# Implied Cost of Capital Investment Strategies - Evidence from International Stock Markets

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## Abstract

*Investors can generate excess returns by implementing trading strategies based on publicly available equity analyst forecasts. This paper captures the information provided by analysts by the implied cost of capital (ICC), the internal rate of return that equates a firm's share price to the present value of analysts' earnings forecasts. We find that U.S. stocks with a high ICC outperform low ICC stocks on average by 6.0% per year. This spread is significant when controlling the investment returns for their risk exposure as proxied by standard pricing models. Further analysis across the world's largest equity markets validates these results.*

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# 1 Introduction

In the past decade, academics have proposed the implied cost of capital (ICC) as a new measure of a company's cost of equity capital. Defined as the internal rate of return that equates share prices to discounted analysts' cash flow forecasts, the ICC has been advocated as alternative to the traditional approach of estimating expected returns using past returns. Since the first articles appeared, the ICC has been used to analyze the market risk premium, asset pricing models, or corporate finance decisions.[1]

This interpretation of the internal rate of return hinges on the assumptions that the average market investor agrees with the forecasts provided by analysts, and that market prices reflect the firms' fundamental values. In practice, these assumptions are not always fulfilled. First of all, markets are not fully efficient. Information about a company's earnings (Ball and Brown, 1968) and recommendations of equity analysts (Michaely and Womack, 1999; Green, 2006) do not seem to be immediately impounded in prices. Instead, market participants require some time to process new information. For example, Cohen and Lou (2012) show that the price adjustment takes more time for complicated firms than for simple firms. Second, although Elton et al. (1981) demonstrate the usefulness of analyst forecasts as surrogate for market expectations, these forecasts might be erroneous and systematically biased due to conflicts of interests of equity analysts (Chan et al., 2007; Becchetti et al., 2007).

These considerations imply that the ICC is not an accurate proxy for expected stock returns in the sense of an equilibrium pricing model. Rather, the ICC can be conceived as a share's implied or actual yield, given market prices and expected cash flows. Similar to bond yield, the ICC captures the market's view about a share's risk. Since this market perception is not always fully accurate, the ICC can be useful to detect mispriced assets. If prices do not reflect fundamental values as predicted by analysts (for example, caused by sluggish price reactions to analyst reports), the ICC diverges from a share's equilibrium return. For example, in case a company trades below fair value, the ICC is higher than the share's equilibrium expected return. If prices subsequently converge to fundamental values, high ICC stocks should – ceteris paribus – provide higher returns relative to their equilibrium expected returns, and vice versa. Hence, there might exist profitable trading strategies using the firms' ICC estimate as stock

[1] Malkiel (1979) and Brigham et al. (1985) propose to estimate the equity risk premium as the difference between the market ICC and the risk-free rate. Similar studies are by Cornell (1999), Gebhardt et al. (2001) and Claus and Thomas (2001). Botosan (1997) is the first to use the ICC as proxy for expected stock returns of individual firms. Other studies use the ICC to test asset pricing models (Lee et al., 2009), or the risk-return trade-off of individual shares (Pástor et al., 2008).

selection indicator.

This paper builds on the large and controversial literature that examines the value of analyst forecasts for investors. A first branch of this literature directly evaluates the profitability of investment returns based on analysts' buy and sell recommendations. The debate goes back to Cowles (1933) who showed that recommendations of most analysts do not generate positive abnormal returns, when looking both at individual securities or the entire market. More recent research[2] comes to the conclusion that – although the recommendations contain some useful investment advice – their value is too small to be exploited by investors: after taking into account the impact of transaction costs, most investment strategies are no longer profitable. A second stream of the literature investigates whether analyst earnings' forecasts are more accurate than time-series forecasts. Using a large data sample, Bradshaw et al. (2012) show that analysts provide better forecasts than time series models only for the short horizon.

Most studies that examine the value of analyst forecasts employ only only a small subset of analyst advice, such as simple buy or sell recommendations (Barber et al., 2001; Jegadeesh et al., 2004; Cvitanic et al., 2006; Barber et al., 2010) or changes in recommendations (Womack, 1996; Jegadeesh et al., 2004; Barber et al., 2010). Since the ICC combines and transforms a large variety of analyst earnings forecasts into one single indicator, including short-term forecasts and long-term growth projections, it offers a richer framework to examine the information contained in these forecasts. Furthermore, with the exception of Jegadeesh and Woojin (2006), most studies focus on the U.S. equity market only. Extending the scope of the analysis to other capital markets allows to verify whether previous results hold true across countries, or are confined to the U.S. example.

This work is also related to recent studies that examine the relation between the ICC and stock returns in the U.S. equity market. Lee et al. (2011), Guay et al. (2011) and Botosan et al. (2011) investigate the relation between various ICC estimates and stock returns. Botosan and Plumee (2005) and Botosan et al. (2011) analyze whether cross-sectional differences in ICC estimates can be explained by their relation to standard firm risk factors or risk characteristics. All these studies find that in the United States, the ICC is related to subsequent stock returns and common proxies of firm risk.[3] The application of the ICC to active portfolio management has received only little attention in the literature. To our knowledge, only Stotz (2005) illustrates

[2]See Womack (1996), Barber et al. (2001), Jegadeesh et al. (2004), Cvitanic et al. (2006) and Barber et al. (2010)

[3]A growing literature examines the suitability of the ICC as proxy for expected stock returns. Such an analysis can be carried out by either comparing ICC estimates with risk proxies (Botosan and Plumee, 2005; Botosan et al., 2011) or realized returns (Easton and Monahan, 2005; Lee et al., 2011).

how the ICC might be useful for investment managers. He, however, considers a more applied setting using a smaller data set.

Finally, this paper also touches some research on the value-to-price ratio (V/P ratio), which is similarly derived from analyst forecasts. This quotient of fundamental firm value to market capitalization has been used to predict the returns of individual stocks (Frankel and Lee, 1998) and entire markets (Lee et al., 1999). Lee and Swaminathan (1999) apply the V/P ratio to portfolio management.

Examining a large U.S. data sample from 1992 to 2009, we find that high ICC stocks indeed provide, on average, higher returns than stocks with a low ICC estimate. A zero-cost trading strategy buying high ICC stocks and selling short low ICC stocks yields an average annual return of 6.0%. This excess return remains significantly positive when controlling the investment returns for portfolio risk as implied by the CAPM and the Carhart (1997) four-factor model. An extension of the U.S. analysis to four other important capital markets largely confirms these findings. Once taking into account the impact of transaction costs, econometric tests show that the risk-adjusted returns of diversified ICC investment strategies are not reliably different from zero. Nevertheless, this paper shows that investors can generate positive risk-adjusted returns after transaction costs when focussing on smaller subsets of stocks. In particular, shorting stocks with very low ICC estimates yields significant returns, as they are persistently overvalued.

By showing that ICC investment strategies generate positive risk-adjusted excess returns, our study provides evidence that the ICC is not just a transformation of well-known and easily measurable firm-risk characteristics. Instead, a firm's implied return conveys important information about the firms' cash-flows which can help investors to detect mispriced assets.

The paper develops as follows. The next section presents the estimation of a firm's implied cost of capital in detail. Section 3 contains a brief description of the U.S. data sample. In section 4 we turn to the main objective of this paper and show that an investment in high ICC stocks significantly outperforms an investment in low ICC stocks. Section 5 compares the results obtained in the United States to other equity markets. Section 6 offers some concluding remarks and implications.

## 2 Implied cost of capital

This study uses the firms' implied cost of capital (ICC) to implement trading strategies based on equity analyst forecasts. The ICC is the internal rate of return that equates expected discounted earnings per share to current price. Expected earnings are obtained from analysts for the short horizon together with assumptions of standard valuation models for the long-run. We follow the literature and use a residual income model (RIM) to estimate the ICC.[4] This pricing model states that the value of a company should equal its invested equity capital, plus the expected discounted residual income from future activities.[5]

**Definition 1.** (Residual income, residual income model): *Let $b_t$ denote the book value of equity per share at the end of year $t$, $e_t$ the earnings per share in year $t$, and $k$ the cost of equity capital. Then the residual income $r_t$ per share is defined as:*

$$r_t = e_t - k(b_{t-1}). \tag{1}$$

*If $E_0[r_t]$ denotes the expected residual income per share in year $t$, the price of a share $p_0$ is*

$$p_0 = b_0 + \sum_{t=1}^{\infty} \frac{E_0[r_t]}{(1+k)^t}. \tag{2}$$

Since earnings forecasts are not available until infinity, one has to make assumptions about expected cash flows in the long-run when implementing the model in practice. This paper resorts to the two-stage approximation of Claus and Thomas (2001)[6]:

**Definition 2.** (Two-stage residual income valuation): *Let $E_0[e_t]$ denote the expected earnings per share. Then the price of a share is*

$$p_0 = b_0 + \underbrace{\sum_{t=1}^{5} \frac{E_0[e_t] - k(b_{t-1})}{(1+k)^t}}_{\textit{growth period}} + \underbrace{\frac{E_0[r_5](1+g)}{(k-g)(1+k)^5}}_{\textit{stable growth}}. \tag{3}$$

This model combines earnings forecasts of analysts for the short horizon with assumptions on firm profitability in the long-run. Formula (3) assumes an initial phase of high earnings growth rates, followed by a stable growth in residual income after year five. In the first three years, expected earnings are taken from equity analysts. After year 3, expected earnings are obtained

[4]The first papers on the ICC relied on the dividend discount model (DDM), see Malkiel (1979) and Brigham et al. (1985). Following empirical studies that show the superiority of the RIM over the DDM to estimate firm value (Francis et al., 2000; Jiang and Lee, 2005), recent papers use the RIM to estimate the ICC.

[5]The residual income model (RIM) was brought forward by Preinreich (1938) and Edwards and Bell (1961).

[6]Alternative implementations of the RIM are by Gebhardt et al. (2001), Gode and Mohanram (2003) or Easton (2004). Botosan and Plumee (2005), Easton (2006) and Botosan et al. (2011) provide a good overview of the different formulae and model assumptions. In unreported tests, we checked the robustness of our results by using other RIM specifications. The results are qualitatively similar, but less significant.

by applying the IBES consensus long-term earnings growth rate to expected earnings in year 3. In the stable growth phase, residual incomes are presumed to grow at the expected inflation rate $g$, which is calculated as the prevailing interest rate on 10-year treasury bonds less an assumed real-rate of three percent.[7]

The ICC is estimated by solving the residual income model (3) for the internal rate of return, given the share price and expected earnings. The solution is straightforward, since the RIM is monotone in the cost of capital $k$, and can be solved iteratively.

# 3 Data and descriptive statistics

## 3.1 Data

The focus of this paper is to analyze investment strategies based on the implied cost of capital in the U.S. equity market. Equity analyst earnings and long-term earnings growth forecasts are obtained from IBES. Instead of individual forecasts, this study uses the median forecasts of all contributing sell-side equity analysts. These consensus forecasts are published on the third Thursday of each calendar month. To ensure that the ICC estimates are based on publicly available information, we employ the last available information of the additionally required data items. Share prices as of the same day are equally provided by IBES. Book value data are obtained from Worldscope since it is more reliable for accounting data compared to IBES. Monthly data on total stock returns are taken from Datastream.

We use the four Carhart (1997) factors to account for firm risk, i.e., the market factor, the size factor, the value factor, and the momentum factor. Monthly data of these risk factors are obtained from the web-site of Kenneth French. In addition we require the firm characteristics related to the factors, i.e., market beta, market capitalization, the B/M ratio and price momentum. Market beta is the company's five year regressed price return sensitivity on the market portfolio, proxied by S&P 500 index.[8] Market capitalization is obtained from IBES. Price momentum is calculated as the change in stock prices over six months prior to each

[7] In case there is no analyst forecast for earnings in year 3, we generate an expected earnings estimate by applying the long-term consensus growth rate to expected earnings in year 2. If projected earnings in year 3 (or in year 2, respectively) are negative, we drop the observation from the sample. Future expected book values are calculated using the clean surplus relation. The assumption of no real growth in residual income after year 5 does not imply the absence of real earnings growth after year 5. It rather incorporates the assumption of decreasing earnings growth rates in the stable growth phase, for usual reasons (competition, antitrust actions, etc.). For more details, see please refer to Claus and Thomas (2001).

[8] If the share price is not available 60 months before any observation, the beta estimation period is reduced down to 24 months. If the available time period is even shorter, the observation is dropped from the sample.

observation.

This study covers the time from January 1992 to January 2009. We include all non-financial firms for which we have sufficient data to estimate the implied cost of capital using the procedure described above, and for which we have the full set of the Carhart firm risk characteristics. We drop all ICC estimates larger than 1. Furthermore, we drop observations with a negative book value of equity. In addition, we remove the lowest and highest 0.5% of the ICC estimates and firm characteristics to reduce the impact of outliers. Finally, we drop all firm observations with a market capitalization below USD 100 million to ensure that the investment strategies are actually feasible.

## 3.2 Summary statistics

Panel A of table 1 reports the summary statistics for the U.S. data set, after the exclusions described above. The sample includes 243,231 observations from 1992 to 2009. The average ICC of around 9.6% is well in line with previous works (Claus and Thomas, 2001; Gebhardt et al., 2001; Lee et al., 2009). Given that the average return on 10-year government bonds was 5.4% over the examined time horizon, this implies an equally-weighted market risk premium of 4.2%, which seems a reasonable approximation. The mean beta estimate is slightly above the theoretical value for the market beta of 1. The average firm size of the sample is at USD 3,204 million. The mean B/M ratio is at 0.31, and the six-month price momentum averages just above 4.2%.

Panel B shows the correlation statistics. To remove the impact of outliers, the correlation matrix is calculated using the natural logarithm of B/M ratio and firm size. There is some negative association between ICC and both firms size and price momentum, similar to Botosan et al. (2011). Since, ceteris paribus, an increase in prices reduces the internal rate of return, see equation (3), a negative relation between ICC and price momentum might be expected. Yet, the negative correlation rejects the joint hypothesis that price momentum is a priced risk factor and that the ICC is an unbiased proxy for expected stock returns. Similar to Botosan et al. (2011), we also document a positive relation between ICC and the B/M ratio. The correlation structure of the different risk characteristics with each other exhibits the standard relation as documented in many empirical asset pricing studies.

[Table 1 goes here.]

# 4 Implied cost of capital investment strategies

If market prices do not reflect fundamental values as predicted by analysts at all times, a share's ICC might be useful to detect mispriced assets. For example, a high ICC can be conceived as sign that the company trades below fair value, and vice versa. Under the premise that share prices converge back towards fair value, investors should invest in high ICC stocks and sell low ICC stocks.[9]

This section analyzes the profitability of a long-short investment strategy consisting in buying high ICC stocks and selling short low ICC stocks. In section 4.2, we correct the investment returns for their risk exposure. Section 4.3 examines the investment strategy under real-life conditions, i.e., including transaction costs. Finally, in section 4.4, we illustrate how the ICC might be useful to improve tactical asset allocation decisions of investment managers.

## 4.1 Portfolio returns

At the end of each month, all stocks in the sample are ranked according to their ICC estimate and grouped into 5 equally-weighted portfolios. Then we measure the subsequent total portfolio returns (i.e., capital gains plus dividend yield) over a holding period of one month and one year. To avoid any look-ahead bias, the return of a company dropping out of the sample during this period (caused by delisting, takeover, etc.) is replaced by the market return over that period.

Long-horizon trading strategies can be examined using overlapping or non-overlapping holding periods. To increase the power of the analysis, the annual trading strategy is calculated using overlapping observations, similar to Jegadeesh and Titman (1993). While a non-overlapping analysis would allow us to include only 18 annual observations for the years from 1992 to 2009, using overlapping holding periods increases the number of observations to 205.

Table 2 reports the average monthly and annual returns of the 5 buy and hold portfolios, as well as the zero-cost long-short portfolio. In addition, the table presents the portfolio characteristics, as measured by the firms' average ICC estimate, market beta, B/M ratio, firm size and price momentum.

On average, the returns of all portfolios are positive and increase with the mean ICC estimate – higher implied returns are associated with higher realized returns. The high ICC portfolio

[9]Forecast errors and biases of equity analysts might distort the relation between a firm's ICC and subsequent stock returns. Still, the results of this paper should be largely unaffected by erroneous forecasts. Unsystematic forecast errors are likely to cancel out, and systematic biases leave the ranking of the companies' ICCs unchanged. Finally, to the extent that market participants believe in biased or erroneous forecasts, the resulting pricing errors are correlated, such that the two errors cancel out.

with monthly (annual) rebalancing yields a return of 14.3% p.a. (15.6% p.a.), which compares to a market return of 6.1% over the same period as measured by the S&P 500. The returns of the long-short portfolios (P5-P1) are significantly positive. When rebalancing the portfolios every month, they yield an annualized return of 7.9%. With an annual excess return of 6.0%, the zero-investment is slightly less profitable when increasing the holding period to 12 months. The table also shows that the portfolios exhibit different average firm characteristics. Similar to the correlation matrix (see table 1), the composition of the portfolios varies according to the firms' ICC. Although the average market beta is similar across portfolios, the table shows that there are significant differences in terms of average firm size, B/M ratio and price momentum. Even though the relation is not monotone, high ICC portfolios tend to include more growth than value companies, and smaller companies. In addition, there is a strong negative association between the portfolio's mean ICC and the past price momentum. ICC strategies thus exhibit some similarities with contrarian investments (DeBondt and Thaler, 1985; Chan, 1988) that invest in past losers. These investments exploit the mean-reversion of stock returns over long time horizons, which predicts that past losers will outperform the market in the future.

The results suggest that the five ICC portfolios have a different exposure to the Carhart (1997) firm risk factors. Consequently, the returns of the long-only portfolios and the excess returns of the long-short portfolios are not risk-free, but are at least partly a compensation for some systematic risk exposure. Since smaller companies usually carry higher risk premia, the returns of the high ICC portfolio are to some extent a compensation for its exposure to small firms. In contrast, the negative association between ICC on the one hand and B/M ratio and price momentum on the other indicates that high ICC portfolios contain less risky companies than the market in these two dimensions: value companies and past winners tend to provide higher average returns.

[Table 2 goes here.]

Given that the ICC is a noisy proxy for a firm's expected rate of return, some positive relation between ICC, common firm risk factors and stock returns is certainly expected. Yet, the results show that there is not a one-to-one match between ICC and firm risk characteristics that were found to determine a share's return. Especially the negative relation between price momentum and subsequent stock returns is opposed to the initial motivation of the momentum factor, but rather fits with the view that stock prices sometimes temporarily diverge from fundamental values, before converging back to fair value.[10]

[10]The stock price reversal found it this paper occurs over a time horizon up to one year, and is thus different

## 4.2 Risk correction

The previous results indicate that the ICC portfolios are partly exposed to common firm risk factors. In this section, we correct the portfolio returns for their risk exposure.

First, we first examine the profitability of ICC strategies within subsamples generated on the basis of B/M ratio, firm size, and price momentum. In a first step, we partition all monthly observations into five size (B/M ratio, momentum) quintiles. Then we sort all stocks within each quintile in five portfolios according to their ICC estimate, and calculate their average returns. This double-sorting analysis allows to disentangle risk effects induced by the firms' exposure to the risk factors firm size, B/M ratio and price momentum from the returns generated by the ICC investment strategy. Put differently, all portfolios within one quintile contain rather identical companies with respect to the B/M ratio (firm size, price momentum) and are thus risk-neutral with respect to this factor.

The results in table 3 show that the ICC effect is largely independent of the firm-risk effects captured by firm size, B/M ratio, and price momentum. In all quintiles the return of the long-short zero-cost portfolio is positive, and in many cases highly significant. In many instances, the portfolio returns increase monotonically with the average ICC. Only when controlling for firm size, the ICC effect is less strong. The general pattern is independent of the rebalancing interval, as the results of the monthly and the annual holding period are very similar.

[Table 3 goes here.]

As a second test, we calculate the risk-adjusted returns of the each of the portfolios constructed in section 4.1. The risk-adjusted returns are estimated as the intercepts (or portfolio alphas) from the following market model regression:

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i F_t^j + \varepsilon_{i,t}, \tag{4}$$

where $r_{i,t}$ is the return of portfolio $i$, $r_{f,t}$ is the return of the of short-term bills as proxy for the risk-free rate, $F_t^j$ is the return of factor $j$, and $\varepsilon_{i,t}$ is the error term. When estimating the model for the zero-investment portfolio P5-P1, we do not subtract the risk-free rate. We estimate two market models: the CAPM with only one factor, the market factor $r_{m,t} - r_{f,t}$, and the Carhart (1997) four-factor model which additionally includes the two Fama and French (1993) value and size factors, and the momentum factor. We estimate the model for both monthly and annual

to previous studies that document reversals either in the short run over very few weeks (Jegadeesh, 1990) or for time horizons from three to five years (DeBondt and Thaler, 1985).

overlapping portfolio returns. Annual risk factors are obtained by chaining the monthly factor returns together.

The results are summarized in table 4. Risk-adjusted returns of the high ICC portfolios (P5) are always positive, and significantly different from zero. In contrast, the risk-adjusted returns of the low ICC portfolios (P1) are very small in absolute terms. A long-only strategy in high ICC stocks yields a CAPM-adjusted return of 6.4% p.a. when rebalancing the portfolio every month, and 7.4% when rebalancing every year. When adjusting the portfolios for their exposure to the Carhart (1997) risk factors, the average return of the annual strategy declines to 2.6%, while the returns of the investment with monthly balancing remain at 6.4% p.a.

The return differential between the two extreme portfolios is significantly positive, regardless of the market model used to control the portfolio returns for their risk exposure. When rebalancing the portfolio every month, the risk-adjusted return of the zero-investment portfolio is 7.6% p.a. with respect to the CAPM; an annual strategy yields with 6.3% slightly lower returns. When controlling the returns for the Carhart (1997) risk factors, the monthly investment strategy yields 7.6% p.a., while when rebalancing the investment every year, the portfolio generates an annual return of 3.7%.

Since the long-short portfolios are almost beta-neutral, i.e., they carry little market risk, the CAPM alpha is almost identical to the unadjusted portfolio return. However, as the zero-cost portfolios are exposed to the Fama and French (1993) value and size factors, the Carhart (1997) alpha is smaller. It is worthwhile to note that the zero-cost investment strategies are negatively exposed to the momentum factor. Since high ICC stocks tend to be past losers, the portfolios are less risky compared to momentum-neutral investments.

[Table 4 goes here.]

The overall conclusion from tables 3 and 4 is that there is a significant ICC effect in U.S. equity markets which is independent of standard risk effects as proxied by the Carhart (1997) model. This effect is in conflict with the joint hypothesis of efficient markets in the semi-strong form and the validity of the Carhart (1997) model, as investors can profitably trade on information contained in publicly available analyst forecasts. Under the premise that markets are not fully efficient at all times, the ICC effect can be explained by valuable information contained in analyst forecasts about the fundamental value of companies. This additional knowledge allows to detect mispriced assets, which generates positive risk-adjusted returns.

Why are these market inefficiencies not exploited by market participants, and thus eliminated?

Most of all, it probably takes time for equity markets to process the information provided by analysts. Similar to the uncertainty explanation of the post-earnings announcement drift by Brav and Heaton (2002) and Francis et al. (2007) suggesting that investor uncertainty prevents an immediate price reaction following earnings announcements, it is reasonable to assume that investors require some time to incorporate analyst earnings' forecasts into investment decisions. The results are also in line with Cohen and Lou (2012) and Drerup (2012) who show that the price reaction to news about company fundamentals is not immediate, but depends on firm complexity and analyst uncertainty. The existence of the ICC effect hence might not imply investor irrationality. Rather, it may reflect a rational learning process of investors who initially lack knowledge about the companies' fundamentals.

If postulating efficient markets at the outset, the abnormal returns of ICC strategies are of course not risk-free, but a compensation for the firms' risk-exposure not captured by the Carhart (1997) pricing model. As any empirical asset pricing study, it is difficult to give a conclusive answer to this debate. It is a reasonable conjecture to conclude that the truth lies somewhere in-between.

## 4.3 Transaction costs

The results of section 4.2 suggest that investors can exploit market inefficiencies to generate positive abnormal returns using the ICC as indicator for mispriced assets. In absolute terms, the profits of the ICC strategies are not very large, which might prevent investors from implementing the strategy in practice. Essentially, the abnormal returns are gross of transaction costs, such as bid-ask spreads or brokerage commissions. 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. This section re-examines the profitability of the ICC strategies including the impact of transaction costs.

To assess the transaction costs we need to estimate the average turnover of the portfolios at each rebalancing date. We calculate the average turnover ratio as the fraction of shares replaced at every time the equity portfolios are rebalanced. Table 5 shows the average turnover ratios for the investment strategies requiring monthly and annual rebalancing. As expected, the longer the rebalancing interval, the more shares have to be replaced. The monthly investment strategy requires replacing between 24% and 44% of the shares in each portfolio, whereas the annual strategy requires a replacement of up to 75% of the shares. The table also shows that the extreme portfolios (P1 and P5) require less rebalancing than the other portfolios. This implies that the long-short investment requires only a turnover of about 23.9% for the monthly strategy, and 62.0% for the annual investment strategy.

[Table 5 goes here.]

We assume that round-trip transaction costs, i.e., the cost of replacing an existing investment with new shares, amount to 2 percent of the transaction value.[11] Round-trip transaction costs of 2% imply annual transaction costs equal 2% of its annual turnover. Thus, transaction costs reduce the risk-adjusted excess returns of the long-short investment with monthly rebalancing by 576 basis points, given an average turnover of 23.9% every month. In contrast, the less active long-short investment with annual holding periods incurs a lower transaction cost of 124 basis points.

Assuming that the standard deviation of the portfolio's risk-adjusted net return is equal to its risk-adjusted return before transaction costs, most of these yields are not statistically different from zero at conventional confidence levels. The portfolio alpha of the long-short portfolio with monthly rebalancing exhibits a t-statistics of only 0.61 (CAPM) and 0.99 (Carhart). In contrast, the abnormal return of the annual investment strategy is marginally significant at the 10% level using the Carhart market model (t-statistic: 1.80). Yet, with respect to the CAPM, this strategy does not yield significantly positive abnormal returns after transaction costs (t-statistic: 1.49).[12]

Does this mean that the ICC is futile to detect mispriced assets in practice? Not necessarily. The investment strategies analyzed above involve buying and selling short two highly diversified portfolios. Diversified portfolios have the advantage of eliminating the idiosyncratic risk of the assets included, which reduces the portfolios' volatility. At the same time, the diversified long-short investments might not only include effectively mispriced stocks, but also a large fraction of assets that are priced accurately. This diminishes the investments' average excess returns.

When considering smaller portfolios that include only stocks with extremely high or low ICC estimates, it might be possible to select stocks with larger average pricing errors. Table 6 presents the raw and risk-adjusted portfolio returns before transaction costs of such smaller ICC portfolios. Whereas the left column of each panel reports portfolio returns when investing in stocks in the extreme ICC quintiles (similar to table 4), the other columns report the returns

[11] Given that companies followed by equity analysts tend to be larger companies, this is a rather conservative assumption. Comparable papers assume lower transaction costs, such as Barber et al. (2001) that use 1.31%. See Keim and Madhavan (1998) for more evidence on transaction costs in the United States.

[12] Since turnover ratios are not constant, the standard deviation of net excess returns might be higher than that of gross returns. Thus, the statistical significance might be even smaller.

when including only stocks whose ICC is in the 10th/90th percentile, 5th/95th percentile, or 2nd/98th percentile.

[Table 6 goes here.]

In line with the conjecture, the return differential between the low and the high ICC portfolio tends to increase when reducing the number of stocks in each portfolio, especially in panel B. At the same time, the statistical significance of the spread decreases. The reason is that, the fewer assets in a portfolio, the more volatile the portfolio returns – which reduces the statistical significance of the spread. Furthermore, an investment in very high ICC stocks does not seem to yield higher risk-adjusted returns. However, the table shows that the returns of an investment in very low ICC stocks yields significantly negative risk-adjusted returns. Put differently, stocks with a very low ICC seem persistently overvalued.

This insight can be used to construct portfolios that are profitable even after transaction costs. For example, a long-short investment with annual rebalancing that sells short stocks with an extremely low ICC (all stocks below the second ICC percentile) and goes long in stocks in the upper ICC quintile generates an average return of 9.6% per year. The risk-adjusted return of this investment is 10.5% using the CAPM as market model, and 8.5% using the Carhart model. Net of transaction costs, the abnormal returns reduce to 9.1% (CAPM) and 7.0% (Carhart), but remain significantly different from zero at the 1% level.

To conclude, this section shows that there exist profitable trading opportunities even for real-world investors. Although the market inefficiencies revealed by the ICC are not large enough to allow for substantial trading opportunities using diversified equity portfolios, investors can exploit the ICC effect when focussing on smaller subsets of stocks. In the light of the market efficiency debate, the results show that ICC effect clearly contradicts the semi-strong form of market efficiency. Yet, it might not be considered a market anomaly in the usual sense as the average mispricing is rather small. As such, the findings confirm Barber et al. (2001) and Cvitanic et al. (2006) who show that the information contained in publicly disseminated analyst forecasts is, on average, not significant in economic terms. Still, considerable risk-adjusted returns after transaction costs for smaller subsets of stocks highlight that, although the market tends to be rather efficient as a whole, it is not efficient for all individual stocks.

### 4.4 Tactical asset allocation

The above results have also some interesting implications to financial practitioners for tactical asset allocation decisions. High ICC estimates mean that shares trade relatively low compared to fundamental values, both when looking at individual companies as well as the entire market. Hence, aggregate market ICC estimates can be useful to predict aggregate stock market returns. Table 7 shows how investors can use the market's average ICC as signal to implement tactical asset allocation strategies that rebalance total funds between equities and risk-free assets, depending on the market's ICC relative to some reference level or cut-off point. In this study, all funds are invested into the market portfolio when the monthly average ICC is higher than this cut-off value; otherwise it is invested in a short-term risk-free bill (see panel B). The cut-off point is the grand mean (median) of monthly average ICC estimates of all companies in the sample.[13] In an alternative strategy, see panel C, all funds are allocated to the portfolio of high ICC stocks (P5) or the risk-free asset, respectively.

The results show that annual TAA strategies that switch between the stock market and the risk-free asset yield similar returns than a buy-and-hold investment in the market, but at much lower volatilities, as the Sharpe ratio indicates. Rebalancing the funds between a risk-free asset and the high ICC portfolio (P5) generates even higher returns and Sharpe ratios, although this investment falls short of the return an investor could generate by simply buying the portfolio of high ICC stocks. Monthly TAA strategies exhibit a similar pattern, but generate considerably lower returns.

This analysis does not reflect the impact of transaction costs. In addition, the portfolio shifts are quite substantial, probably higher than many fund managers are willing to make.

[Table 7 goes here.]

## 5 International capital markets

This section analyzes the ICC effect in other important capital markets, and thus provides an international robustness check of the results obtained in the United States. We replicate the analysis for Canada, France, Japan, and the United Kingdom.[14] Although equity markets of these four countries are highly developed and intertwined, they experienced rather different

[13] We acknowledge that using the sample grand mean or median introduces a minor look-ahead bias.

[14] This paper contains only a summary of the international analysis. More detailed results are available on request.

economic and market developments during the sample period, such as a long-lasting recession in Japan or a period of high economic growth in the United Kingdom. These cross-country differences must be taken into account when interpreting the results. A second source of possible divergence is the availability of IBES data. The RIM following Claus and Thomas (2001) relies on the long-term consensus growth rate of equity analysts. Although estimating this growth rate has a long tradition in the United States, it used to be less common in other markets. Hence this methodology leads to a considerable decrease in the available data set in these four countries. The upside of using the RIM to estimate the ICC is that it is immune to differences in national accounting rules, as Frankel and Lee (1996) show.

We use the same data sources for the international analysis as for the United States, and follow the same data adjustment and exclusion procedures as described in section 3.1. Table 8 provides an overview of the four international data sets. The data for Japan are the largest, including 42,857 monthly observations. The Canadian sample is the smallest with 11,803 observations. All data are denoted in local currency. As expected, there is some considerable discrepancy between countries. Average ICC estimates vary between 6.28% in Japan and 10.26% in the United Kingdom. Given that low expected earnings reduce ceteris paribus the ICC, this possibly reflects different growth perspectives in these countries, as mentioned earlier. Average beta estimates are below 1 across all countries. This indicates that the companies included in the international analysis tend to be less cyclical than the market average. Finally, price-to-fundamental ratios vary a lot across countries. French stocks included in the sample have traded on average at much higher P/B ratios compared to Japan and the U.K. The correlation statistics of the ICC and firm risk characteristics, see panel B, is fairly similar across countries, however.

[Table 8 goes here.]

Table 9 summarizes the results. Panel A presents the average monthly returns of the low ICC portfolios, the high ICC portfolios, and the long-short portfolios, as well as the portfolios' risk-adjusted returns (portfolio alphas) using the CAPM as market model. Panel B shows the results when using annual rebalancing intervals. Finally, panel C reports the risk characteristics of the long-short portfolios.[15]

[15] We use monthly returns of each country's main stock market index less the yield of three-month government bills to proxy for the market factor. We refrain from presenting the risk-adjusted returns for the Carhart model, since there are no standardized factor returns $HML$, $SMB$, and $MOM$ available. Country-specific factor returns use partly very different portfolio construction methodologies and return definitions, making the results not comparable across countries.

The long-short portfolios yield annualized average returns of 3.6% in Canada to 9.7% in Japan when rebalancing the portfolio every month. Annual investment strategies provide rather similar returns, ranging from 3.8% in Canada to 8.8% in Japan. The return differential between low and high ICC stocks is not statistically significant in all countries. Whereas the spread in Canada fails to be significant, the difference between high and low ICC stocks is highly significant in Japan. In France and the United Kingdom, the spread is only significant for the investment strategies with monthly rebalancing.

Since the ICC is only little related to market beta (see panel C), the risk-adjusted returns of the long-short portfolio with respect to the CAPM are not very different from the raw returns. In France, Japan, and the United Kingdom, the portfolio alphas are significantly positive for both monthly and yearly investments. However, the lower panel shows that the long-short portfolios are strongly exposed to the Fama-French risk factors size and B/M ratio, suggesting that the estimated CAPM alpha is not a risk-free return. In all countries, the high ICC portfolio comprises significantly smaller companies, and is thus more risky. The association of the portfolios to the risk indicator B/M ratio is less obvious: whereas in France and Japan, the P5-P1 portfolio is positively related to the B/M ratio, the opposite holds true for Canada and the United Kingdom, similar to the U.S. sample. Finally, all long-short portfolio returns are negatively exposed to price momentum. If past price momentum is a sign for higher risk exposure, the long-short portfolio returns are less risky compared to the market average. Hence, although the zero investment strategies are clearly not risk-neutral with respect to the Carhart factors, they not necessarily carry higher risk premia on average – similar to the U.S. example.

The results indicate that the ICC effect is not limited to the U.S. capital market, but is also present in other countries. In France, Japan and the United Kingdom, analyst forecasts contain important information about the fundamental value of companies, and hence are valuable for investors. However, the results also show that the ICC effect varies across countries. Especially in Canada, stocks with a high ICC do not significantly outperform low ICC stocks. There can be several reasons for this result. First, analyst forecasts might not convey any valuable information about the companies' future cash-flows for Canadian stocks. A second possibility is that the Canadian stock market is more efficient compared to other countries. If markets are efficient in the semi-strong form, they impound information provided by analysts immediately into prices, leaving no room for the post-announcement returns studied in this paper. Finally, the Canadian data sample is rather small, including on average less than 60 companies per month. Such a low number of companies reduces the power of the analysis.

[Table 9 goes here.]

# 6 Concluding remarks

This paper analyzes the relation between a firm's implied cost of capital and subsequent stock returns. Using a simple trading strategy, this study shows that in the U.S. equity market stocks with a high ICC outperform low ICC stocks on average by 6.0% p.a. The return differential remains significantly positive after correcting the investment for its risk exposure implied by the CAPM and the Carhart (1997) four-factor market model. An extension of the analysis to four other important capital markets confirms these results on an international level.

This study gives also two practical examples of how investors can use the ICC to their benefit. First, when focussing on small subsets of stocks, investors can generate substantial risk-adjusted returns after transaction costs. In particular, investors should shed stocks with a very low ICC, as their risk-adjusted returns are persistently negative. A long-short investment with annual rebalancing that sells short stocks with extremely low ICC estimates and goes long in stocks in the upper ICC quintile generates for example abnormal returns of 9.1% p.a.with respect to the CAPM and 7.0% p.a.with respect to the Carhart model, net of transaction costs. Second, since high implied market returns can be conceived as a sign that equity markets are likely to be undervalued, the market ICC might be a useful indicator for tactical asset allocation decisions between equities and risk-free assets.

The results of this paper have some interesting implications. As such, the existence of profitable trading strategies based on the firms' ICC rejects the joint hypothesis of efficient markets and the validity of the Carhart (1997) pricing model. Put differently, the ICC is not a mere transformation of well-known and easily measurable firm-risk characteristics, but contains some additional predictive power for the firms' future returns. In the light of previous studies that document violations of the efficient market hypothesis, the ICC effect means that equity analyst forecasts provide valuable information about the fundamental value of companies which can help investors to detect mispriced assets.

Why do these market inefficiencies persist over time? On the one hand, equity markets probably need some time to handle the information contained in equity analyst forecasts, similar to the uncertainty explanation of the post-earnings-announcement drift. On the other hand, market participants face transaction costs when actually implementing ICC investment strategies. The fact that large, diversified ICC investments are little profitable after transaction costs shows that some of the market inefficiencies documented in this study might be too small to be eliminated by trading activities of arbitrageurs.

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# Tables

Table 1: Summary statistics

Panel A: Descriptive Statistics

| | Mean | Standard deviation | 25% centile | 50% centile | 75% centile |
|---|---|---|---|---|---|
| Implied cost of capital | 9.58% | 3.03% | 7.69% | 9.24% | 11.05% |
| Market beta | 1.03 | 0.70 | 0.53 | 0.94 | 1.40 |
| B/M ratio | 0.31 | 0.77 | 0.06 | 0.15 | 0.34 |
| Size (in mn USD) | 3,204 | 7,042 | 369 | 957 | 2,737 |
| Price momentum | 4.62% | 33.18% | −14.29% | 2.45% | 19.57% |

Panel B: Correlation statistics

| | ICC | Market beta | log(B/M ratio) | log(size) | Price momentum |
|---|---|---|---|---|---|
| Implied cost of capital | 1.000 | | | | |
| Market beta | −0.030 | 1.000 | | | |
| log(B/M ratio) | 0.108 | −0.011 | 1.000 | | |
| log(size) | −0.206 | −0.054 | −0.419 | 1.000 | |
| Price momentum | −0.217 | −0.002 | −0.108 | 0.015 | 1.000 |

The table presents the summary statistics of the implied cost of capital estimates (ICC) and the Carhart (1997) firm risk characteristics. Panel A summarizes the mean, standard deviation, median, and quartiles of the data sample, panel B the correlation statistics. Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the implied cost of capital estimation. The sample period is from January 1992 to January 2009. Observations: 243,231.

Table 2: Portfolio returns

| Portfolio | ICC | Monthly returns | Annual returns | Market beta | B/M ratio | Size | Price Momentum |
|---|---|---|---|---|---|---|---|
| P1 (low ICC) | 6.61% | 0.53% | 9.60% | 1.09 | 0.46 | 1,056 | 12.30% |
| P2 | 8.40% | 0.83% | 11.44% | 0.94 | 0.22 | 1,398 | 8.59% |
| P3 | 9.46% | 1.05% | 13.44% | 0.95 | 0.22 | 1,218 | 5.71% |
| P4 | 10.70% | 1.13% | 13.98% | 1.01 | 0.25 | 905 | 1.60% |
| P5 (high ICC) | 13.77% | 1.19% | 15.55% | 1.10 | 0.37 | 532 | −5.55% |
| P5-P1 | 7.17%*** | 0.66%*** | 5.96%** | 0.00 | −0.10*** | −524*** | −17.85%*** |
| t-statistics | (56.07) | (2.72) | (2.03) | (0.17) | (−6.83) | (−16.38) | (−20.62) |

The table reports the monthly and annual (overlapping) returns of the 5 portfolios constructed according to the firms' ICC estimate. P1 comprises the low ICC stocks, and P5 the high ICC stocks. P5-P1 is the portfolio that is long in P5 and short in P1. In addition, the table reports the average firm characteristics of each of the portfolios, i.e. the ICC estimate, market beta, B/M ratio, firm size and price momentum. The t-statistics in parenthesis below are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 3: Double-sorted portfolio returns

Panel A: Book-to-market equity neutral portfolios

| | Monthly returns | | | | | Annual returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 2 | 3 | 4 | High | Low | 2 | 3 | 4 | High |
| P1 | 1.00% | 0.56% | 0.32% | 0.34% | 0.49% | 14.54% | 8.59% | 8.08% | 7.68% | 8.83% |
| P2 | 0.91% | 0.93% | 0.84% | 0.67% | 0.63% | 14.14% | 11.54% | 11.05% | 8.60% | 9.59% |
| P3 | 1.45% | 0.92% | 0.85% | 0.79% | 0.88% | 17.62% | 13.03% | 12.86% | 10.28% | 10.17% |
| P4 | 1.49% | 1.19% | 1.17% | 0.93% | 0.74% | 19.18% | 14.44% | 13.34% | 11.23% | 11.94% |
| P5 | 1.88% | 1.37% | 1.34% | 1.08% | 0.96% | 24.63% | 19.04% | 16.40% | 12.85% | 11.06% |
| P5-P1 | 0.88% | 0.81% | 1.02% | 0.74% | 0.47% | 10.10% | 10.46% | 8.31% | 5.17% | 2.75% |
| t-statistics | (2.65) | (2.64) | (3.46) | (3.01) | (1.81) | (2.99) | (3.41) | (4.33) | (1.97) | (1.05) |

Panel B: Size neutral portfolios

| | Monthly returns | | | | | Annual returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Small | 2 | 3 | 4 | Big | Small | 2 | 3 | 4 | Big |
| P1 | 0.98% | 0.79% | 0.48% | 0.47% | 0.30% | 14.20% | 11.77% | 9.01% | 9.50% | 7.60% |
| P2 | 1.02% | 1.11% | 0.73% | 0.80% | 0.56% | 16.02% | 14.06% | 9.87% | 10.59% | 9.30% |
| P3 | 1.26% | 1.11% | 0.88% | 1.03% | 0.83% | 15.67% | 14.72% | 11.23% | 12.44% | 10.53% |
| P4 | 1.37% | 1.34% | 1.05% | 1.03% | 0.98% | 15.39% | 14.79% | 12.76% | 13.27% | 12.49% |
| P5 | 1.27% | 1.22% | 1.11% | 0.95% | 0.96% | 17.27% | 14.70% | 15.09% | 14.08% | 13.78% |
| P5-P1 | 0.29% | 0.43% | 0.63% | 0.47% | 0.67% | 3.06% | 2.93% | 6.08% | 4.59% | 6.18% |
| t-statistics | (1.18) | (1.52) | (2.12) | (1.43) | (2.05) | (1.34) | (0.86) | (2.10) | (1.18) | (1.90) |

Panel C: Price momentum neutral portfolios

| | Monthly returns | | | | | Annual returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Losers | 2 | 3 | 4 | Winners | Losers | 2 | 3 | 4 | Winners |
| P1 | 0.55% | 0.51% | 0.30% | 0.33% | 0.86% | 9.47% | 9.36% | 8.77% | 8.90% | 11.33% |
| P2 | 1.16% | 0.87% | 0.83% | 0.64% | 1.00% | 11.96% | 10.74% | 10.46% | 10.73% | 13.73% |
| P3 | 1.19% | 1.07% | 0.89% | 0.82% | 1.26% | 13.13% | 13.02% | 11.93% | 12.88% | 15.48% |
| P4 | 1.13% | 0.91% | 0.80% | 0.84% | 1.65% | 13.34% | 13.30% | 12.82% | 13.34% | 15.92% |
| P5 | 0.89% | 0.67% | 1.06% | 1.21% | 2.15% | 14.61% | 13.67% | 15.29% | 14.98% | 19.29% |
| P5-P1 | 0.35% | 0.16% | 0.76% | 0.88% | 1.30% | 5.13% | 4.34% | 6.52% | 6.08% | 7.96% |
| t-statistics | (1.13) | (0.66) | (3.29) | (3.72) | (4.05) | (1.54) | (1.50) | (2.90) | (2.94) | (2.57) |

The table reports the returns for the five ICC portfolios within B/M ratio (panel A), firm size (panel B) and price momentum-neutral portfolios (panel C). First, all stocks are sorted into five size, B/M ratio and momentum portfolios. Then all stocks within each quintile is sorted again in five portfolios according to their ICC estimate. Then we calculate the average portfolio returns. The left columns reports the portfolio returns using a monthly holding period; the right columns report the returns using annual (overlapping) holding periods. P1 comprises the low ICC stocks, and P5 the high ICC stocks. P5-P1 denotes the portfolio that is long in P5 and short in P1. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 4: Risk-adjusted portfolio returns

Panel A: Monthly stock returns

| Portfolio | $\alpha$ | $(r_m - r_f)$ | $SMB$ | $HML$ | $MOM$ |
|---|---|---|---|---|---|
| P1 | −0.10% | 1.09*** | | | |
| t-statistics | (−0.67) | (28.00) | | | |
| P5 | 0.53%** | 1.20*** | | | |
| t-statistics | (1.99) | (16.47) | | | |
| P5-P1 | 0.63%** | 0.10 | | | |
| t-statistics | (2.58) | (1.47) | | | |
| P1 | −0.15% | 1.02*** | 0.42*** | 0.08* | −0.05* |
| t-statistics | (−1.32) | (26.53) | (7.69) | (1.78) | (−1.76) |
| P5 | 0.53%*** | 1.13*** | 0.68*** | 0.49*** | −0.38*** |
| t-statistics | (2.79) | (18.62) | (8.04) | (5.13) | (−7.90) |
| P5-P1 | 0.68%*** | 0.10 | 0.36*** | 0.42*** | −0.33*** |
| t-statistics | (3.32) | (1.60) | (3.84) | (4.55) | (−6.23) |

Panel B: Annual stock returns

| Portfolio | $\alpha$ | $(r_m - r_f)$ | $SMB$ | $HML$ | $MOM$ |
|---|---|---|---|---|---|
| P1 | 1.07% | 0.94*** | | | |
| t-statistics | (0.62) | (10.98) | | | |
| P5 | 7.39%* | 0.87*** | | | |
| t-statistics | (1.88) | (3.67) | | | |
| P5-P1 | 6.32%* | −0.07 | | | |
| t-statistics | (1.85) | (−0.34) | | | |
| P1 | −1.12% | 0.96*** | 0.74*** | −0.01 | 0.05 |
| t-statistics | (−1.57) | (19.47) | (11.25) | (−0.09) | (0.91) |
| P5 | 2.62%* | 1.06*** | 1.02*** | 0.69*** | −0.22*** |
| t-statistics | (1.72) | (15.77) | (11.43) | (8.76) | (−4.24) |
| P5-P1 | 3.74%*** | 0.10 | 0.29** | 0.70*** | −0.27*** |
| t-statistics | (2.69) | (1.26) | (2.36) | (10.39) | (−2.69) |

The table reports the CAPM and Carhart (1997) alphas obtained from the market model regression

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i F_t^j + \varepsilon_{i,t}, \tag{4}$$

where $r_{i,t}$ is the return of portfolio $i$, $r_{f,t}$ is the return of the of short-term bills as proxy for the risk-free rate, $F_t^j$ is the return of factor $j$, and $\varepsilon_{i,t}$ is the error term. Panel A reports the portfolio alphas using a monthly holding period, panel B reports the portfolio alphas using annual (overlapping) holding periods. P1 comprises the low ICC stocks, and P5 the high ICC stocks. P5-P1 denotes the portfolio that is long in P5 and short in P1. The t-statistics in parenthesis below are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 5: Replacement ratios for ICC-portfolios

| Portfolio | monthly rebalancing | annual rebalancing |
|---|---|---|
| P1 (low ICC) | 23.86% | 60.22% |
| P2 | 38.29% | 70.15% |
| P3 | 43.97% | 74.94% |
| P4 | 41.14% | 74.06% |
| P5 (high ICC) | 23.91% | 63.68% |

The table reports the average replacement ratios for the five ICC portfolios using monthly and annual rebalancing intervals. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 6: Raw and risk-adjusted portfolio returns for smaller ICC portfolios

Panel A: Monthly portfolio returns

| ICC percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
|---|---|---|---|---|
| low ICC portfolio | 0.53% | 0.51% | 0.25% | 0.43% |
| high ICC portfolio | 1.19% | 1.20% | 1.20% | 1.01% |
| long-short portfolio | 0.66%*** | 0.69%** | 0.95%*** | 0.58% |
| t-statistics | (2.72) | (2.43) | (3.11) | (1.60) |
| CAPM $\alpha$ | | | | |
| low ICC portfolio | −0.10% | −0.15% | −0.43%* | −0.27% |
| t-statistics | (−0.67) | (−0.80) | (−1.88) | (−0.93) |
| high ICC portfolio | 0.53%** | 0.52%* | 0.51% | 0.31% |
| t-statistics | (1.99) | (1.73) | (1.50) | (0.81) |
| long-short portfolio | 0.63%** | 0.67%** | 0.94%*** | 0.58% |
| t-statistics | (2.58) | (2.34) | (3.04) | (1.57) |
| Carhart (1997) $\alpha$ | | | | |
| low ICC portfolio | −0.15% | −0.16% | −0.40%** | −0.29% |
| t-statistics | (−1.32) | (−1.09) | (−2.20) | (−1.20) |
| high ICC portfolio | 0.53%*** | 0.48%** | 0.47%* | 0.27% |
| t-statistics | (2.79) | (2.22) | (1.78) | (0.81) |
| long-short portfolio | 0.68%*** | 0.64%*** | 0.87%*** | 0.56% |
| t-statistics | (3.32) | (2.61) | (2.96) | (1.53) |

Panel B: Annual portfolio returns

| Investment percentiles | 20th/80th | 10th/90th | 5th/95th | 2nd/98th |
|---|---|---|---|---|
| low ICC portfolio | 9.60% | 9.34% | 8.08% | 5.94% |
| high ICC portfolio | 15.55% | 16.07% | 15.88% | 14.53% |
| long-short portfolio | 5.96%** | 6.74%** | 7.08%** | 8.59%*** |
| t-statistics | (2.03) | (1.98) | (2.26) | (2.78) |
| CAPM $\alpha$ | | | | |
| low ICC portfolio | 1.07% | 0.42% | −0.99% | −3.13% |
| t-statistics | (0.62) | (0.22) | (−0.41) | (−1.16) |
| high ICC portfolio | 7.39%* | 7.72%* | 7.33% | 6.14% |
| t-statistics | (1.88) | (1.78) | (1.63) | (1.28) |
| long-short portfolio | 6.32%* | 7.30%* | 8.32%** | 9.27%** |
| t-statistics | (1.85) | (1.82) | (2.01) | (2.51) |
| Carhart (1997) $\alpha$ | | | | |
| low ICC portfolio | −1.11% | −1.66%** | −3.09%*** | −5.85%*** |
| t-statistics | (−1.52) | (−2.02) | (−3.04) | (−3.99) |
| high ICC portfolio | 2.62%* | 2.47%* | 1.69% | −0.72% |
| t-statistics | (1.72) | (1.83) | (0.84) | (−0.27) |
| long-short portfolio | 3.74%*** | 4.13%** | 4.77%** | 5.14%** |
| t-statistics | (2.69) | (2.54) | (2.06) | (2.25) |

The table presents the raw and risk-adjusted returns of portfolios that consist of stocks with extremely high or low ICC estimates. The low ICC portfolio contains only stocks below a given ICC percentile, the high ICC portfolio contains only stocks above a given ICC percentile. The long-short portfolio is long in the high ICC stocks and short in the low ICC stocks. The ICC percentiles indicate which percentiles of stocks are included in the portfolios (e.g., in the 20th/80th specification, the low ICC portfolio includes stocks whose ICC is below the 20th percentile and the high ICC portfolio includes stocks whose ICC is above the 80th percentile).
Panel A reports the raw and risk-adjusted returns when rebalancing the portfolios every month. Panel B reports the results when rebalancing the portfolios every year. The CAPM alphas and Carhart (1997) alphas are obtained from the market model regression described in table 4. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 7: Tactical asset allocation

Panel A: Static asset allocation

| Investment | | monthly rebalancing | annual rebalancing |
|---|---|---|---|
| Stock market | return (p.a.) | 8.33%** | 9.01%** |
| | t-statistics | (2.30) | (2.32) |
| | Sharpe ratio | 0.312 | 0.289 |
| P5 (high ICC) | return (p.a.) | 14.24%*** | 15.55%*** |
| | t-statistics | (2.68) | (3.75) |
| | Sharpe ratio | 0.482 | 0.505 |
| Risk-free asset | return (p.a.) | 3.67%*** | 3.64%*** |
| | t-statistics | (32.90) | (9.64) |

Panel B: Tactical asset allocation – stock market and risk-free asset

| Investment | | monthly rebalancing | annual rebalancing |
|---|---|---|---|
| Cutoff value: | return (p.a.) | 6.15%** | 9.24%*** |
| grand mean ICC | t-statistics | (2.00) | (3.35) |
| | Sharpe ratio | 0.196 | 0.414 |
| Cutoff value: | return (p.a.) | 5.17%** | 8.16%*** |
| grand median ICC | t-statistics | (1.97) | (3.20) |
| | Sharpe ratio | 0.139 | 0.373 |

Panel C: Tactical asset allocation – high ICC stocks and risk-free asset

| Investment | | monthly rebalancing | annual rebalancing |
|---|---|---|---|
| Cutoff value: | return (p.a.) | 13.17%*** | 14.54%*** |
| grand mean ICC | t-statistics | (3.37) | (5.97) |
| | Sharpe ratio | 0.590 | 0.626 |
| Cutoff value: | return (p.a.) | 11.72%*** | 11.79%*** |
| grand median ICC | t-statistics | (3.83) | (5.12) |
| | Sharpe ratio | 0.641 | 0.605 |

The table reports annualized returns, t-statistics and Sharpe ratios of static and tactical asset allocation strategies. Panel A reports the return of a static buy-and-hold investment in the stock market, the high ICC portfolio (P5), and the risk-free rate. Panels B and C report the annualized returns of tactical asset allocation strategies when investing into the stock market/the high ICC portfolio if the monthly average ICC is above the cut-off value, and in risk-free bonds otherwise. The cut-off value is the grand mean of the ICC and the grand median of the ICC, respectively. The t-statistics are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. The sample period is from January 1992 to January 2009, including annual returns up to January 2010. Observations: 243,231.

Table 8: Summary statistics – international data sets

Panel A: Descriptive Statistics

| | Mean | Standard deviation | 25% centile | 50% centile | 75% centile |
|---|---|---|---|---|---|
| **Canada** (11,803 obs.) | | | | | |
| Implied cost of capital | 9.64% | 3.46% | 7.49% | 9.16% | 11.24% |
| Market beta | 0.81 | 0.59 | 0.40 | 0.73 | 1.14 |
| B/M ratio | 0.48 | 1.35 | 0.09 | 0.25 | 0.53 |
| Size (in mn CAD) | 3,541 | 5,302 | 608 | 1,480 | 3,641 |
| Price momentum | 3.42% | 29.75% | -12.98% | 2.30% | 17.52% |
| **France** (22,781 obs.) | | | | | |
| Implied cost of capital | 9.84% | 3.29% | 7.56% | 9.32% | 11.56% |
| Market beta | 0.74 | 0.40 | 0.46 | 0.71 | 0.98 |
| B/M ratio | 0.23 | 0.58 | 0.03 | 0.09 | 0.26 |
| Size (in mn EUR) | 2,811 | 6,406 | 283 | 645 | 2,100 |
| Price momentum | 3.28% | 29.86% | -12.93% | 2.80% | 18.74% |
| **Japan** (42,857 obs.) | | | | | |
| Implied cost of capital | 6.28% | 3.05% | 4.23% | 5.77% | 7.72% |
| Market beta | 0.69 | 0.36 | 0.45 | 0.69 | 0.95 |
| B/M ratio | 0.62 | 0.46 | 0.32 | 0.54 | 0.81 |
| Size (in mn JPY) | 444,723 | 631,127 | 73,158 | 189,599 | 533,208 |
| Price momentum | -0.51% | 26.18% | -16.82% | -2.06% | 12.94% |
| **U.K.** (31,633 obs.) | | | | | |
| Implied cost of capital | 10.26% | 2.93% | 8.42% | 9.98% | 11.76% |
| Market beta | 0.84 | 0.43 | 0.55 | 0.82 | 1.09 |
| B/M ratio | 0.64 | 3.95 | 0.10 | 0.25 | 0.46 |
| Size (in mn GBP) | 2,155 | 3,811 | 338 | 790 | 2,136 |
| Price momentum | 4.08% | 26.67% | -10.68% | 3.89% | 17.90% |

Panel B: Correlation Statistics

| | ICC | Market beta | log(B/M ratio) | log(size) | Price momentum |
|---|---|---|---|---|---|
| **Canada** (11,803 obs.) | | | | | |
| Implied cost of capital | 1.00 | | | | |
| Market beta | 0.11 | 1.00 | | | |
| log(B/M ratio) | 0.04 | 0.09 | 1.00 | | |
| log(size) | -0.22 | -0.10 | -0.38 | 1.00 | |
| Price momentum | -0.14 | -0.02 | -0.13 | 0.06 | 1.00 |
| **France** (22,781 obs.) | | | | | |
| Implied cost of capital | 1.00 | | | | |
| Market beta | 0.03 | 1.00 | | | |
| log(B/M ratio) | 0.21 | -0.12 | 1.00 | | |
| log(size) | -0.23 | 0.22 | -0.36 | 1.00 | |
| Price momentum | -0.15 | -0.05 | -0.06 | 0.04 | 1.00 |
| **Japan** (42,857 obs.) | | | | | |
| Implied cost of capital | 1.00 | | | | |
| Market beta | -0.00 | 1.00 | | | |
| log(B/M ratio) | 0.22 | -0.08 | 1.00 | | |
| log(size) | -0.26 | 0.21 | -0.36 | 1.00 | |
| Price momentum | -0.22 | -0.03 | -0.08 | 0.04 | 1.00 |
| **U.K.** (31,633 obs.) | | | | | |
| Implied cost of capital | 1.00 | | | | |
| Market beta | -0.03 | 1.00 | | | |
| log(B/M ratio) | 0.11 | -0.00 | 1.00 | | |
| log(size) | -0.19 | 0.03 | -0.19 | 1.00 | |
| Price momentum | -0.26 | -0.01 | -0.09 | 0.05 | 1.00 |

The table presents the summary statistics of the implied cost of capital estimates (ICC) and the Carhart (1997) firm risk characteristics for the four international data sets. Panel A summarizes the mean, standard deviation, and quartiles of the data sample, panel B the correlation statistics. For more information, see table 1. The sample period is from January 1992 to January 2009.

Table 9: ICC strategies in international capital markets

Panel A: Monthly portfolio returns

| | Canada | France | Japan | United Kingdom |
|---|---|---|---|---|
| P1 (low ICC) | 0.57% | 0.40% | −0.27% | 0.64% |
| P5 (high ICC) | 0.87% | 1.07% | 0.54% | 1.37% |
| P5-P1 | 0.30% | 0.67%** | 0.81%*** | 0.73%** |
| t-statistics | (0.83) | (2.16) | (2.77) | (2.14) |
| CAPM alphas | | | | |
| P1 (low ICC) | 0.07% | 0.01% | −0.03% | 0.28% |
| t-statistics | (0.26) | (0.04) | (−0.15) | (1.22) |
| P5 (high ICC) | 0.35% | 0.67%** | 0.77%** | 1.03%*** |
| t-statistics | (1.14) | (2.09) | (2.56) | (3.06) |
| P5-P1 | 0.27% | 0.66%** | 0.80%*** | 0.75%** |
| t-statistics | (0.77) | (2.16) | (2.74) | (2.20) |

Panel B: Annual portfolio returns

| | Canada | France | Japan | United Kingdom |
|---|---|---|---|---|
| P1 (low ICC) | 9.53% | 7.63% | −1.14% | 10.07% |
| P5 (high ICC) | 13.39% | 13.01% | 7.68% | 16.17% |
| P5-P1 | 3.85% | 5.38% | 8.82%*** | 6.10% |
| t-statistics | (1.25) | (1.45) | (3.33) | (1.58) |
| CAPM alphas | | | | |
| P1 (low ICC) | 2.63% | 1.26% | −0.12% | 5.26%** |
| t-statistics | (1.07) | (0.70) | (−0.09) | (2.26) |
| P5 (high ICC) | 5.78%* | 7.04%* | 9.00%*** | 11.29%*** |
| t-statistics | (1.90) | (1.90) | (3.72) | (2.99) |
| P5-P1 | 3.14% | 5.78%* | 9.12%*** | 6.04%* |
| t-statistics | (0.96) | (1.69) | (3.79) | (1.66) |

Panel C: Risk exposure of P5-P1 portfolios

| | Canada | France | Japan | United Kingdom |
|---|---|---|---|---|
| Difference in Market beta | 0.05*** | 0.03* | 0.02 | −0.03** |
| t-statistics | (2.68) | (1.73) | (1.48) | (−2.41) |
| Difference in B/M ratio | −0.25*** | 0.07*** | 0.17*** | −1.38*** |
| t-statistics | (−5.49) | (3.80) | (8.33) | (−14.66) |
| Difference in firm size (mn) | −1,032*** | −664*** | −162,079*** | −384*** |
| t-statistics | (−14.28) | (−6.89) | (−8.35) | (−6.20) |
| Difference in price momentum | −7.96%*** | −10.28%*** | −7.29%*** | −12.08%*** |
| t-statistics | (−7.17) | (−9.66) | (−7.23) | (−10.36) |

The table presents the monthly and annual (overlapping) returns of the 5 portfolios constructed according to the firms' ICC in the four international data sets. P1 comprises the low ICC stocks, and P5 the high ICC stocks. P5-P1 denotes the portfolio that is long in P5 and short in P1. In addition, the table reports the CAPM alphas obtained from the market model regression described in table 4, and the average firm characteristics of each portfolio. The t-statistics in parenthesis are calculated using Newey and West (1987) HAC standard errors; for annual returns, we include 11 lags. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively. The sample period is from January 1992 to January 2009, including annual returns up to January 2010.