing literature as it further examines the profitability of ICC-based investment strategies by building on and selectively combining the approaches used by Esterer and Schröder (2014) and those presented in other ICC-related literature. The differences between the methodology of this thesis and the methods used in earlier literature and by Esterer and Schröder (2014) are discussed further in section 4.

Unlike Esterer and Schröder (2014) or any previous study, the results reported in this thesis imply that investment strategies presented in this thesis designed to take advantage of stocks' ICC estimates can yield positive abnormal returns even after transaction costs. Therefore, the results suggest that these strategies yield positive abnormal returns when implemented in practice. Despite these results, it is yet unknown whether other investment strategies based on ICC estimates could yield abnormal returns. Alternative ICC-based investment strategies might include, for example, strategies that utilise other proxies besides ICC or strategies based on ICC estimates obtained from the cross-sectional model introduced by Hou et al. (2012). However, further research assessing alternative ICC-based strategies is needed to improve our understanding of the profitability of these strategies.

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# Appendices

## Appendix 1: Number of stocks in ICC-based portfolios

This Appendix reports the number of stocks included in five portfolios constructed according to the firms' ICC estimate. The portfolios are constructed in the following way; at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Portfolio P1 comprises the stocks with the lowest ICC estimates, and portfolio P5 comprises the stocks with the highest ICC estimates. Column "Total" reports the total number of stocks in portfolios P1, P2, P3, P4 and P5. The reported number of stocks in each portfolio is calculated after a portfolio has been rebalanced at the beginning of the month, indicated in the column "Month of rebalancing". In this thesis, I report the returns of both monthly and yearly rebalanced portfolios. These yearly rebalanced portfolios are constructed otherwise similarly to monthly re-balanced portfolios but rebalanced only once a year at the beginning of each year, i.e., at the same time when monthly rebalanced portfolios are rebalanced at the beginning of January. Thus, yearly rebalanced P1, P2, P3, P4 and P5 portfolios are similar to those monthly rebalanced portfolios that are rebalanced in January.

| *Number of stocks included in portfolios* | | | | | | |
|---|---|---|---|---|---|---|
| Month of rebalancing | P1 | P2 | P3 | P4 | P5 | Total |
| January 2000 | 67 | 67 | 67 | 67 | 68 | 336 |
| February 2000 | 70 | 69 | 70 | 69 | 70 | 348 |
| March 2000 | 70 | 70 | 70 | 70 | 71 | 351 |
| April 2000 | 71 | 71 | 71 | 71 | 71 | 355 |
| May 2000 | 71 | 70 | 70 | 70 | 71 | 352 |
| June 2000 | 70 | 70 | 70 | 70 | 70 | 350 |
| July 2000 | 73 | 72 | 72 | 72 | 73 | 362 |
| August 2000 | 71 | 71 | 71 | 71 | 72 | 356 |
| September 2000 | 74 | 73 | 73 | 73 | 74 | 367 |
| October 2000 | 76 | 76 | 75 | 76 | 76 | 379 |
| November 2000 | 75 | 74 | 75 | 74 | 75 | 373 |
| December 2000 | 75 | 75 | 74 | 75 | 75 | 374 |
| January 2001 | 74 | 74 | 74 | 74 | 75 | 371 |
| February 2001 | 71 | 71 | 70 | 71 | 71 | 354 |
| March 2001 | 71 | 71 | 70 | 71 | 71 | 354 |
| April 2001 | 73 | 73 | 72 | 73 | 73 | 364 |
| May 2001 | 72 | 72 | 71 | 72 | 72 | 359 |
| June 2001 | 75 | 74 | 75 | 74 | 75 | 373 |
| July 2001 | 74 | 74 | 74 | 74 | 75 | 371 |
| August 2001 | 76 | 76 | 75 | 76 | 76 | 379 |
| September 2001 | 75 | 75 | 75 | 75 | 76 | 376 |
| October 2001 | 76 | 76 | 75 | 76 | 76 | 379 |
| November 2001 | 78 | 78 | 78 | 78 | 78 | 390 |
| December 2001 | 79 | 78 | 79 | 78 | 79 | 393 |
| January 2002 | 81 | 80 | 80 | 80 | 81 | 402 |
| February 2002 | 78 | 77 | 78 | 77 | 78 | 388 |
| March 2002 | 79 | 79 | 78 | 79 | 79 | 394 |
| April 2002 | 79 | 79 | 78 | 79 | 79 | 394 |
| May 2002 | 79 | 79 | 79 | 79 | 80 | 396 |
| June 2002 | 81 | 80 | 80 | 80 | 81 | 402 |
| July 2002 | 80 | 79 | 80 | 79 | 80 | 398 |
| August 2002 | 80 | 79 | 80 | 79 | 80 | 398 |
| September 2002 | 75 | 75 | 75 | 75 | 75 | 375 |

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|---|---|---|---|---|---|---|
| October 2002 | 83 | 83 | 82 | 83 | 83 | 414 |
| November 2002 | 87 | 87 | 87 | 87 | 87 | 435 |
| December 2002 | 90 | 90 | 90 | 90 | 91 | 451 |
| January 2003 | 94 | 94 | 94 | 94 | 94 | 470 |
| February 2003 | 95 | 94 | 94 | 94 | 95 | 472 |
| March 2003 | 93 | 92 | 92 | 92 | 93 | 462 |
| April 2003 | 94 | 93 | 93 | 93 | 94 | 467 |
| May 2003 | 93 | 93 | 93 | 93 | 93 | 465 |
| June 2003 | 93 | 93 | 93 | 93 | 93 | 465 |
| July 2003 | 95 | 94 | 94 | 94 | 95 | 472 |
| August 2003 | 101 | 100 | 100 | 100 | 101 | 502 |
| September 2003 | 101 | 100 | 101 | 100 | 101 | 503 |
| October 2003 | 99 | 99 | 98 | 99 | 99 | 494 |
| November 2003 | 99 | 98 | 99 | 98 | 99 | 493 |
| December 2003 | 98 | 98 | 98 | 98 | 99 | 491 |
| January 2004 | 99 | 99 | 98 | 99 | 99 | 494 |
| February 2004 | 98 | 98 | 98 | 98 | 98 | 490 |
| March 2004 | 100 | 99 | 100 | 99 | 100 | 498 |
| April 2004 | 100 | 99 | 99 | 99 | 100 | 497 |
| May 2004 | 101 | 100 | 100 | 100 | 101 | 502 |
| June 2004 | 100 | 100 | 100 | 100 | 100 | 500 |
| July 2004 | 99 | 98 | 99 | 98 | 99 | 493 |
| August 2004 | 88 | 88 | 88 | 88 | 88 | 440 |
| September 2004 | 88 | 88 | 87 | 88 | 88 | 439 |
| October 2004 | 87 | 87 | 87 | 87 | 88 | 436 |
| November 2004 | 93 | 92 | 92 | 92 | 93 | 462 |
| December 2004 | 92 | 92 | 92 | 92 | 92 | 460 |
| January 2005 | 93 | 92 | 93 | 92 | 93 | 463 |
| February 2005 | 92 | 92 | 91 | 92 | 92 | 459 |
| March 2005 | 94 | 93 | 93 | 93 | 94 | 467 |
| April 2005 | 93 | 93 | 93 | 93 | 94 | 466 |
| May 2005 | 94 | 93 | 93 | 93 | 94 | 467 |
| June 2005 | 91 | 91 | 91 | 91 | 92 | 456 |
| July 2005 | 91 | 91 | 91 | 91 | 91 | 455 |
| August 2005 | 88 | 88 | 88 | 88 | 88 | 440 |
| September 2005 | 88 | 87 | 88 | 87 | 88 | 438 |
| October 2005 | 85 | 85 | 85 | 85 | 85 | 425 |
| November 2005 | 88 | 87 | 88 | 87 | 88 | 438 |
| December 2005 | 87 | 87 | 87 | 87 | 88 | 436 |
| January 2006 | 88 | 88 | 88 | 88 | 89 | 441 |
| February 2006 | 89 | 89 | 88 | 89 | 89 | 444 |
| March 2006 | 88 | 88 | 88 | 88 | 89 | 441 |
| April 2006 | 90 | 90 | 89 | 90 | 90 | 449 |
| May 2006 | 93 | 93 | 93 | 93 | 94 | 466 |
| June 2006 | 96 | 95 | 95 | 95 | 96 | 477 |
| July 2006 | 95 | 95 | 94 | 95 | 95 | 474 |
| August 2006 | 95 | 95 | 94 | 95 | 95 | 474 |
| September 2006 | 91 | 91 | 91 | 91 | 92 | 456 |
| October 2006 | 91 | 90 | 90 | 90 | 91 | 452 |
| November 2006 | 99 | 98 | 99 | 98 | 99 | 493 |
| December 2006 | 102 | 101 | 102 | 101 | 102 | 508 |
| January 2007 | 104 | 103 | 104 | 103 | 104 | 518 |
| February 2007 | 105 | 105 | 105 | 105 | 105 | 525 |
| March 2007 | 107 | 106 | 106 | 106 | 107 | 532 |
| April 2007 | 107 | 107 | 107 | 107 | 107 | 535 |
| May 2007 | 107 | 107 | 106 | 107 | 107 | 534 |

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|---|---|---|---|---|---|---|
| June 2007 | 108 | 108 | 108 | 108 | 109 | 541 |
| July 2007 | 107 | 107 | 107 | 107 | 107 | 535 |
| August 2007 | 104 | 104 | 103 | 104 | 104 | 519 |
| September 2007 | 108 | 108 | 108 | 108 | 109 | 541 |
| October 2007 | 110 | 109 | 110 | 109 | 110 | 548 |
| November 2007 | 110 | 110 | 110 | 110 | 110 | 550 |
| December 2007 | 109 | 108 | 108 | 108 | 109 | 542 |
| January 2008 | 111 | 110 | 110 | 110 | 111 | 552 |
| February 2008 | 112 | 112 | 111 | 112 | 112 | 559 |
| March 2008 | 113 | 113 | 112 | 113 | 113 | 564 |
| April 2008 | 114 | 114 | 114 | 114 | 115 | 571 |
| May 2008 | 115 | 114 | 114 | 114 | 115 | 572 |
| June 2008 | 116 | 116 | 116 | 116 | 116 | 580 |
| July 2008 | 116 | 116 | 116 | 116 | 117 | 581 |
| August 2008 | 113 | 113 | 113 | 113 | 113 | 565 |
| September 2008 | 107 | 106 | 106 | 106 | 107 | 532 |
| October 2008 | 106 | 105 | 105 | 105 | 106 | 527 |
| November 2008 | 106 | 105 | 105 | 105 | 106 | 527 |
| December 2008 | 105 | 105 | 105 | 105 | 106 | 526 |
| January 2009 | 107 | 106 | 106 | 106 | 107 | 532 |
| February 2009 | 106 | 105 | 105 | 105 | 106 | 527 |
| March 2009 | 106 | 106 | 106 | 106 | 107 | 531 |
| April 2009 | 109 | 109 | 109 | 109 | 110 | 546 |
| May 2009 | 95 | 95 | 95 | 95 | 96 | 476 |
| June 2009 | 97 | 97 | 96 | 97 | 97 | 484 |
| July 2009 | 103 | 103 | 102 | 103 | 103 | 514 |
| August 2009 | 105 | 105 | 105 | 105 | 106 | 526 |
| September 2009 | 107 | 106 | 106 | 106 | 107 | 532 |
| October 2009 | 107 | 107 | 107 | 107 | 107 | 535 |
| November 2009 | 116 | 115 | 115 | 115 | 116 | 577 |
| December 2009 | 118 | 118 | 118 | 118 | 119 | 591 |
| January 2010 | 96 | 95 | 95 | 95 | 96 | 477 |
| February 2010 | 96 | 96 | 96 | 96 | 96 | 480 |
| March 2010 | 95 | 94 | 95 | 94 | 95 | 473 |
| April 2010 | 93 | 93 | 93 | 93 | 93 | 465 |
| May 2010 | 103 | 103 | 103 | 103 | 104 | 516 |
| June 2010 | 103 | 103 | 103 | 103 | 103 | 515 |
| July 2010 | 102 | 102 | 102 | 102 | 102 | 510 |
| August 2010 | 102 | 102 | 102 | 102 | 102 | 510 |
| September 2010 | 105 | 105 | 104 | 105 | 105 | 524 |
| October 2010 | 110 | 110 | 110 | 110 | 111 | 551 |
| November 2010 | 111 | 110 | 110 | 110 | 111 | 552 |
| December 2010 | 113 | 113 | 113 | 113 | 113 | 565 |
| January 2011 | 116 | 115 | 115 | 115 | 116 | 577 |
| February 2011 | 119 | 119 | 119 | 119 | 120 | 596 |
| March 2011 | 121 | 120 | 121 | 120 | 121 | 603 |
| April 2011 | 124 | 124 | 123 | 124 | 124 | 619 |
| May 2011 | 128 | 128 | 127 | 128 | 128 | 639 |
| June 2011 | 130 | 130 | 130 | 130 | 131 | 651 |
| July 2011 | 130 | 130 | 130 | 130 | 131 | 651 |
| August 2011 | 130 | 130 | 130 | 130 | 130 | 650 |
| September 2011 | 129 | 129 | 128 | 129 | 129 | 644 |
| October 2011 | 130 | 130 | 130 | 130 | 130 | 650 |
| November 2011 | 130 | 130 | 130 | 130 | 131 | 651 |
| December 2011 | 130 | 130 | 130 | 130 | 131 | 651 |
| January 2012 | 133 | 133 | 133 | 133 | 134 | 666 |

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|---|---|---|---|---|---|---|
| February 2012 | 136 | 136 | 135 | 136 | 136 | 679 |
| March 2012 | 135 | 135 | 134 | 135 | 135 | 674 |
| April 2012 | 134 | 134 | 134 | 134 | 134 | 670 |
| May 2012 | 134 | 134 | 133 | 134 | 134 | 669 |
| June 2012 | 134 | 134 | 134 | 134 | 135 | 671 |
| July 2012 | 135 | 134 | 134 | 134 | 135 | 672 |
| August 2012 | 131 | 131 | 131 | 131 | 132 | 656 |
| September 2012 | 130 | 129 | 129 | 129 | 130 | 647 |
| October 2012 | 129 | 129 | 128 | 129 | 129 | 644 |
| November 2012 | 127 | 127 | 126 | 127 | 127 | 634 |
| December 2012 | 125 | 125 | 125 | 125 | 126 | 626 |
| January 2013 | 127 | 127 | 127 | 127 | 128 | 636 |
| February 2013 | 126 | 126 | 126 | 126 | 127 | 631 |
| March 2013 | 126 | 125 | 126 | 125 | 126 | 628 |
| April 2013 | 127 | 126 | 126 | 126 | 127 | 632 |
| May 2013 | 125 | 125 | 124 | 125 | 125 | 624 |
| June 2013 | 125 | 124 | 124 | 124 | 125 | 622 |
| July 2013 | 126 | 125 | 125 | 125 | 126 | 627 |
| August 2013 | 124 | 124 | 124 | 124 | 125 | 621 |
| September 2013 | 125 | 124 | 124 | 124 | 125 | 622 |
| October 2013 | 121 | 121 | 121 | 121 | 122 | 606 |
| November 2013 | 118 | 118 | 118 | 118 | 119 | 591 |
| December 2013 | 120 | 119 | 119 | 119 | 120 | 597 |
| January 2014 | 121 | 121 | 121 | 121 | 122 | 606 |
| February 2014 | 118 | 117 | 118 | 117 | 118 | 588 |
| March 2014 | 118 | 117 | 118 | 117 | 118 | 588 |
| April 2014 | 120 | 119 | 120 | 119 | 120 | 598 |
| May 2014 | 124 | 124 | 124 | 124 | 124 | 620 |
| June 2014 | 120 | 120 | 119 | 120 | 120 | 599 |
| July 2014 | 122 | 122 | 122 | 122 | 122 | 610 |
| August 2014 | 122 | 121 | 121 | 121 | 122 | 607 |
| September 2014 | 123 | 122 | 123 | 122 | 123 | 613 |
| October 2014 | 121 | 121 | 121 | 121 | 121 | 605 |
| November 2014 | 121 | 120 | 120 | 120 | 121 | 602 |
| December 2014 | 119 | 119 | 118 | 119 | 119 | 594 |
| January 2015 | 117 | 117 | 117 | 117 | 117 | 585 |
| February 2015 | 113 | 112 | 113 | 112 | 113 | 563 |
| March 2015 | 110 | 110 | 110 | 110 | 110 | 550 |
| April 2015 | 115 | 115 | 114 | 115 | 115 | 574 |
| May 2015 | 126 | 125 | 125 | 125 | 126 | 627 |
| June 2015 | 127 | 127 | 127 | 127 | 128 | 636 |
| July 2015 | 125 | 124 | 125 | 124 | 125 | 623 |
| August 2015 | 133 | 132 | 133 | 132 | 133 | 663 |
| September 2015 | 132 | 132 | 131 | 132 | 132 | 659 |
| October 2015 | 130 | 130 | 130 | 130 | 131 | 651 |
| November 2015 | 128 | 128 | 128 | 128 | 128 | 640 |
| December 2015 | 127 | 127 | 126 | 127 | 127 | 634 |
| January 2016 | 130 | 130 | 130 | 130 | 131 | 651 |
| February 2016 | 131 | 130 | 130 | 130 | 131 | 652 |
| March 2016 | 130 | 130 | 130 | 130 | 130 | 650 |
| April 2016 | 132 | 131 | 132 | 131 | 132 | 658 |
| May 2016 | 132 | 132 | 131 | 132 | 132 | 659 |
| June 2016 | 134 | 133 | 133 | 133 | 134 | 667 |
| July 2016 | 135 | 134 | 134 | 134 | 135 | 672 |
| August 2016 | 133 | 133 | 133 | 133 | 134 | 666 |
| September 2016 | 137 | 136 | 136 | 136 | 137 | 682 |

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|---|---|---|---|---|---|---|
| October 2016 | 136 | 135 | 136 | 135 | 136 | 678 |
| November 2016 | 136 | 135 | 135 | 135 | 136 | 677 |
| December 2016 | 137 | 137 | 137 | 137 | 138 | 686 |
| January 2017 | 136 | 136 | 136 | 136 | 137 | 681 |
| February 2017 | 136 | 136 | 135 | 136 | 136 | 679 |
| March 2017 | 135 | 135 | 135 | 135 | 135 | 675 |
| April 2017 | 136 | 135 | 135 | 135 | 136 | 677 |
| May 2017 | 137 | 136 | 137 | 136 | 137 | 683 |
| June 2017 | 137 | 136 | 136 | 136 | 137 | 682 |
| July 2017 | 136 | 136 | 136 | 136 | 136 | 680 |
| August 2017 | 137 | 137 | 137 | 137 | 138 | 686 |
| September 2017 | 139 | 138 | 139 | 138 | 139 | 693 |
| October 2017 | 139 | 138 | 138 | 138 | 139 | 692 |
| November 2017 | 137 | 137 | 137 | 137 | 138 | 686 |
| December 2017 | 135 | 134 | 135 | 134 | 135 | 673 |
| January 2018 | 136 | 135 | 136 | 135 | 136 | 678 |
| February 2018 | 134 | 134 | 134 | 134 | 135 | 671 |
| March 2018 | 132 | 132 | 132 | 132 | 132 | 660 |
| April 2018 | 136 | 135 | 135 | 135 | 136 | 677 |
| May 2018 | 139 | 138 | 138 | 138 | 139 | 692 |
| June 2018 | 139 | 138 | 138 | 138 | 139 | 692 |
| July 2018 | 137 | 136 | 137 | 136 | 137 | 683 |
| August 2018 | 135 | 135 | 134 | 135 | 135 | 674 |
| September 2018 | 135 | 134 | 134 | 134 | 135 | 672 |
| October 2018 | 130 | 129 | 130 | 129 | 130 | 648 |
| November 2018 | 126 | 126 | 126 | 126 | 127 | 631 |
| December 2018 | 127 | 126 | 127 | 126 | 127 | 633 |
| January 2019 | 126 | 125 | 125 | 125 | 126 | 627 |
| February 2019 | 124 | 124 | 124 | 124 | 125 | 621 |
| March 2019 | 126 | 125 | 125 | 125 | 126 | 627 |
| April 2019 | 125 | 125 | 125 | 125 | 125 | 625 |
| May 2019 | 124 | 124 | 124 | 124 | 125 | 621 |
| June 2019 | 123 | 122 | 123 | 122 | 123 | 613 |
| July 2019 | 121 | 121 | 120 | 121 | 121 | 604 |
| August 2019 | 118 | 118 | 118 | 118 | 118 | 590 |
| September 2019 | 117 | 116 | 117 | 116 | 117 | 583 |
| October 2019 | 117 | 116 | 116 | 116 | 117 | 582 |
| November 2019 | 116 | 115 | 115 | 115 | 116 | 577 |
| December 2019 | 113 | 112 | 113 | 112 | 113 | 563 |
| January 2020 | 113 | 112 | 112 | 112 | 113 | 562 |
| February 2020 | 112 | 111 | 111 | 111 | 112 | 557 |
| March 2020 | 109 | 108 | 109 | 108 | 109 | 543 |
| April 2020 | 110 | 109 | 110 | 109 | 110 | 548 |
| May 2020 | 106 | 106 | 106 | 106 | 106 | 530 |
| June 2020 | 103 | 103 | 103 | 103 | 103 | 515 |
| July 2020 | 103 | 103 | 103 | 103 | 103 | 515 |
| August 2020 | 102 | 102 | 101 | 102 | 102 | 509 |
| September 2020 | 102 | 102 | 102 | 102 | 103 | 511 |
| October 2020 | 101 | 100 | 101 | 100 | 101 | 503 |
| November 2020 | 99 | 98 | 99 | 98 | 99 | 493 |
| December 2020 | 102 | 101 | 101 | 101 | 102 | 507 |
| January 2021 | 102 | 101 | 101 | 101 | 102 | 507 |
| February 2021 | 101 | 101 | 101 | 101 | 101 | 505 |
| March 2021 | 101 | 101 | 100 | 101 | 101 | 504 |
| April 2021 | 100 | 99 | 99 | 99 | 100 | 497 |
| May 2021 | 99 | 99 | 98 | 99 | 99 | 494 |

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|---|---|---|---|---|---|---|
| June 2021 | 97 | 97 | 97 | 97 | 97 | 485 |
| July 2021 | 93 | 93 | 92 | 93 | 93 | 464 |
| August 2021 | 92 | 92 | 91 | 92 | 92 | 459 |
| September 2021 | 91 | 90 | 90 | 90 | 91 | 452 |
| October 2021 | 87 | 86 | 86 | 86 | 87 | 432 |
| November 2021 | 86 | 86 | 86 | 86 | 87 | 431 |
| December 2021 | 87 | 87 | 86 | 87 | 87 | 434 |
| January 2022 | 40 | 40 | 40 | 40 | 41 | 201 |
| February 2022 | 41 | 40 | 40 | 40 | 41 | 202 |
| March 2022 | 39 | 39 | 39 | 39 | 38 | 194 |
| April 2022 | 39 | 39 | 39 | 39 | 38 | 194 |
| May 2022 | 38 | 38 | 37 | 38 | 38 | 189 |
| June 2022 | 37 | 37 | 36 | 37 | 37 | 184 |
| July 2022 | 35 | 34 | 35 | 34 | 35 | 173 |
| August 2022 | 34 | 33 | 33 | 33 | 34 | 167 |
| September 2022 | 33 | 32 | 32 | 32 | 33 | 162 |
| October 2022 | 32 | 31 | 31 | 31 | 32 | 157 |
| November 2022 | 31 | 30 | 30 | 30 | 31 | 152 |
| December 2022 | 30 | 29 | 29 | 29 | 30 | 147 |

## Appendix 2: Portfolio returns 2000-2022

This Appendix reports the monthly and annual geometric mean returns of the five portfolios constructed according to the firms' ICC estimate; however, the ICC estimates are calculated using an alternative specification by assuming that the growth rate of residual income beyond the explicit forecast period is zero. Column "Monthly returns" reports the monthly returns of portfolios in which, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Column "Annual returns" reports the annual returns of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. P1 comprises the stocks with the lowest ICC, and P5 comprises the stocks with the highest ICC. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, this Appendix reports the average ICC estimates of the firms included in each portfolio. The *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The sample period is from January 2000 to the end of the year 2022.

*Panel A: ICCs estimated by assuming that the growth rate of residual income after the explicit forecast period is zero*

| | ICC (%) | Monthly returns | Annual returns |
|---|---|---|---|
| P1 (low ICC) | 5.0% | 0.40% | 6.18% |
| P2 | 7.6% | 0.53% | 7.33% |
| P3 | 9.5% | 0.57% | 6.60% |
| P4 | 11.7% | 0.60% | 7.76% |
| P5 (high ICC) | 18.3% | 0.69% | 9.08% |
| P5-P1 | 13.3% | 0.33% | 3.40% |

## Appendix 3: Risk-adjusted portfolio returns 2000-2022 (Growth rate=0)

Similarly to Table 3, this Appendix reports the risk-adjusted returns gross of transaction costs of the five portfolios constructed according to the firms' ICC estimate; however, the results reported in this Appendix are based on ICC estimates, which are calculated using an alternative specification by assuming that the growth rate of residual income beyond the explicit forecast period is zero. Panel A reports the monthly risk-adjusted returns of portfolios in which, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Panel B reports the return of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. P1 comprises the stocks with the lowest ICC, and P5 comprises the stocks with the highest ICC. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, this Appendix reports the CAPM and four-factor model regression coefficients. The CAPM regression coefficients are obtained from the regression model described by equation (7), and the four-factor regression coefficients are obtained from the regression model shown by equation (8). The *,** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The sample period is from January 2000 to the end of the year 2022.

| *Panel A: Monthly returns* | | | | | |
|---|---|---|---|---|---|
| | α | Beta | SMB | HML | MOM |
| P1 | 0.12 | 1.05*** | | | |
| t-stat | (0.82) | (32.7) | | | |
| P2 | 0.05 | 0.95*** | | | |
| t-stat | (0.43) | (40.0) | | | |
| P3 | 0.09 | 1.04*** | | | |
| t-stat | (0.78) | (40.6) | | | |
| P4 | 0.11 | 1.13*** | | | |
| t-stat | (0.86) | (39.4) | | | |
| P5 | 0.42** | 1.39*** | | | |
| t-stat | (2.26) | (34.2) | | | |
| P5-P1 | 0.30 | 0.34*** | | | |
| t-stat | (1.47) | (7.54) | | | |
| P1 | 0.23* | 1.05*** | 0.52*** | -0.27*** | -0.12*** |
| t-stat | (1.79) | (33.83) | (8.57) | (-5.89) | (-3.35) |
| P2 | 0,09 | 0,94*** | 0,36*** | -0,09** | -0,08*** |
| t-stat | (0,90) | (38,27) | (7,51) | (-2,55) | (-2,90) |
| P3 | 0,15 | 0,99*** | 0,51*** | -0,01 | -0,15*** |
| t-stat | (1,49) | (41,52) | (11,01) | (-0,37) | (-5,52) |
| P4 | 0,09 | 1,07*** | 0,58*** | 0,23*** | -0,16*** |
| t-stat | (0,84) | (42,87) | (12,01) | (6,31) | (-5,54) |
| P5 | 0.52*** | 1.23*** | 0.75*** | 0.31*** | -0.35*** |
| t-stat | (3.78) | (37.32) | (11.58) | (6.53) | (9.57) |
| P5-P1 | 0.29* | 0.18*** | 0.23*** | 0.58*** | -0.24*** |
| t-stat | (1.72) | (4.56) | (2.90) | (9.87) | (-5.22) |

| *Panel B: Annual returns* | | | | | |
|---|---|---|---|---|---|
| | α | Beta | SMB | HML | MOM |
| P1 | 2.05 | 1.11*** | | | |
| t-stat | (0.89) | (9.65) | | | |
| P2 | 2.00 | 1.13*** | | | |
| t-stat | (1.02) | (11.49) | | | |
| P3 | 1.24 | 0.71*** | | | |

| | | | | | |
|---|---|---|---|---|---|
| t-stat | (1.07) | (12.23) | | | |
| P4 | 2.67 | 1.13*** | | | |
| t-stat | (1.13) | (9.62) | | | |
| P5 | 4.99* | 1.37*** | | | |
| t-stat | (1.76) | (9.66) | | | |
| P5-P1 | 2.94 | 0.26* | | | |
| t-stat | (1.07) | (1.90) | | | |
| P1 | 3.01 | 0.89*** | 0.92*** | -0.22* | -0.18* |
| t-stat | (1.37) | (8.64) | (3.84) | (-1.85) | (-1.77) |
| P2 | 0.17 | 0.95*** | 0.62*** | -0.13 | 0.09 |
| t-stat | (0.09) | (11.14) | (3.08) | (-1.27) | (1.09) |
| P3 | -0.28 | 0.98*** | 0.64*** | -0.04 | 0.03 |
| t-stat | (-0.15) | (10.71) | (2.98) | (-0.37) | (0.32) |
| P4 | -0.18 | 0.97*** | 1.02*** | 0.24** | -0.03 |
| t-stat | (-0.08) | (9.29) | (4.16) | (1.99) | (-0.26) |
| P5 | 2.42 | 1.14*** | 1.26*** | 0.34** | -0.13 |
| t-stat | (0.99) | (9.94) | (4.74) | (2.53) | (-1.17) |
| P5-P1 | -0.60 | 0.25* | 0.35 | 0.56*** | 0.05 |
| t-stat | (-0.21) | (1.86) | (1.11) | (3.56) | (0.36) |

## Appendix 4: Average sector weights of portfolios

This Appendix reports the average sector weights of the five portfolios constructed according to the firms' ICC estimate. Panel A reports the average sector weights of portfolios in which, at the beginning of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into five equally-weighted portfolios. Panel B reports the average sector weights of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. The sector weights of the five portfolios are calculated by first computing the fraction each sector comprises of each portfolio at the end of rebalancing date *t* by calculating the sum of weights of each stock belonging to a certain sector at that point in time. The average sector weights reported in this Appendix are the average of sector weights at the end of each rebalancing date *t* during the sample period from January 2000 to the end of the year 2022.

*Panel A: Monthly rebalanced portfolios constructed by assuming that the growth rate after the explicit forecast period equals the expected inflation rate*

| | Industrials | Basic Materials | Financials | Real Estate | Utilities | Telecom | Consumer Staples | Energy | Technology | Consumer Discretion | Health Care |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 18.30% | 5.29% | 5.86% | 11.57% | 3.31% | 3.84% | 7.95% | 3.88% | 10.65% | 16.70% | 12.63% |
| P2 | 24.42% | 6.79% | 7.47% | 5.69% | 3.01% | 2.94% | 11.51% | 1.86% | 9.16% | 18.01% | 9.12% |
| P3 | 28.36% | 6.83% | 10.79% | 2.97% | 3.60% | 2.85% | 9.16% | 1.82% | 8.32% | 19.43% | 5.86% |
| P4 | 27.59% | 6.76% | 15.90% | 2.36% | 2.76% | 3.33% | 7.54% | 2.41% | 6.91% | 20.37% | 4.07% |
| P5 | 22.49% | 7.76% | 18.67% | 2.55% | 1.87% | 3.56% | 4.83% | 3.57% | 7.21% | 24.98% | 2.48% |

*Panel B: Annually rebalanced portfolios constructed by assuming that the growth rate after the explicit forecast period equals the expected inflation rate*

| | Industrials | Basic Materials | Financials | Real Estate | Utilities | Telecom | Consumer Staples | Energy | Technology | Consumer Discretion | Health Care |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 16.33% | 6.04% | 7.00% | 14.48% | 3.75% | 3.76% | 6.87% | 3.95% | 10.19% | 15.80% | 11.82% |
| P2 | 24.02% | 6.93% | 7.43% | 3.97% | 3.09% | 3.04% | 12.49% | 2.24% | 8.92% | 17.70% | 10.13% |
| P3 | 29.21% | 6.65% | 11.70% | 1.71% | 3.65% | 2.71% | 8.73% | 1.65% | 8.92% | 19.64% | 5.44% |
| P4 | 28.45% | 5.93% | 15.23% | 1.82% | 3.15% | 3.23% | 7.69% | 2.28% | 6.50% | 21.85% | 3.87% |
| P5 | 22.83% | 7.18% | 16.86% | 2.32% | 1.69% | 4.08% | 5.70% | 3.46% | 7.48% | 25.22% | 3.13% |

## Appendix 5: Risk-adjusted returns of industry sorted portfolios 2000-2022

Similarly, as Table 3, this Appendix reports the risk-adjusted returns gross of transaction costs of the five portfolios constructed according to the firms' ICC estimate. However, the results reported in this Appendix are calculated by using an alternative specification constructing portfolios by first sorting all stocks into eleven sector portfolios based on companies' GICS sector classification and then sorting all stocks in these sector portfolios again into five equally-weighted portfolios according to their ICC estimate. Panel A reports the monthly risk-adjusted returns of portfolios that are rebalanced at the beginning of each month, and Panel B reports the returns of portfolios that are constructed similarly but rebalanced once a year at the beginning of each year. P1 comprises the stocks with the lowest ICC, and P5 comprises the stocks with the highest ICC. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, this Appendix reports the CAPM and four-factor model regression coefficients. The CAPM regression coefficients are obtained from the regression model described by equation (7), and the four-factor regression coefficients are obtained from the regression model shown by equation (8). The *,** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. The sample period is from January 2000 to the end of the year 2022.

| *Panel A: Monthly returns* | | | | | |
|---|---|---|---|---|---|
| | α | Beta | SMB | HML | MOM |
| P1 | 0.16 | 1.08*** | | | |
| t-stat | (1.20) | (36.43) | | | |
| P2 | -0.05 | 0.99*** | | | |
| t-stat | (-0.43) | (41.39) | | | |
| P3 | 0.08 | 1.04*** | | | |
| t-stat | (0.75) | (42.33) | | | |
| P4 | 0.17 | 1.13 | | | |
| t-stat | (1.33) | (41.17) | | | |
| P5 | 0.43*** | 1.30*** | | | |
| t-stat | (2.62) | (36.54) | | | |
| P5-P1 | 0.26* | 0.21*** | | | |
| t-stat | (1.70) | (6.33) | | | |
| P1 | 0.27** | 1.05*** | 0.54*** | -0.13*** | -0.16*** |
| t-stat | (2.23) | (36.51) | (9.59) | (-3.21) | (-4.96) |
| P2 | 0.01 | 0.96*** | 0.43*** | -0.06* | -0.12*** |
| t-stat | (0.14) | (40.80) | (9.29) | (-1.79) | (-4.52) |
| P3 | 0.10 | 1.01*** | 0.50*** | 0.02 | -0.11*** |
| t-stat | (1.00) | (43.35) | (10.94) | (0.55) | (-4.13) |
| P4 | 0.16 | 1.08*** | 0.57*** | 0.14*** | -0.14*** |
| t-stat | (1.55) | (43.36) | (11.63) | (3.95) | (-5.12) |
| P5 | 0.53*** | 1.17*** | 0.67*** | 0.21*** | -0.31*** |
| t-stat | (4.25) | (39.12) | (11.46) | (4.91) | (-9.17) |
| P5-P1 | 0.26* | 0.12*** | 0.13** | 0.35*** | -0.15*** |
| t-stat | (1.85) | (3.53) | (1.96) | (7.01) | (-3.86) |
| *Panel B: Annual returns* | | | | | |
| | α | Beta | SMB | HML | MOM |
| P1 | 2.70 | 1.15*** | | | |
| t-stat | (1.18) | (10.04) | | | |
| P2 | 1.40 | 1.04*** | | | |
| t-stat | (0.78) | (11.61) | | | |
| P3 | 3.04* | 1.08*** | | | |
| t-stat | (1.89) | (13.44) | | | |
| P4 | 3.21 | 1.13*** | | | |
| t-stat | (1.40) | (9.87) | | | |

| | | | | | |
|---|---|---|---|---|---|
| P5 | 4.72* | 1.28*** | | | |
| t-stat | (1.88) | (10.23) | | | |
| P5-P1 | 2.02 | 0.14 | | | |
| t-stat | (0.95) | (1.28) | | | |
| P1 | 2.77 | 0.92*** | 1.08*** | -0.21* | -0.13 |
| t-stat | (1.46) | (10.35) | (5.16) | (-1.98) | (-1.54) |
| P2 | 0.40 | 0.96*** | 0.54** | -0.07 | 0.01 |
| t-stat | (0.19) | (9.55) | (2.32) | (-0.63) | (0.13) |
| P3 | 0.66 | 1.01*** | 0.64*** | 0.03 | 0.08 |
| t-stat | (0.40) | (13.04) | (3.54) | (0.32) | (1.03) |
| P4 | 1.06 | 0.95*** | 0.99*** | 0.25** | -0.09 |
| t-stat | (0.50) | (9.60) | (4.25) | (2.18) | (-0.88) |
| P5 | 2.29 | 1.08*** | 1.17*** | 0.22* | -0.08 |
| t-stat | (1.00) | (10.12) | (4.66) | (1.72) | (-0.76) |
| P5-P1 | -0.49 | 0.16 | 0.09 | 0.42*** | 0.05 |
| t-stat | (-0.21) | (1.49) | (0.35) | (3.32) | (0.51) |