The Relationship Between Implied Cost of Capital and Expected Return: Evidence from a Cross-Sectional Earnings Model

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Abstract

In this thesis, we investigate the relationship between the implied cost of capital and expected return. We provide the relevant literature overview, theories and motivation that eventually lead to our empirical analysis. We compute five different implied cost of capital (ICC) measures based on model-generated forecasted earnings instead of analysts' earnings forecasts. Further, we introduce the composite ICC measure, which is in the very focus of our empirical work. As the basis of our empirical analysis we construct a sample of 56,384 unique firm-year observations dating from 1967 to 2012. First, we justify the use and prove the validity of our model-generated ICC measure with the help of the Expected Return Model. Second, we show that ICC performs well in predicting ex-post realized returns on a portfolio level however, our Realized Return Model provides only weak evidence in support of such predictive power. Third, by imposing an assumption on realized return decomposition, we find that there is a difference between ICC and the hypothetical expected returns. This difference is mainly explained by market beta volatility, cash flow volatility and the correlation of expected returns and cash flows.

Keywords: expected return, implied cost of capital, ICC, cross-sectional earnings model.

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1 Introduction

Expected return is a crucial element in a large array of economics, finance and asset pricing research as well as multiple practical applications. Despite of its significant role in academic and business settings, expected return is not directly observable, which makes it extremely difficult to measure. Several long-standing classical asset pricing models have been commonly used to approximate the expected return along with a proxy of simple time-series average of realized returns often met in the literature. As an alternative to these approaches, rather recently the implied cost of capital method that does not rely on historical realized returns or any specific asset pricing model, but rather shifts the focus to investors' forward-looking expectations on cash flows of the firm, has gained academic attention. With all its merits, the implied cost of capital approach relies on the estimates of firms' future cash flows, which makes it vulnerable to the bias in analysts' forecasts of earnings if those are used to approximate firms' future cash flows. This thesis derives implied cost of capital estimates using the earnings forecasts from a cross-sectional earnings model instead of analysts' forecasts and aims to verify if implied cost of capital is a reliable measure of expected returns, if there are differences between the two and which factors can help to explain these differences.

1.1 Why Study Expected Returns?

Firm's expected stock return[1] is an important concept for academics, investors and policy-makers, as it is a key factor in various managerial and investment decisions concerning the allocation of resources. The usage of expected returns spans from practical assignments such as selecting portfolios, evaluating portfolio performance, company valuation, performance target setting or estimating the cost of capital to more theoretical applications like measuring abnormal returns in event studies or studying the relation between firm level risk characteristics and expected returns.

[1] Terms 'expected return', 'cost of capital' and 'cost of equity capital' are used synonymously throughout this thesis.

Cochrane (2011) goes as far as referring to the understanding of the factors driving expected return variation as the "central organizing question in current asset-pricing research" (p. 1047). Due to its high relevancy across different disciplines at both practical and theoretical levels, expected return has long been in the spotlight of practitioners and academics.

There are two ways to look at expected return: capital market's approach and firm's approach. In capital markets, investors expect a return on stock that is commensurate to the level of risk they are undertaking by investing in a stock. While from a firm's perspective, expected return is the return that the firm has to offer in order to raise capital, i.e. it is the cost of capital for the firm. Thus, expected return and cost of capital should be the same and they can be inferred from the capital markets' information like stock price or from the firm-level financial data.

It has been shown that there is significant cross-sectional and time-series variation in expected returns. There exists a substantial amount of literature aimed at explaining the expected returns and the economic factors that drive the variation behind expected returns (refer to Cochrane, 2011 for a survey of related literature). These studies present a large array of theories on the variation of expected returns, including macroeconomic, behavioural and finance theories as well as theories based on frictions (segmented markets, intermediated markets, liquidity). Different theoretical definitions of expected return are offered by these theories.

In empirical applications, no single universal measure of expected return exists and a variety of estimates are used as proxies for expected return since by nature it is impossible to directly observe expected returns and aggregate individual investors' expectations over returns to a market level. However, despite the agreement on the importance of expected returns there is no consensus on how it should be estimated - Hughes, Liu and Liu (2009) state that "the vast literature in finance, economics, and accounting has demonstrated that expected return is very difficult to measure" (p. 257). Hence, no individual measure of expected return prevails.

1.2 Measuring Expected Returns: Methods and Problems

Traditionally, expected return estimation relied on empirical asset pricing models or simplistic approximations, such as average historical realized returns. Both of these two approaches have been identified with gaps in theoretical reasoning and weaknesses in empirical modelling. To circumvent these issues, an alternative to the commonly used expected return measures that does not rely on any specific asset pricing test or realized historical returns was developed – the proposed measure is called the implied cost of capital.

Before the idea of inferring expected return on the firm's stock from its implied cost of capital started circulating, classical asset pricing models prevailed. Probably the most well-known and most widely-used asset pricing model is Sharpe (1964) and Lintner's (1965) capital asset pricing model (CAPM) along with its multiple extensions. Even though CAPM carries a rather simple message (that a return on asset is in essence determined by its sensitivity to market movements), the underlying assumptions of homogenous expectations and no transaction costs were criticised as unrealistic and empirical analyses based on CAPM are also not always convincing. In response to CAPM, various multifactor models, including arbitrage pricing model, offered an alternative explanation of the drivers behind expected return variation. Multifactor models are based on the premise that expected return depends on certain firm risk characteristics or, in the case of arbitrage pricing model, on a number of pervasive macroeconomic factors. These models are often criticized for the lack of theoretical ground and excessive reliance on empirics. Furthermore, the empirical evidence on the reliability of multifactor models in estimating expected returns also suggests that the resulting estimates are notoriously imprecise (Fama & French, 1997). Hence, there is no consensus on one superior asset pricing model and the conclusions based on these models should be taken with a pinch of salt when analysing expected returns.

Despite the abundant asset pricing theories, the vast literature in expected return research is commonly referring to average historical realized return as a proxy for expected return. Many studies approximate expected return by averaging firm-level realized returns over time-series or over cross-section. Acknowledging the fact that realized returns differ from expected returns due to the information surprises that happen between the formation of expectations and announcement of realized returns (in line with return decomposition framework by Vuolteenaho, 2002), this literature argues that information surprises tend to cancel out over time or within portfolios of stocks. Nonetheless, there is ample evidence that due to sampling restrictions information surprises do not cancel out and historical realized returns are indeed noisy proxies of the expected returns (see Elton, 1999). Hence, seeing a need for an expected return proxy that does not rely on realized historical returns or a particular pricing model scholars came up with the idea of implied cost of capital.

Implied cost of capital is a rather new proxy for expected returns, compared to the traditional proxies, and is defined as the discount rate that equates the present value of firm's cash flows with the current price of the stock. It is a forward-looking measure that focuses on stockholders' expectations on the future cash flows of the firm, rather than relying on historical realized return data or any specific asset pricing model. Using implied cost of capital, the estimates of expected return are derived directly from stock prices and cash flow forecasts using discounted cash flow valuation approach. The two most common models in implied cost of capital literature used to get the proxies for expected return are discounted dividend model and residual income model. A wide range of different measures for implied cost of capital can be found in the literature depending on model specification and certain assumptions.

Despite the vast emerging research in the area of implied cost of capital, the evidence on its ability to explain expected returns is mixed. Gode and Mohanram (2003) test the validity of their implied risk premium (implied cost of capital minus risk free rate) measures by regressing them on commonly known firm risk characteristics and conclude that they are largely correlated with the risk characteristics in the predicted direction and, thus, are good proxies for expected return (in a similar fashion Botosan, 1997; Gebhardt, Lee & Swaminathan, 2001; Botosan & Plumlee, 2005; and Botosan, Plumlee & Wen, 2011 also find evidence in favour of implied cost capital as a proxy of expected returns). However, Easton and Monahan (2005) test several implied cost of capital measures against realized returns and show that none of the measures are positively correlated with realized returns after the cash flow news and return news are being controlled for, and the resulting implied cost of capital estimates are associated with a large measurement error.

Hence, at least several questions arise that motivate the analysis in this thesis: are implied cost of capital measures reliable proxies for expected returns? Are there systematic differences between implied cost of capital and expected return? How can the measures of implied cost of capital be improved?

1.3 Is Implied Cost of Capital a Reliable Proxy for Expected Return?

Implied cost of capital attempts to circumvent the issues in measuring expected returns by reference to historical returns and provides insight that traditional asset pricing tests were not able to provide in the expected return research. However, a highly debated question in the literature is how reliable implied cost of capital estimates actually are in approximating expected returns. Some authors suggest that there are ways to improve implied cost of capital estimates as proxies for expected returns by altering the research design, while others indicate that there might be structural differences between implied cost of capital measures and expected returns.

The estimation of implied cost of capital highly relies upon the forecasts of firms' earnings as it is the discount rate that equates the present value of the future earnings of the firm to its current stock price, therefore it is essential to have reliable estimates of future earnings. To date the most common source of these earnings estimates in the literature is the analysts' earnings forecasts. However, the analysts' earnings forecasts have been criticized for being biased: a high measurement error, over-optimism in analysts' forecasts and inability to update these forecasts in a timely manner produces biased earnings forecasts and results in biased implied cost of capital estimates (see Claus & Thomas, 2001; Easton & Monahan, 2005; Easton & Sommers, 2007; and Guay, Kotari & Shu, 2011). Hence, to improve the implied cost of capital estimates the analysts' earnings forecasts should be substituted by a more reliable measure.

In this thesis, we use the cross-sectional earnings model as a substitute for the biased analysts' earnings forecasts. We replicate the model by Hou, van Dijk and

Zhang (2012), who argue that their cross-sectional model is able to explain the variation in expected firm profitability, where earnings are a function of total assets, dividends, and accruals. Hou et al. (2012) run pooled cross-sectional regression on a large sample of firms and calculate the earnings estimates for up to 5 years in the future based on the resulting coefficients. The authors further argue that the implied cost of capital estimates based on the earnings forecasts from their cross-sectional model are a better proxy for expected returns than those based on analysts' earnings forecasts. With that in mind, in our analysis we use a cross-sectional earnings model to get the earnings forecasts for the calculation of implied cost of capital estimates.

Even though implied cost of capital is emerging as one of the popular alternatives to the average realized return as a proxy for expected return, it is still debated if implied cost of capital is a reliable measure. Various tests on the reliability of implied cost of capital measures for approximating expected returns have been performed testing it against the future realized returns or various firm risk characteristics. The inconclusive evidence based on these tests is compounded by the theoretical findings in Hughes, Liu and Liu (2009), who claim that given stochastic expected returns, implied costs of capital should systematically differ from expected returns and the difference can be explained by certain firm characteristics. Thus, the analysis of the relation between implied cost of capital and expected returns shall take into consideration the mentioned firm risk characteristics.

The difference between implied cost of capital and expected return should be explained by beta volatility, cash flow volatility, the correlation between expected returns and cash flows, and growth in cash flows. As Hughes et al. (2009) argue in their paper, the research in the expected return field has operated under the assumption that expected returns are constant and failed to acknowledge that expected returns can be stochastic. The authors further show that given the proposition that expected returns are stochastic, the implied cost of capital and expected return are systematically different, and the difference can be explained by certain firm risk characteristics: beta volatility, cash flow volatility, the correlation between expected returns and cash flows, and growth in cash flows. This thesis focuses on the relation between implied cost of capital and expected return, and tests if these firm risk characteristics are able to explain the difference between expected returns and implied cost of capital, which is estimated using earnings forecasts from a cross-sectional earnings model.

1.4 Structure of the Thesis

This thesis starts with *Section 2* providing theoretical background to the expected return research, describing the relevant concepts and methods, and highlighting the relevance of the implied cost of capital method. *Section 3* describes the concept of implied cost of capital, provides a review of related literature, defines the scope of research in this thesis and formulates the hypothesis. *Section 4* starts with the description of the research methodology, selection of data and econometric model. Further, the overview of steps in empirical testing is provided followed by the results of empirical analysis. Then we provide the research findings in *Section 5*. *Section 6* concludes the thesis and indicates potential areas for future research.

2 Expected Return: Theory and Practice

This chapter describes the concepts relevant to the research of expected returns, provides definitions and references to the current scholarly literature, and gives a review of existing methods pertinent to the approximation of expected returns. Relative strengths and weaknesses of the methods reviewed are also stated. They form the basis for a further exploration of alternative methods available to estimate expected returns.

2.1 Introduction to the Expected Return

Expected return is an important concept in academic and practical fields, including corporate finance, asset pricing and portfolio theory. It can be defined as the return that an investor expects to earn on average when making an investment in an asset. Expected return is a crucial characteristic of the capital markets, since it guides investors among the different assets they can invest in, and, to the extent that the capital market is efficient, is useful for firms making investment decisions (Gordon & Gordon, 1997). Thus, as it is also described in the further sections, expected returns are a matter of interest for both investors and businesses as well as academics.

Perhaps the most distinctive and, at the same time, restrictive feature of the expected return is that it is unobservable in the market. As Ilmanen (2011) claims, "for most assets, expected returns are uncertain *ex ante* but they are also unknowable *ex post*. This is in contrast to realized returns, which are knowable *ex post* but which do not reveal what investors expected"[2] (p. 57). Because of the fact that the expected return is not directly observable, various models have been established to approximate it. Prevailing reliance on realized returns or returns generated by risk factor based models as proxies for expected returns has been challenged in recent

[2] According to Ilmanen (2011), the only security for which the expected return is known both *ex ante* and *ex post* is a default-free, zero-coupon government bond. The yield that is expected and received, given that the bond is held to maturity, is in fact the expected return.

academic studies. Furthermore, new empirical approaches to estimate expected returns that are largely driven by firm's accounting data have been proposed. To apply any of these models, an understanding of the expected return is crucial. This section aims to provide a general understanding of the concept of expected return.

2.1.1 Two perspectives towards the expected return

There are two ways to look at the expected return: from the capital market or investor's point of view and from the perspective of the firm. Schlegel (2015) describes why the required return by the capital markets or expected return is equal to the cost of capital of the company. A concise summary of this discussion is provided in the two following subsections.

2.1.1.1 Investor's perspective

It is generally assumed that investors are risk-averse and, therefore, require a certain return on their risky investments. The higher the level of risk associated with an investment, the higher the return required to compensate for this risk. It is common to decompose the expected return into risk-free yield and a certain risk premium, where risk-free yield is the return required on assets with no or minimal risk, e.g. US Treasury bonds. The riskier investments would thus require higher risk premiums, resulting in higher returns.

The efficient market hypothesis, which is commonly assumed in classical finance literature, provides that the relationship between risk and return should always hold. This is because arbitrage processes bring back the equilibrium: if the market is efficient, investors would always choose the asset that offers the highest return among assets of the same risk level (Brealey, Myers, & Allen, 2009). Investors would withdraw their investments and put them into more profitable securities of the same risk class. This process would continue until capital markets are in equilibrium, proving the risk-return relationship holds.

Risk can be defined as the probability that the realized return is different from the expected return. In practice, it is usually measured by the variance of returns:

the more volatile returns are, the riskier an investment is. Markovitz (1952) proposed that part of stock's variance can be eliminated by portfolio diversification.

2.1.1.1.1 Different asset classes

The investors face a large variety of different assets they can invest in. Ilmanen (2011) summarizes the types of assets into four main classes: stocks, government bonds, corporate bonds and alternative assets. Even though stocks and bonds were usually perceived as traditional assets classes, and the remaining assets as alternative, the distinction is less and less clear-cut. According to Ilmanen (2011), the main alternatives consist of real estate, commodities, hedge fuds and private equity, but a trend of alternative assets becoming familiar and shifting to traditional ones has been observed over time.

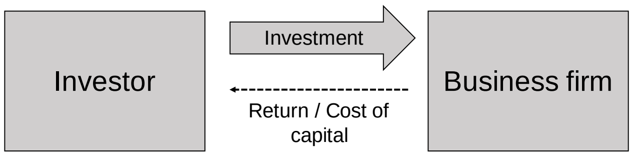
Different asset classes might be associated with different risk premiums that they should provide. Government bonds might be seen as the least risky assets carrying a bond risk premium equal to the excess return of a default-free long-term bond over a sequence of short-term bonds, which is often called the term premium. Corporate bonds, compared to government bonds, bear a key risk of non-repayment – credit risk, which shall be compensated with a credit risk premium. Stocks (or equities), traditionally coined as "the most important source of long-term excess returns" (Ilmanen, 2011), provide an equity risk premium in excess of a return on some reference non-equity alternative.

Some of the research focuses on the expected returns on bonds or alternative assets. For example, Elton (1999) investigates the expected returns on government bonds and argues that estimates of the expected returns on bonds based on realized returns should be reasonably accurate because government bonds have little asset-specific information affecting prices: there is a wide consensus on which macroeconomic factors affect government bond prices, time when changes in these factors are announced is fixed and known and these announcements are rapidly incorporated into prices. The key focus of this thesis, however, is equities, since it aims to proxy the expected return using corporate accounting data, as explained in further sections. Therefore, in the remainder of this paper the term of expected returns refers to the expected return on equities, rather than government or corporate bonds or alternative assets.

2.1.1.2 Firm's perspective

Expected return might as well be considered from the point of view of the firm. Summarizing the literature in the field, Schlegel (2015) claims that the cost of capital from the firm's perspective is the required return it has to offer to investors – shareholders and bondholders. If the firm did not offer the required return, it would not be able to raise the capital it needs. In other words, the expected return on equity should equal the firm's cost of capital in efficient markets – this relationship is illustrated in *Figure 1* below.

Figure 1: Relationship between return and cost of capital



Source: Schlegel (2015).

In line with the risk and return relationship, as described previously, the cost of capital depends on the riskiness of the capital invested. The most common sources of capital include equity and debt. Following the standard practice in finance, the firm's cost of capital is calculated by averaging the required returns for different sources of capital at the firm's disposal taking into account the respective weights of these different sources. This is commonly denominated as Weighted Average Cost of Capital (WACC).

Although WACC method is generally accepted and rather intuitive, it has also been subject to certain criticisms. It is debated how to best determine the weights for different components of capital (weights based on current market values vs. target structure) and the cost of debt and equity, as summarized by Schlegel (2015, p. 12). Estimating cost of equity might be seen as the most complicated exercise in calculation of WACC (Conroy & Harris, 2011) and it has also been debated on what is the best method to do that. This thesis focuses on the cost of equity capital (or expected return on equity), and does not discuss further cost of debt or the weights of debt and equity in the overall capital structure. The "cost of capital" therefore refers exclusively to the cost of equity capital in the remainder of this paper, unless specifically indicated otherwise.

2.1.2 Characteristics of expected return

2.1.2.1 Observability

Expected returns are by nature not observable, since they are something that investors individually perceive, but do not expressly state, let alone record it in some way that would allow to compile a credible dataset of expected returns. Due to the fact that expected returns are "inherently unobservable" (Elton, Gruber, Brown, & Goetzemann, 2011, p. 236), different methods are used to approximate them for empirical purposes.

Until recently, the traditional research in the field has been highly reliant on realized returns to approximate the expected returns. However, as more and more alternatives to such approach are being proposed, the usage of realized returns as an expected return proxy is being increasingly ruled out in favour of alternative methods. Hence the motivation of this thesis comes largely from the fact that the expected returns are not directly observable and there is no superior method to derive its estimates.

2.1.2.2 Aggregation

The value of a company's stock depends on how the market as a whole (market participants in aggregate) evaluate its future earning potential. To determine the value of a company's stock the aggregate of all market participants' expectations has to be considered.

In a simplified practical example, expected return can be expressed as the expected value of an investment given its returns in different scenarios, i.e. the sum of possible returns on an asset weighted by the probabilities of these returns materializing. It appears that different investors have varying evaluations of potential returns and associated probabilities, which results in a range of different individual expected returns. Thus, as "there are so many diverse opinions, it is difficult to forecast change in aggregate expectations" (Elton et al., 2011, p. 236). In conclusion, there is no sensible way to combine the expectations of individual investors in the market on the future returns of a stock into one expected return.

Consequently, to circumvent the issue aggregation the firm-oriented measures of cost of capital rather than market-oriented measures are used for approximation of the expected return on stocks.

2.2 Conventional Methods to Estimate the Expected Return

Expected stock return has long been a focus of financial literature being a key part in the analysis of the relationship between the expected return and various firm-level characteristics. Because of their inherent characteristics, namely difficulty in aggregation and lack of observability, expected returns are not measured directly, but commonly approximated using asset pricing models, various financial ratios, historical return data or survey data. This section aims to provide an overview of the methods for approximation of the expected return that are most commonly met in the traditional expected return literature, and to discuss their relative merits and shortcomings.

2.2.1 *Ex post* realized return

By far the most commonly used proxy for the expected return in the literature is the historical realized return. Since the expected returns are not observed *ex ante*, empirical studies use *ex post* averaged returns as a proxy for expected returns. It is a usual practice to employ historical firm-level realized returns (e.g. an average within a certain period) to approximate it. This approach rests on the assumption that over a long period noises to the realized returns level out and the average equals expected return.

Despite of its common use in the literature it is widely argued, however, that firm-level realized returns are not a reliable proxy for expected returns. Primarily, the major concern is that expected returns are affected by certain information surprises and thus ex post realized returns differ from expected returns. This is discussed in more detail in the following section on the return decomposition.

To counter the argument, Easton and Monahan (2016) claim, that it is a "normal practice" in asset pricing to use portfolio-level returns, instead of firm-level returns – implying that on a portfolio level any information surprises should cancel each other out and portfolio-level realized returns would thus give precise estimates of the expected returns. Even so, portfolio-level returns are prone to criticism, for example Elton (1999) argues that the realized returns are noisy proxies for expected returns:

> *The use of average realized returns as a proxy for expected returns relies on a belief that information surprises tend to cancel out over the period of a study and realized returns are therefore an unbiased measure of expected returns. However, I believe there is ample evidence that this belief is misplaced* (p. 1199).

Further, Miller (1977) argues that in a market with heterogeneous expectations and short-selling constraints, the mean ex post return does not represent average ex ante expectations of all investors, but rather shows the return expectations of a minority group of investors who are optimistic about the stock.

There are also practical implications that inhibit the use of realized return for approximation of the expected return. For firms with short trading history a reliable sample of realized returns might not be available for cross-sectional or temporal averaging; and even having a long time-series of realized returns for samples of firms might cause concerns that moments of distribution are potentially non-stationary (Easton & Monahan, 2016). Averaging of historical returns can also be highly arbitrary and different sample periods might produce estimates that significantly differ (Harris, 1986). Lundblad (2007) finds that a lengthy data sample is required to show a positive risk-return relationship, when realized returns are used as a proxy for expected return. Adding to that, Lakonishok (1993) argues that at least 70 years of data are required to show significant relationship between cost of equity capital and market beta, which is a widely accepted measure of risk, if average realized returns are used as a proxy. Finally, Lee, Ng and Swaminathan (2009) argue that the problem of realized returns as a proxy of expected returns is exacerbated in international settings, where there are geographical limits on data availability.

2.2.1.1 Realized return decomposition

Construct validity is of crucial importance for the theory in social sciences and for the measurement of abstract theoretical concepts: "construct validation is concerned with the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts (or constructs) being measured" (Carmines & Zeller, 1979, p. 23). In this paper, as described in further sections the relationship between a proxy for the expected return and future realized returns is tested. Therefore, it is important to describe the theoretical relationship between the two.

Following Botosan, Plumlee and Wen (2011), the realized return can be decomposed into the expected return and the unexpected (or abnormal) return due to new information:

$$r_{real,t} = E_{t-1}(r_t) + UR_t \tag{1}$$

Based on this relationship, the realized return in time t ($r_{real,t}$) is the expected return in time t-1 ($E_{t-1}(r_t)$) adjusted by the impact at time t of any relevant news (UR_t): information about corporate restructurings, launch of new products or "any announcement that would substantially change the market's perception of the future earning power of the firm" (Elton, 1999, p. 1215). Further, the unexpected return factor can be split into parts based on the type of news.

Campbell (1991) and Vuolteenaho (2002) propose that the unexpected return element can be decomposed into unexpected return due to a change in rational expectations about future cash flows and unexpected return due to a change in rational expectations about future returns. The two sources of unexpected return are hereby referred to as "cash flow news" and "expected return news". In line with Vuolteenaho (2002), the relationship between the news elements and realized return can be summarized in the following equation:

$$r_{real,t} = E_{t-1}(r_t) + (N_{cf,t} - N_{r,t}) \tag{2}$$

where $N_{cf,t}$ represents the cash flow news and $N_{r,t}$ represents expected return news. The interpretation of the unexpected return element in *Equation (2)* is as follows: if it is negative, then either the expected cash flows decreased or expected stock returns increased, or both. This relationship might be better illustrated if the terms in *Equation (2)* are slightly rearranged:

$$r_{real,t} - E_{t-1}(r_t) = N_{cf,t} - N_{r,t} \tag{3}$$

As already mentioned, traditionally the research assumes that the expected returns are approximated by realized returns, as the unexpected element is averaged-out in the cross-section (across firms or time). However, Merton (1980) argues that the unexpected return or "unanticipated part of the market return (i.e., the difference between the realized and expected return) should not be forecastable by any predetermined variables" (p. 326). In a similar fashion, Elton (1999) argues that the information events are not in fact averaged-out across firms or time. Vuolteenaho (2002) shows that cash flow news drives the variation in the firm-level stock returns and is positively correlated with shocks in the expected return, and that cash flow news information is firm-specific whereas return news information is related to systematic macroeconomic trends. Campbell (1991) concludes that cash flow news and return news are correlated: "increases in future expected cash flows tend to be associated with decreases in future expected returns, a correlation which amplifies the volatility in stock returns" (p. 176). Therefore, the unexpected return component is an important factor when investigating the expected return. Cash flow news and return news are taken into account for analysis purposes in this thesis.

2.2.2 Traditional theories of asset pricing models

2.2.2.1 Capital Asset Pricing Model (CAPM)

Capital Asset Pricing Model, usually referred to as CAPM, appears to be the most commonly used model for estimating the expected returns. Based on the work of

Sharpe (1964) and Lintner (1965), the single-factor model conveys a rather simple message: the securities in the market earn a risk-free rate of return and a risk premium depending on their beta, which measures the sensitivity of the security to market movements. Stocks with betas higher than 1.0 tend to amplify the market movements, while those between 0 and 1.0 move in the same direction as the market, however, to a lesser extent (Brealey, Myers, & Allen, 2011). CAPM can be expressed in the following equation:

$$E(r_i) = r_f + E(r_m - r_f)\beta_i \tag{4}$$

where r_f is the risk-free rate, $E(r_m - r_f)$ is the expected market risk premium and β_i is the beta of security i. It is clear that CAPM assumes that the expected return on a security varies in direct proportion (size of which depends on its beta) to the market risk premium. In this framework, beta measures how much market risk should be priced and the market risk premium indicates the price of the undiversifiable market risk. Thus, CAPM shows that the price of a single stock is always linearly related to the return on market portfolio.

Empirical usage of CAPM requires historical financial data: to measure a stock's beta one has to look at the covariance of stock's returns with market portfolio and the variance of the market portfolio (Brealey et al., 2011). This is usually performed by running a simple linear regression.

Despite the fact that CAPM is considered to be the "first, most famous and (so far) most widely used" (Cochrane, 2005, p. 152) model in asset pricing, it has been increasingly challenged as the preferred option for calculating the cost of capital. The primary point of criticism is the vulnerability of CAPM with respect to its own assumptions. The assumptions of homogenous expectations and no transaction costs imply that every investor in the market holds an identical diversified portfolio. However, it has been pointed out in many studies (see for example Pratt, Grabowski, & Brealey, 2014) that investors in reality do not hold the market portfolio, thus the risk not fully diversified as CAPM would suggest.

Given the above criticisms and a frequent disagreement between the theory behind CAPM and the empirics, a number of augmented versions of CAPM have been developed, which are reviewed in the further sections.

2.2.2.2 Intertemporal Capital Asset Pricing Model (ICAPM)

An extension to CAPM introduced by Merton (1973) is the Intertemporal Capital Asset Pricing Model (ICAPM). Similarly to CAPM, ICAPM states that the expected return on an asset depends on its covariance with market portfolio. However, in addition to the classic relationship of asset return and the market premium via its beta, ICAPM introduces the time element into the framework. Expected return of an asset is also dependent on the state variables that proxy the changes in the investment opportunity set (Mahakud & Dash, 2016). Therefore, an asset has a number of betas reflecting the different state variables.

ICAPM predicts that in the intertemporal framework, where assets are carried on for multiple periods of time, in equilibrium investors require a compensation for the systematic risk and for unexpected shifts in the investment opportunity set. Merton (1973) explains that in an uncertain environment investors seek to maximize their life-time utility of consumption. Thus, in addition to the diversification needs, investors seek compensation for unexpected changes in the opportunity set (Faff & Chan, 1998).

Although a very important theoretical contribution to classic asset pricing, ICAPM is criticized to lack empirical relevance and importance in decision making. Breeden (1979) argues that it is difficult to apply ICAPM in empirical settings, because of the troublesome identification of the multiple state variables it entails.

2.2.2.3 Consumption-Based Capital Asset Pricing Model (CCAPM)

An extension to Merton's (1973) ICAPM with simpler pricing equations with more potential to be empirically tested was presented by Breeden (1979) in his Consumption-Based Capital Asset Pricing Model (CCAPM). This continuous-time model permits stochastic consumption goods prices and stochastic investment opportunity, but simplifies the pricing equation by showing that the expected return on an asset can be determined solely by its beta towards aggregate consumption. This is because consumption beta incorporates the intertemporal nature of decisions and takes into account other forms of wealth that are to be considered when measuring the systematic risk (Mahakud & Dash, 2016).

As pointed out by the author himself, CCAPM has certain limitations, primarily relating to the usage of aggregate consumption in empirical testing, which might be difficult due to collection and availability of data.

2.2.3 Multifactor asset pricing models

2.2.3.1 Arbitrage Pricing Theory (APT)

As an alternative to CAPM, Ross (1976, 1977) introduced the Arbitrage Pricing Theory (APT) which explains the expected return on an asset based on its relationship with many common macroeconomic factors. APT stems from an idea that the assumptions of quadratic preferences and multivariate normal distribution used in CAPM can be relaxed. Instead, a number of less restrictive underlying assumptions are used in APT: “homogeneous investor expectations, risk averse utility maximizing investors, frictionless and perfectly competitive capital market with no asymptotic arbitrage opportunities” (Mahakud & Dash, 2016). Ross (1976) thus argues that CAPM can be viewed as a special case of APT, where the sole risk factor used in determining the expected return of an asset is its covariance with market portfolio.

More generally, APT provides a framework where given that there are no arbitrage opportunities in the market, the expected returns depend linearly on a number of pervasive macroeconomic factors, that affect the risk of holding an asset, and an asset-specific random variable. The underlying mechanism in this model is that macroeconomic variables (e.g. changes in inflation, GNP, currency exchange rates) reflect economy-wide shocks that affect expected cash flows and subsequently resonate on the asset required returns.

2.2.3.2 Three factor model

The three factor model of Fama and French (1993) finds that three stock market factors explain the stock market movement. The three factors are the overall market portfolio, the difference between returns on portfolios of small and big stocks, and the difference between returns on portfolios with high book-to-market and low book-to-market ratio. Fama and French (1993) argue that the three factor model is relevant in predicting the expected returns in contrast to the CAPM which is characterised by "the lack of evidence that it is relevant" (p. 54), as it explains the systematic patterns of profitability and growth that can be the source of the common risk factors.

Evidence, however, shows that the reliability of the expected return measures based on the factor models is limited. Fama and French (1997) evaluate the three factor model and CAPM used for estimation of industry expected returns and show that standard errors of more than 3% per year are typical for both the CAPM, and three factor model. Consequently, they conclude that "Estimates of cost of equity for industries are imprecise <…> Estimates of the cost of equity for firms and projects are surely even less precise" (p. 153).

2.2.3.3 Other multifactor models

Extending the three factor model, Carhart (1997) introduced the momentum factor into the four factor model. Momentum is the difference between the returns of the winning portfolio and the losing portfolio. Carhart (1997) concluded that the three original factors from Fama and French (1993) and momentum explain the performance of the mutual funds.

Although, an interesting extension to the three factor model, the four factor model is not without its caveats. Easton and Monahan (2016) argue that the four-factor model is controversial and not based on acknowledged theory, and stress that size, book-to-market ratio and momentum factors were originally presented as anomalies rather than a norm.

A number of other variations and extensions of the multifactor model were introduced (e.g. Pastor & Stambaugh, 2003, Titman, Wei & Xie, 2004, Keene & Peterson, 2007, Novy-Marx, 2013), however they are not discussed here further.

2.2.4 Other proxies for expected return

2.2.4.1 Dividend yield

The academic literature on return predictability has to a large extent relied on the predetermined firm-level characteristics to estimate expected returns. One of these characteristics is dividend yield, which mathematically can be defined as the ratio between dividends paid per share and stock price. Dividend yield indicates how much a firm pays out in dividends in relation to its share price, i.e. the return to firm's equity holders.

Kothari and Shanken (1997) summarized the two important theoretical views on the predictive power of financial ratios, including dividend yield – efficient markets and inefficient markets view. The first view relates to the discount rate effect: when holding expected cash flows constant, risk characteristics that increase the rate at which the cash flows are discounted decrease the market price of the stock leading to higher expected return and higher dividend yield. Alternatively, the second (inefficient markets) view explains that the extent to which the market is overvalued or undervalued at a certain point in time is embedded in the financial ratios. If the market is overvalued then the financial ratios are low, and vice versa. Expected future returns will also remain high (low) in the case of under-pricing (over-pricing) as long as the mispricing is likely to be corrected in the future.

Empirical studies have found that dividend yield has significant predictive power for returns both in cross-section (Litzenberger & Ramaswamy, 1979) and time series (Rozeff, 1984; Shiller, 1984; Fama & French, 1988a, 1989; and Campbell and Shilller, 1988). For example, having tested multiple models describing the impact of taxes on financial asset returns, Hess (1983) concluded that "dividend yields may be proxying for changes in the expected returns of securities over time" (p. 553). Bacchetta, Mertens, and Wincoop (2009) have shown that stock market return expectations and expectation errors are significantly predicted by dividend yield.

To the contrary, it has been shown that dividend yield explains just a small fraction of the expected return variation in the short-term (5% of variation in monthly or quarterly returns), and only increases somewhat for longer horizon returns (Fama & French, 1988).

2.2.4.2 Survey data

Yet another measure for the expected returns is data from the surveys of individual investors, CFOs or consumers: regular surveys are being carried out asking about the expectations on stock market returns. It is not uncommon to use the survey results to approximate expected returns.

In their study analysing investors' expectations on future market returns, Greenwood and Shleifer (2014) for example use six different data sources: the Gallup investor survey, the Graham-Harvey Chief Financial Officer surveys, the American Association of Individual Investors survey, the Investor Intelligence survey of investment newsletters, Robert Shiller's investor survey, and the Survey Research Center at the University of Michigan. They compare the different estimates of future returns from surveys and find that they are highly correlated. Further, Greenwood and Shleifer (2014) test the return expectations against three different measures of expected returns suggested by literature, namely dividend yield, surplus consumption and the consumption wealth ratio, and find results that are contrary to those expected: "for all but one of our measures of survey expectations, there is a strong and significant negative correlation between expectations measured and ERs [*expected returns*, authors' note]" (p. 736).

So the survey expectations about future returns are imperfect proxies for expected return, in fact, they are significantly negatively correlated. Greenwood and Shleifer (2014) discuss that there might be behavioural reasons behind such a tendency, e.g. investor's misperception about cash flows and/or their growth, or groups of investors with differing beliefs. Moreover, surveys show that investors' expectations on returns are driven by past returns. Brigham, Shome and Vinson (1985) add that surveys are prone to biased responses or biased samples of respondents.

2.3 Summary

In summary, the above subsections offer an overview of the methods most commonly used in estimating expected returns and examples of other alternative measures, although it should not be viewed as a comprehensive summary of the broad range of asset pricing models available. In other words, it gives a flavour of what are the most popular tools in the toolbox of a researcher interested in expected returns, but does not go further in examining the specifics of each individual tool in the set.

The tools reviewed in the above subsections are not to be discredited or degraded – there are advantages and disadvantages in using one or another and they have been widely used (some more than others) by researchers and many still are.

However, most of these tools measuring expected return, as discussed in the previous subsections, focus on capital markets' information like stock price, realized return and market analyst forecasts or risk characteristics of the firm. The major focus of these approaches is on the perception of markets on the future performance of firms' stock.

An alternative approach is to take the firm's perspective, i.e. to look at the performance of the firm purely in the product markets and infer the expected return from the reported accounting data. This approach is the centre-piece of this thesis trying to supplement the range of existing theories on expected return estimation with a rather new and relatively unexplored tool – the measure of implied cost of capital (ICC).

3 Implied Cost of Capital

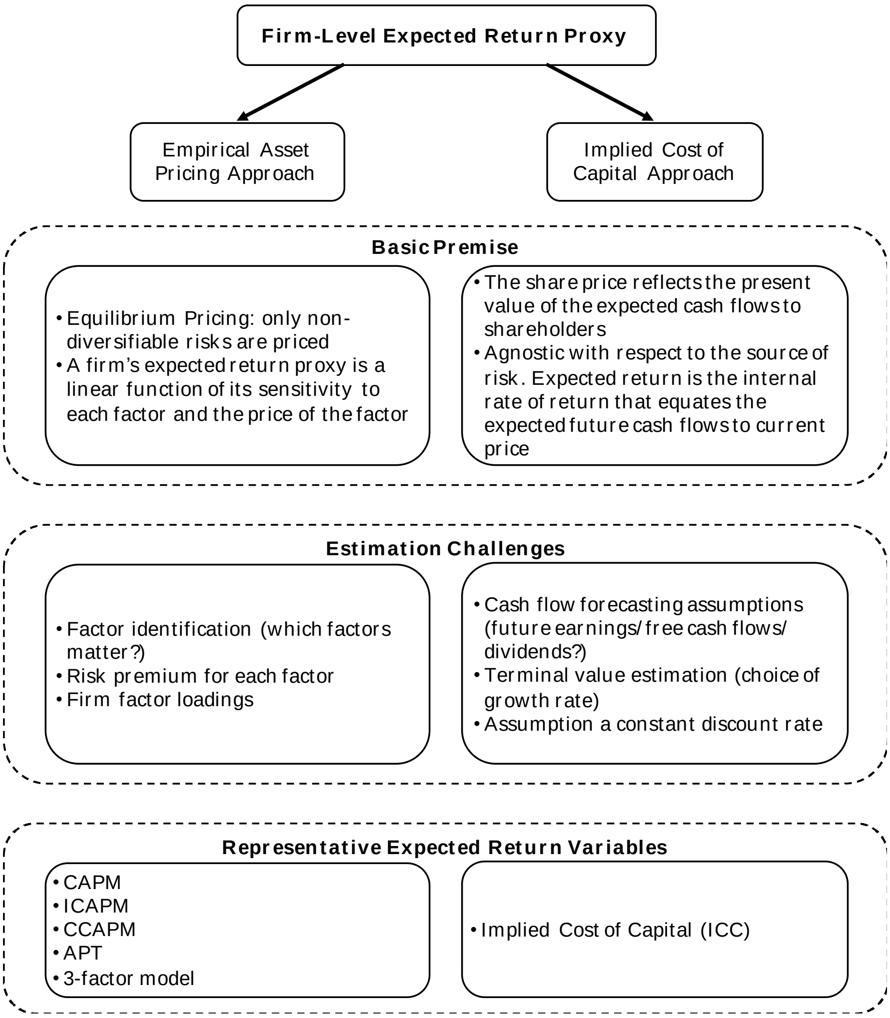
This section introduces the concept of implied cost of capital (ICC) as an alternative measure of expected return. The definition of ICC and the mathematical formula behind it are provided here. This section also reviews the extant scholarly literature on ICC as a proxy for expected return with a focus on different methods used to estimate ICC, validating the resulting estimates as well as comparing them to other commonly used expected return proxies. Common issues in empirical ICC literature are indicated, which provide the basis for empirical methodology applied in this thesis. The hypothesis of this thesis is stated in the end of this section.

3.1 Introduction

In the previous section, the existing methods for approximation of the expected return that are most commonly used in traditional expected return research were reviewed. Clearly, the literature reviewed shows that none of the methods is superior vis-à-vis the others and alternative approaches to estimate expected returns are encouraged.

These expected return measures most commonly met in the traditional expected return literature can be contrasted to a rather new and innovative approach for estimation of expected return – ICC. The two approaches towards approximating the firm-level expected return (empirical asset pricing approach and implied cost of capital approach), their basic premise, estimation challenges and representative expected return variables are illustrated in *Figure 2* below.

Figure 2. Family Tree of Expected Return Proxies



Source: adapted from Lee, So & Wang (2017).

In contrast to empirical asset pricing approach, ICC shows the present value of the expected cash flows to the stockholders of the firm rather than focusing on risk characteristics of the firm. ICC does not require identification of the risk factors that are relevant for equity returns and calculation of firm factor loadings and risk premium for each factor. However, ICC is sensitive to certain assumptions on future cash flows of the firm, calculation of the terminal value (choice of earnings growth rate in limited horizon models) and assumption of a constant inter-temporal discount rate. These and other nuances of the ICC approach are described in detail in the following sections.

3.2 Definition

As an alternative to the conventional methods for estimation of expected returns described in the previous section, the implied cost of capital (ICC) approach was introduced. Instead of focusing on the risk characteristics of the firm or the historical realized returns of its stock, ICC equates firm's forecasted cash flows to its current stock price.

The common definition of implied cost of capital in the prominent literature is the internal rate of return that equates the firm's current stock price with the present value of its future cash flows. The basic approach towards estimating the implied cost of capital is the widely-used discounted cash flow valuation. Following Lee, Ng and Swaminathan (2009), the implied cost of capital can be expressed in the following discounted cash flow formula:

$$P_t = \sum_{k=1}^{\infty} \frac{E_t(FCF_{t+k})}{(1+r_e)^k} \tag{5}$$

Here P_t is the current price of an equity, $E_t(FCF_{t+k})$ is the expected value of the future cash flows and r_e is the expected return.

The two most commonly used approaches to estimate the implied cost of capital are the discounted dividend growth model and residual income model. Both models are described further in *Section 3.3.1.1*.

Compared to other measures of expected return the main advantage of ICC is that it is a forward looking measure utilizing forecasts or estimates of firm's future fundamentals. Compared to the widely-used ex post average realized return, in this respect implied cost of capital is a superior measure of expected returns.

3.3 Literature Review

3.3.1 Estimating implied cost of capital

The ICC measures originate from the idea that estimating the expected return based on a time series of historical realized returns is notoriously imprecise, and instead accounting valuation models, such as for example residual income model, should be used to derive the expected return or the cost of capital. The concept of ICC was first described in 2001 in a study by Gebhardt, Lee and Swaminathan, who use discounted residual income model to calculate the cost of capital and investigate its systematic relationship with firm-level risk characteristics. Authors found that firm-level ICC is a function of its industry participation, book-to-market ratio, forecasts of long term growth rate and the dispersion of analyst earnings forecasts, which can be used to forecast the future ICC. Although, ICC was first coined by Gebhardt et al. (2001), the usage of accounting-based valuation techniques in deriving the cost of capital goes well beyond their study.

As early as in the 1970's, Malkiel (1979) used a discounted dividend model for estimation of the equity risk premiums to illustrate his point that increasing risk premiums raised the cost of capital for firms which resulted in sluggish fixed invest in the US economy in 1960's and 1970's. In the calculation of the equity risk premium, Malkiel (1979) estimates the expected equity return from the discounted dividend pricing equation, where the current stock price is equal to discounted dividends over the 20 years plus a terminal value. Long-term growth rate of dividends for the first five years is taken from Value Line database and for later periods is discounted to reach the economy growth rate.

Similarly, Birgham, Shome and Vinson (1985) use dividend growth model with non-constant growth to calculate the risk premium for electric utility and industrial companies. They estimate the cost of capital for each company in the set, calculate an industry average and obtain the equity risk premiums by subtracting the risk-free rates based on Treasury bond yields. Authors conclude that ex post realized returns do not reflect ex ante expectations and risk premiums (at least in electric utility and industrial sectors) are volatile.

Dividend growth model is also employed by Gordon and Gordon (1997), who estimate the expected returns and explain its variation among stocks for Standard and Poor's (S&P) 500 market index companies. In contrast to other studies, they assume that dividends have a finite horizon for growth. Finite horizon model is also assumed by Botosan (1997), who investigates the relationship between disclosure level and cost of capital, and estimates the cost of equity capital using an accounting valuation formula derived from discounted dividend model instead of the classical

CAPM or multiple factor measures. In a similar fashion to Gordon and Gordon (1997), Harris (1986) also uses dividend growth model with financial analysts' forecast from IBES database to estimate the risk premiums for S&P 500 market index. However, the author chooses a simplified formula to estimate the cost of capital, where it equals the sum of next year's expected dividend yield and expected growth in dividends.

In contrast to the research that uses dividend discount model to estimate ICC, other authors work based on the residual income model. From the extensive literature review, Gebhard et al. (2001) seem to be the first ones to use the residual income model in the context of cost of capital. Residual income model is based on the "clean surplus" accounting rule and instead of using the forecasted dividends, it considers firms' accounting values – book value and expected abnormal earnings.[3]

In their study on equity premium, Claus and Thomas (2001) derive the equity premium estimates from ICC measures from a residual income model and compare them with the historical equity premium from 1926 in the US. Authors estimate ICC for the market using 5 year estimates of earnings from IBES and assuming a long-term earnings growth equal to expected inflation rate. Claus and Thomas (2001) conclude that for the sample of 1985-1998 historical equity premium estimates (around 8%) are notoriously imprecise, and suggest that the equity premium derived from ICC calculations (3.4%) is a more precise estimate.

While Gebhardt et al. (2001) and Claus and Thomas (2001) explicitly assume the long-term growth rate of earnings beyond the forecast horizon (median industry return on equity and expected inflation rate assumed by the mentioned authors respectively), Easton et al. (2002) implicitly estimate the earnings growth from the forecasted earnings, recorded book values and observed market prices in the residual income model. The authors rewrite the residual income equation in regression form and obtain the coefficients for earnings growth and ICC for a portfolio of stocks. In this way, the simultaneous calculation of the earnings growth rate and ICC gives an

[3] See Section 3.3.1.1.2 for a detailed description of the residual income model.

estimate of ICC that is adjusted for the fact that estimates might be imprecise because (i) book value differs from market price and (ii) short-term forecasts might not reflect future long-term earnings. This adjustment is ensured by modelling the earnings growth rate in the model, rather than assuming it. Easton et al. (2002) conclude that their estimates of equity premium are higher than those observed in other studies using residual income model, because they estimate the earnings growth rate rather than assume it.

Fama and French (2002) are trying to explain the equity premium puzzle, i.e. that the stock returns are too high compared to the risk free return given the volatility in consumption, and estimate the expected stock return using two firm fundamentals – dividends and earnings. The authors use simple dividend and earnings growth models to estimate expected returns and find that over the period of 1872-1950 estimates from dividend and earnings growth models perform on par with the realized average returns, while during 1951-2000 dividend and earnings growth model-based estimates are more precise than those based on historical average realized returns. Fama and French (2002) argue that estimates from dividend and earnings models are closer to the true expected value, because they have lower standard errors, aggregate risk aversion measure based on these estimates is consistent throughout the covered period and these estimates are more consistent with book-to-market ratios. They conclude that the "unconditional expected equity premium of the last 50 years is probably far below the realized premium" (p. 658).

Leveraging on the work of other authors (Claus & Thomas, 2001; Gode & Mohanram, 2003; Gebhardt, Lee & Swaminathan, 2001; O'Hanlon & Steele, 2000; Easton, Taylor, Shroff & Sougiannis, 2002) Easton (2006) investigates whether the differences between accounting or regulatory regimes can have an impact on the cost of capital estimates. The author estimates cost of capital for the stocks comprising Dow Jones Industrial Average using the models of the mentioned authors and evaluates the effect of regulatory differences, i.e. differences in generally accepted accounting principles and practices (GAAP) on these estimates. Easton (2006) finds that differences in the long-term growth rate of earnings resulting from differences in GAAP might result in imprecise cost of capital estimates and cause spurious inferences.

Pastor, Sinha and Swaminathan (2008) test the inter-temporal risk-return trade-off using market-level ICC as a proxy for expected returns. Unlike most other studies, they focus on the time series rather than cross-section. In calculating the ICC using the dividend growth model, the authors split the present value of the firm into two parts – present value of free cash flows up to the terminal period and present value of free cash flows after the terminal period (free cash flows are calculated by weighting the earnings forecast by the factor of one minus plowback rate). The long-term growth rate of earnings is assumed to be equal to the GDP growth rate. Pastor et al. (2008) show that market-level ICC outperforms the realized returns in detecting the risk-return trade-off. Similarly, Lee, So and Wang (2017) find that ICC measures are useful in explaining time series variation in expected returns.

Christodoulou, Clubb and McLeay (2016) use a linear information model which is based on the residual income model relying solely on published financial data to estimate the expected returns. The accounting-based estimates are extracted using linear information dynamics framework based on residual income on a firm-by-firm basis. The results show that expected return estimates from this model on average resemble the realized returns; however, no evidence is found that these estimates predict one year-ahead realized returns (which is commonly used to test the model efficiency in expected return literature) (Christodoulou et al., 2016). Concluding, the authors reckon that the capital market's return expectations are important for firm performance and that the research on accounting-based estimates of expected stock return is subject to further refinement.

In a similar fashion (although they also look at the stock price), Lyle, Callen and Elliott (2013) use linear pricing equations based on residual income model relying on accounting estimates, but also including a term capturing dynamic risk in the economy, to show the relationship between accounting fundamentals and expected return on equity. The authors yield an equation for the stock price "composed of a linear combination of five components: book value, abnormal earnings, expectations of abnormal earnings, long-term abnormal earnings, and the level of systematic risk in the economy" (p. 920) and estimate the parameters in-sample, which are later applied out of sample to estimate the cost of capital. Lyle et al. (2013) carry out an empirical test of their cost of capital estimates and conclude that they are significantly associated with future returns both in sample and out of sample.

Ashton and Wang (2013) also follow the linear information dynamics model in estimating the ICC together with the long-term earnings growth rate. The authors find regression coefficients for the current earnings, current book value of equity and last period's book value of equity by regressing expected earnings on these variables. Based on the estimated coefficients, ICC and long-term growth measures are derived. The authors find that the resulting ICC and long-term growth estimates are largely in line with previous research.

Another approach towards calculating the present value of future earnings in estimation of ICC, is abnormal earnings growth model. Easton (2004) use a model that simultaneously estimates ICC and the rate of change in abnormal growth in earnings for a portfolio of stocks. Current stock prices and forecasts of earnings and of the short-term earnings growth rate are used as inputs to the model. To validate the results of empirical analysis, Easton (2004) compares the ICC estimates with price-earnings ratio divided by short-term earnings growth rate (PEG ratio). Easton (2004) concludes estimates from his abnormal earnings growth model perform better than those based on PEG ratio since the estimates of expected returns based on PEG ratio are biased downwards.

A variant of abnormal earnings growth model (named earnings persistence model by the authors) is used in Li and Mohanram (2014), who estimate the future earnings based on current earnings (they also implement the residual income model). The authors estimate earnings using a pooled cross-sectional regression with forecasted earnings on one side and current earnings, a dummy variable for negative earnings, and the interaction term between current earnings and the dummy variable on the other side of the equation. Li and Mohanram (2014) argue that their models produce reliable estimates of expected return as they show good results in validation tests based on accuracy, forecast bias and association with future returns.

The reviewed studies on measuring the implied cost of capital are summarized in *Table 1* below.

Table 1. Summary of literature review on measuring ICC

Reference	Valuation model	Period	Earnings forecast data	Long-term growth	Summary
Malkiel (1979)	Dividend discount model	1960-1977	Value Line	Value Line / Real GDP growth	Cost of equity capital estimates for the calculation of equity risk premium
Birgham et al. (1985)	Dividend discount model	1966-1984	Value Line / IBES / Salomon Brothers / Merrill Lynch	Value Line (ROE * retention rate)	Cost of equity capital estimates for electric utility and industrial companies
Harris (1986)	Dividend discount model	1982-1984	IBES	IBES (5-year growth rate)	Cost of equity capital estimates for S&P 5oo to calculate the risk premium
Gordon & Gordon (1997)*	Dividend discount model	1985-1991	IBES	IBES (long-term growth rate in earnings)	Expected return estimates used to explain variation among stocks

Continued on the next page

Reference	Valuation model	Period	Earnings forecast data	Long-term growth	Summary
Botosan (1997)	Dividend discount model	1991-1994	Value Line	N/A (Finite horizon model)	Estimates of cost of equity capital used to investigate the effects of disclosure level on cost of capital
Gebhardt et al. (2001)	Residual income model	1979-1995	IBES	IBES (Median industry ROE)	ICC relationship with firm level characteristics (book-to-market ratio, industry membership, etc.) investigated
Claus & Thomas (2001)	Residual income model	1985-1998	IBES	Assumed by authors (expected inflation rate)	Estimates of equity premium used to show that the often assumed historical equity premium is too high
Easton et al. (2002)	Residual income model	1981-1998	IBES	N/A (Calculated implicitly in the model)	Simultaneously estimated cost of capital and growth rate of earnings, equity premium computed and compared with other estimates
Fama & French (2002)	Dividend discount model	1872-2000	N/A (realized dividends and earnings data)		Explaining equity premium puzzle
					Continued on the next page

Reference	Valuation model	Period	Earnings forecast data	Long-term growth	Summary
Gode & Mohanram (2003)*	Abnormal earnings growth model	1984-1998	IBES	Long-term economy growth rate of 3%	Implementation of Ohlson and Juettner-Nauroth (2005)* methodology
Easton (2004)*	Abnormal earnings growth model	1981-1999	IBES	N/A	Simultaneously estimates ICC and the rate of change in abnormal earnings growth
Pastor et al. (2008)	Dividend discount model	1981-2002	IBES	GDP growth rate	Investigating the risk-return trade-off using ICC
Ashton & Wang (2013)	Residual income model	1975-2006	IBES	N/A (Estimated endogenously)	Estimating of ICC together with long-term growth rate
Lyle et al. (2013)	Residual income model	1980-2010	IBES	N/A	Testing ICC estimates based on reported accounting data

Continued on the next page

Reference	Valuation model	Period	Earnings forecast data	Long-term growth	Summary
Li & Mohanram (2014)	Residual income & Abnormal earnings growth models	1969-2012	Model generated	Based on model	Testing ICC with earnings from a cross-sectional model
Christodoulou et al. (2016)	Residual income model (adapted)	1964–2011	N/A (Predicted earnings are used in the model)	N/A	Testing ICC estimates based on reported accounting data

** The papers by Gordon and Gordon (1997), Gode and Mohanram (2003), Easton (2004) and Ohlson and Juettner-Nauroth (2005) and the models therein are used in this thesis for the purposes of calculating the implied cost of capital measures.*

The above table provides an overview of different models that were implemented in the research to calculate the ICC estimates. In this thesis, as explained also in further sections, papers by Gordon and Gordon (1997), Gode and Mohanram (2003), Easton (2004) and Ohlson and Juettner-Nauroth (2005) and the models therein are referred to for estimation of ICC. In particular, five ICC measures and a composite measure comprised of those five are used in this thesis: R_{oj} (following Ohlson and Juettner-Nauroth, 2005), R_{gor} (following Gordon and Gordon, 1997), R_{peg} and R_{pegst} (following Easton, 2004), and R_{gm} (following implementation of the model of Ohlson and Juettner-Nauroth (2005) by Gode and Mohanram, 2003).

The model by Easton (2004) and the resulting R_{peg} and R_{pegst} measures are based on the assumption that market expects zero growth in abnormal earnings beyond the forecast horizon. R_{peg} also assumes that the market expectation for dividends in the first year equals zero. The difference between R_{peg} and R_{pegst} is that the former is based on long-run earnings forecasts (*t=4* and *t=5*), while the latter is based on short-term earnings forecasts (*t=1* and *t=2*).

In the abnormal earnings valuation model by Ohlson and Juettner-Nauroth (2005) several assumptions are imposed with respect to the market's expectations of short-term earnings, abnormal earnings and the short-term and long-term abnormal earnings growth rate. The principal difference between R_{gm} and R_{oj} that are derived from Ohlson and Juettner-Nauroth (2005) is that the former is estimated using short-term earnings growth, while the latter is estimated using both short-term and long-term earnings growth.

A finite specification of the well-known Gordon and Gordon (1997) model produces R_{gor} measure, which assumes that beyond the forecast horizon market's expectation is that the firm's return on equity reverts to its expected return.

3.3.1.1 Models to estimate ICC

To summarize the above overview on estimation of implied cost of capital using different models, dividend discount model, residual income valuation model and abnormal earnings growth model are most commonly used to calculate the implied cost of capital measures. Abnormal earnings model is a conceptually similar to residual income model. The three models are described in the below sections.

3.3.1.1.1 Dividend discount model

The dividend discount model is directly derived from the usual discounted cash valuation (see *Equation (5)*) and it relates the current stock price to its future dividends (equity cash flows) discounted at the rate equivalent to implied cost of capital. The flat-term structure dividend discount model can be expressed in the following way:

$$P_t = \sum_{k=1}^{\infty} \frac{E_t(D_{t+k})}{(1+r_e)^k} \tag{6}$$

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

Assuming that dividend expectations can be represented as a sum of one period value and the remaining future dividends growing at the same growth rate infinitely (finite horizon model), *Equation (6)* can be rewritten in the following manner:

$$P_t = \sum_{k=1}^{n} \frac{E_t(D_{t+k})}{(1+r_e)^k} + \left(\frac{E_t(D_{t+n+1})(1+g)}{(r_e-g)^k}\right)\left(\frac{1}{1+r_e}\right)^n \tag{7}$$

where n is the number of years with non-constant growth rate of dividends and g is the long-term growth rate of dividends.

3.3.1.1.2 Residual income model

The residual income is arithmetically equivalent to the above-described dividend discount model, but gives a better intuition into the economic profits that drive stock's future cash flows (Gebhardt et al., 2001). Following from *Equation (6)*, Gebhardt et al. (2001) show that the stock price can be expressed in terms of the firm's book value and infinite sum of its discounted residual income (economic profits), given that book value and income forecasts are in line with the "clean surplus" accounting approach.[4] The expression is as follows:

[4] Clean surplus accounting gives significance to the statement on changes in owner's equity, which integrates the bottom line items from the balance sheet and the income statement (see for example Ohlson, 1995). According to clean surplus accounting, changes in

$$
\begin{aligned}
P_t &= B_t + \sum_{k=1}^{\infty} \frac{E_t[NI_{t+k} - r_e B_{t+k-1}]}{(1+r_e)^k} \\
&= B_t + \sum_{k=1}^{\infty} \frac{E_t[(ROE_{t+k} - r_e) B_{t+k-1}]}{(1+r_e)^k}
\end{aligned} \tag{8}
$$

where B_t refers to book value at time t, NI_{t+k} is net income for period $t+k$, ROE_{t+k} is the after-tax return on equity for the period $t+k$ and the remaining components are as defined earlier. This equation follows the theory behind dividend discount model and only differs from the latter in that it expresses firm's value in terms of accounting numbers of the firm.

For practical purposes, residual income model is often transformed to a finite time horizon version, where the earnings expectations are split into two parts: the discounted earnings within a time horizon that are explicitly forecasted and the terminal value. Terminal value expresses the value of the firm beyond the time horizon for which explicit earnings forecasts are made.

Compared to the dividend discount model, residual income model "makes better use of currently available information to reduce the importance of assumed growth rates, and it narrows the range of allowable growth rates by focusing on growth in rents, rather than dividend growth" (Claus & Thomas, 2001, p. 1632).

3.3.1.1.3 Abnormal earnings growth model

Abnormal earnings growth model is conceptually similar to residual income valuation model. Easton (2004) describe the relationship between the two models in the following way:

> *Just as in residual income model where future residual income is nonzero if price is not equal to book value (that is, future*

---

shareholder equity that are not resulting from firm's interactions with shareholders (dividends, share repurchases, etc.) are included in the income statement. Therefore, change in the book value from period to period is equal to the difference between earnings and net dividends ($b_t = b_{t-1} + NI_t - D_t$).

> *residual income represents the future earnings adjustment - growth in book value - to recognize the difference between price and book value) future abnormal growth in earnings adjusts for the difference between next period's accounting earnings and next period's economic earnings* (p. 93).

Abnormal earnings growth model emphasizes firm's future earnings and earnings growth, where abnormal change in earnings represents "the change in earnings in excess of the return on net reinvestment during the period" (Gode & Mohanram, 2003, p. 402). Abnormal earnings growth model can thus be expressed in the following equation in line with Ohlson and Juettner-Nauroth (2005):

$$P_0 = \frac{eps_1}{r_e} + \left(\frac{eps_2 - eps_1 - r_e(eps_1 - dps_1)}{r_e(r_e - g_p)} \right) \tag{9}$$

where P_0 is the current (time $t=0$) price per share, eps_1 and eps_2 are expected earnings per share at time $t=1$ and $t=2$ respectively, dps_1 is expected dividends per share, r_e is cost of equity capital, and g_p is perpetual earnings growth rate.

3.3.1.2 Analysts' earnings forecasts

Finally, it is important to stress that the estimation of ICC in contemporary research relies upon certain assumptions concerning the future earnings of firms. A vast majority of studies in this research area, as also summarized above, use analysists forecasts of future earnings and an assumed earnings growth rate for earnings beyond the forecast horizon (sometimes together with some terminal value assumption) to define the indefinite earnings stream for firms. As these mechanics are many times of critical importance to the results of studies estimating ICC, they in itself have been subject to a certain critique.

A large body of literature relies on analysts' forecasts for estimates of earnings needed to calculate ICC. Analysts' forecasts of earnings for several periods in the future are published in advance in several databases, for example the IBES database by Thomson Reuters. From the practical perspective these forecasts work as an indicator for investors on the future performance of stocks. In academy, the analysts' forecasts of earnings were traditionally considered as a reliable proxy of the development in company's earnings, that may be used for cost of capital calculations. However, this view has been challenged by some and the analysts' forecasts of earnings are criticized to be upwardly biased leading to biased expected return estimates.

Claus and Thomas (2001) highlight that optimism in analysts' forecasts varies across companies and over time due to different analysts' incentives. They argue that in the early years of their sample (mid-1980's) analysts in the US tended to strike optimistic forecasts to earn favour from the management. While already in the end of the 1990's the trend seems to be reversed, as the management guided forecasts downwards willing to exceed or meet the forecasts when the actuals were announced. Easton and Monahan (2005) show that there is a positive correlation between the reliability of expected return forecasts and the quality of analysts' forecasts of earnings, which is measured by the long term growth rate. They conclude that generally ICC is not a reliable measure of expected returns attributing the lack of reliability at least partly to the low quality of analysts' forecasts of earnings and showing that high quality forecasts (those associated with low long term earnings growth rate) do indeed result in precise expected return estimates for some ICC measures.

Easton and Sommers (2007) analyse the expected return estimates based on the analysts' forecasts aiming to confirm if the forecasted earnings are optimistically biased and if they result in upwardly biased expected return estimates. The authors compare the expected return estimates based on current market prices and analyst-forecasted next period earnings with the estimates based on current prices and current period earnings. This provides an ex ante measure of optimism in the analysts' forecasts of earnings, as the comparison is done at the time the forecast is made. Easton and Sommers (2007) argue that it is the distinguishing feature of their analysis, as other authors focus on ex post comparisons, i.e. estimates using the analysts' forecasted earnings versus the realized earnings. The authors apply methods from Easton et al. (2002) and O'Hanlon and Steele (2000) using the analysts' forecasts data and current accounting data respectively for the simultaneous estimation of ICC and the growth rate (assumptions on or estimation of earnings growth rate is discussed in the subsequent section). They conclude that the forecasts are indeed optimistically biased and they lead to upwardly biased ICC estimates (2.84% upward bias on average). Moreover, Easton and Sommers (2007) show that "analysts' optimism (and hence the bias in implied expected rates of return) varies with firm size and with analysts' recommendations" (p. 986). As firm size increases and the percentage of "strong buy" or "buy" recommendations in the consensus forecast decreases the optimism in analysts' forecasts and thus the bias increases.

In their paper, Guay, Kotari and Shu (2011) focus on the measurement error in the ICC estimates attributable to the errors in analysts' forecasts of short term and long term earnings. As forecasting suffers from timing (failure to provide timely updates to the forecasts upon price movements) issues, analysts' earnings forecasts contain a predictable error: "the error correlates negatively with the firm's immediate past price performance, and the negative relation varies with firm characteristics such as size, book-to-market ratio, and analyst following" (Guay et al., 2011, p. 127). The authors suggest two methods to adjust the analysts' forecasts (ICC measures) for the measurement errors – explicitly correcting analysts' forecasts for expected measurement errors or implicitly correcting for sluggish forecasts by changing the timing of inputs into the accounting-based model. The proposed remedies to the measurement error appear to significantly improve the cost of capital estimates. However, Guay et al. (2011) caution that the proposed methods to correct for the analysts' forecast error are not perfect and might not provide precise estimates for individual firms.

In summary, analysts' earnings forecasts are widely used as inputs into the accounting-based models for cost of capital estimation. However, the utilization of these forecasts has been widely criticized as it has been shown that due to the measurement error, over-optimism in analysts' forecasts and inability to update these forecasts in a timely manner results in biased earnings forecast, and thus biased ICC estimates. The bias is especially pronounced for big firms, firms with many "buy" recommendations from analysts and firms with volatile performance; it also varies with long-term growth rate, book-to-market ratio and analyst following. Some remedies to rectify the measurement error, optimism bias and timing issues have been proposed, however, the resulting ICC measures are still not utterly convincing, especially at an individual firm level. Furthermore, analysts' earnings forecasts cannot be relied upon due to limited time-series and cross-sectional availability: analysts' forecasts are not available for smaller and medium firms, especially for earlier periods (Hou, van Dijk and Zhang, 2012). Therefore, alternative ways to get the future earnings of firms could be explored and this is one of the aims of this thesis. One of the alternative ways to estimate the future earnings of firms is to use the cross-sectional earnings forecast model, which is described in the following section.

3.3.1.3 Cross-sectional earnings model

In response to the concerns over reliability of analysts' earnings forecasts used in deriving ICC estimates Hou, van Dijk and Zhang (2012) developed a cross-sectional earnings model generating future earnings estimates to be used as a proxy for expected cash flows. The cross-sectional earnings model from Hou et al. (2012) is used in this thesis to substitute for biased analysts' earnings forecasts.

The authors argue that there are multiple issues with analysts' forecasts of earnings (as reviewed in the previous section). Issues relating to bias in analysts' forecasts as well as coverage which is limited both across cross-section and time-series motivate Hou et al. (2012) to create a model for earnings independent of analysts' forecasts. Referring to previous studies (see Fama & French, 2000, 2006; Hou & Robinson, 2006; Hou & van Dijk, 2011) the authors argue that cross-sectional models have the ability to explain the variation in expected firm profitability and based on these studies they developed a cross-sectional model, where earnings are a function of total assets, dividends, and accruals.

Hou et al. (2012) analyse all firms listed in NYSE (New York Stock Exchange), Amex and Nasdaq for which the data is available in CRSP monthly returns files and Compustat fundamentals annual files during the period 1968-2008 (more than 170,000 firm-year observations in total). The authors run a pooled cross-sectional regression using ten previous years of data regressing earnings on total assets, dividends, a dummy variable for dividend payers, previous year earnings, a dummy variable for negative earnings and accruals to get the estimates for earnings forecasts. For each firm in the sample and each year the authors compute earnings forecast for up to 5 years in the future using the coefficients from a pooled cross-sectional regression. Hou et al. (2012) claim that earnings forecasts from their model are better proxies for expected earnings, as they show a significantly smaller forecast bias and higher earnings response coefficient than analysts' earnings forecasts.

Having the earnings estimates for up to five years ahead, Hou et al. (2012) use these estimates as a proxy for expected cash flows and based on these estimates they calculate five different individual ICC estimates and a composite ICC estimate (average of the five individual ICC estimates). Further, they evaluate the resulting ICC estimates by regressing them on future realized returns and conclude that their estimates and future realized returns are strongly significantly correlated. Hou et al. (2012) also compare their ICC estimates with an analyst-based ICC, i.e. computed using the analysts' earnings forecasts, and argue that "model-based ICC is a more reliable predictor of future stock returns than the analyst-based ICC" (p. 506). The results are able to survive a number of robustness tests, including alternative model specifications, adjustments for analyst forecast bias and specific computation methods.

In line with previous research, the authors also perform an analysis on the relation between their model-based ICC and various firm characteristics. Hou et al. (2012) claim that inferences on the ability of risk characteristics to explain the variation in cross-sectional expected returns are sensitive to the choice of expected return proxy, i.e. model-based ICC versus realized returns. With that in mind, the authors encourage future investigation of expected returns using model-based ICC as a proxy.

3.3.1.4 Long-run growth rate

ICC estimated in a residual income model or dividend growth model relies in particular on the earnings growth rate for earnings beyond the forecast period. Easton et al. (2002) stress that "estimates of the expected rate of return on equity may be very sensitive to assumptions about the rate of growth in residual income" (p. 659). Most studies rely on certain assumed growth rate of earnings and some apply more comprehensive approaches like estimation of the earnings growth simultaneously with cost of capital.

Constant long-term growth rate of earnings assumed in a large part of studies pertaining to ICC has been criticized and alternative approaches were suggested. In particular, earnings beyond the short-term horizon are assumed to growth at a constant rate and errors in growth rate directly affect the cost of equity estimate: "the more positive (negative) is the error in the long-term growth rate, the more upwardly (downwardly) biased is the implied COE" (Nekrasov & Ogneva, 2011, p. 415). In practice, however, a number of factors affect the firm's long-term growth rate; therefore, studies assuming constant growth rate might result in spurious inferences (Easton, 2006, 2007).

In their study, Gebhardt et al. (2001) assume that the return on equity beyond the forecast horizon (year 3) fades linearly to the industry median until year 12 using the mean reversion technique arguing that this fade "captures the long-term erosion in return on equity over time" (p. 142). The industry median is calculated using the historical data on 48 Fama and French industries for the past 10 years and excluding the firms in loss positions. Gordon and Gordon (1997) rather assume that beyond the forecast horizon the return on equity equals the expected return on equity capital at the forecast horizon for all future years. Both Gebhardt et al. (2001) and Gordon and Gordon (1997) assume that the earnings after the forecast horizon are earned in perpetuity.

In contrast, Claus and Thomas (2001) and Gode and Mohanram (2003) assume that the residual income or abnormal earnings respectively grow at the universal rate for all firms. The authors measure the growth rate by an estimate of the expected inflation rate. The expected inflation is derived from the risk free rate assuming that it is approximately equal to 3% by Claus and Thomas (2001). Similarly, Gode and Mohanram (2003) derive the growth rate by subtracting 3% from the risk free rate assumed to be equal to the yield of a 10 year US Treasury note. Pastor et al. (2008) also tie the long-term growth rate to a macroeconomic indicator: they assume that the growth rate beyond forecast horizon equals the GDP growth. GDP growth rate is calculated "as the sum of the long-run real GDP growth rate (a rolling average of annual real GDP growth) and the long-run average rate of inflation based on the implicit GDP deflator" (Pastor et al., 2008, p. 2871).

Other authors claim that the assumed growth rates for earnings beyond forecast horizon fail to reflect the growth rate suggested by the data. Instead they attempt to estimate the growth rate beyond the forecast horizon from the stock price and the accounting data simultaneously with ICC.

Easton et al. (2002) for example simultaneously estimate ICC and the residual income growth rate implied by the data for portfolio of stocks. Using the data on current stock prices, current book value of equity and short-term forecasts of earnings, authors calculate the expected growth rate of residual income, the expected (implied) cost of capital and the expected equity risk premium. According to Easton et al. (2002), "simultaneous estimation of these expected rates provides a means of adjusting for the reliance of *their* [authors' edition] method on book value of equity and forecasts of accounting earnings for a short horizon" (p. 673). Authors conclude that their estimates of equity risk premium based on simultaneously estimated growth rates are higher than those in related literature using residual income valuation, but closer to the estimates based on historical earnings in Fama and French (2002). A similar approach in simultaneous estimation of ICC and the residual income growth rate implied by the data is employed by O'Hanlon and Steele (2000).

Nekrasov and Ogneva (2011) suggest a model where long-term growth rate in earnings is estimated endogenously from the firm data. Referring to the work of Easton et al. (2002), who simultaneously estimate average cost of equity and average long-term growth for a sample of firms, they extend this approach to estimate long-term growth at individual firm level. Nekrasov and Ogneva are motivated by the common practice in the industry to evaluate individual privately held firms with reference to its peers (companies with similar risk characteristics) and thus estimate "a firm's COE (growth) as the sum of the COE (growth) typical of firms with the same risk-growth profile plus a firm-specific component" (2011, p. 416). Authors test their cost of equity and growth estimates using out-of-sample future realized returns and realized earnings growth, and conclude that their measures are valid.

The simultaneous estimation procedure can be also applied in the abnormal earnings growth model. Easton (2004) provides a model to simultaneously estimate ICC and the rate of change in abnormal growth in earnings for a portfolio of stocks. The model uses current stock prices and forecasts of earnings and of the short-term earnings growth rate as inputs. The author compares the resulting ICC estimates with PEG ratio (price-earnings ratio divided by short-term earnings growth rate). Easton (2004) concludes that expected return estimates based on PEG ratio are biased downwards if compared to the estimates derived from abnormal earnings growth model, which simultaneously estimates the long-term growth rate.

The advantage of assuming the long-term growth rates at a certain constant level or phasing them towards some constant value (e.g. industry median) over time is that it enables the model to provide firm-specific cost of capital estimates. Whereas, the models where long-term growth is calculated endogenously can generally only produce estimates of cost of capital for portfolios of stocks (with the exception of a model by Nekrasov and Ogneva, 2011). Easton (2007) argues, however, that the disadvantage of the assumed long-term growth rate is that it might differ from the growth rate that is implied by the data, which might lead to imprecise ICC estimates.

3.3.2 Validation of ICC

As illustrated in the previous sections, there are multiple ways to estimate ICC and a number of concerns have to be addressed. In order to check the validity or reliability of the resulting ICC estimates produced using these methods, there are two main approaches employed in the literature: check the correlations of resulting expected return proxies with the commonly used risk proxies or look at the explanatory power of these expected return proxies for realized returns. These two approaches are discussed in the following sections.

3.3.2.1 Risk-characteristics-based tests

Several studies in ICC research apply the risk-characteristics-based tests to validate their results. As a standard approach, these studies (e.g. Botosan, 1997; Gebhardt et al., 2001; Gode & Mohanram, 2003; Botosan & Plumlee, 2005; Botosan et al., 2011) use the commonly accepted firm risk characteristics such as return volatility, firm size, analyst following, CAPM beta, growth, book-to-market ratio, equity market value, leverage and others to confirm the empirical validity of their ICC estimates.

For example, Botosan et al. (2011) regress their 12 ICC estimates adapted from other studies on the risk free rate, market beta, leverage, book-to-price ratio, growth, and market value of equity. The authors hypothesize that a positive correlation (negative for market value of equity) between the expected return proxy and risk characteristics provides support to the validity of that proxy. Based on this framework, Botosan et al. (2011) find that the Target Price Method introduced in Botosan and Plumlee (2002) and the PEG method in Easton (2004) produce the most reliable expected return estimates.

Gebhardt et al. (2001) compute the implied risk premium (i.e. ICC minus risk free rate) and examine its cross-sectional relation with 14 firm risk characteristics grouped into five risk categories (market volatility, leverage, liquidity and information environment, variability and predictability of earnings and other pricing anomalies). Performing their empirical analysis on a large set of US-based companies, the authors find that a large part of the cross-sectional variation in their implied risk premium estimates can be explained by four risk characteristics (the mean implied risk premium of firm's industry from the prior year, firm's current book-to-market ratio, firm's forecasted growth rate and the dispersion in firm's analyst forecasts). Similarly, Gode and Mohanram (2003) regress their implied risk premium estimates based on Ohlson and Juettner-Nauroth (2005) and two versions of residual income valuation model adapted from Gebhardt et al. (2001) and Liu et al. (2002) on beta, unsystematic risk, earnings variability, size and leverage, and control for long-term growth, book-to-market ratio and lagged industry risk premium. Authors claim that the implied risk premiums are correlated to the risk characteristics in the predicted fashion with an exception for earnings variability. However, Gode and Mohanram (2003) also find that the risk premium from Gebhardt et al. (2001) is significantly negatively correlated with analysts' short-term and long-term forecasts, whereas the risk premium from Ohlson and Juettner-Nauroth (2005) shows a significant positive correlation.

Therefore, depending on the choice of method for calculation of ICC (or the resulting implied risk premium) the evidence on relation between ICC and firm risk characteristics seems to vary. In support of the inconclusiveness of empirical evidence, Easton (2007) and Easton and Monahan (2016) question the validity of testing

ICC measures against the firm risk characteristics. The key motivation behind using the accounting-based cost of capital measures to estimate expected returns is the absence of a well-established theoretical model explaining the variation in firm-level expected returns via its risk factors. Hence, according to Easton (2007) employing the risk-characteristics-based tests to validate accounting-based expected return proxies "is at odds with the motivation for using accounting-based estimates" (p. 313). Other authors (see for example Wang, 2018), however, argue that the commonly used risk proxies such as beta, leverage, default risk or market value of equity can be used as a first order approximation in testing the relation with ICC estimates even though the true risk factors which determine the expected return are not known.

3.3.2.2 Returns-based tests

Easton and Monahan (2005) develop an empirical approach using realized returns as a benchmark to test seven ICC measures imputed from prices and analysts' earnings forecasts and originating from studies of other authors (as summarized in *Section 3.3.1*). They test the reliability of ICC measures with reference to its association with the realized returns, having acknowledged that realized returns are a noisy proxy for expected returns, therefore explicitly controlling for the information surprises in line with the return decomposition framework of Vuolteenaho (2002). In their study, evidence on the reliability of different expected return proxies follows from the regression coefficients from a regression of the future realized returns on ICC measures, cash flow news and return news. Cash flow news proxy reflects the fact that positive revisions to future profitability lead to a realized return that is higher than the expected return while return news proxy corresponds to the changes in investors' expectations about the future discount rates; both aforementioned proxies are based on the analysts' forecasts.

In their study, Easton and Monahan (2005) evaluate seven accounting-based ICC measures – one benchmark measure, developed by the authors, and six other proxies referring to the other studies. First measure is essentially an inverse of price to forward earnings ratio – a naïve benchmark by Easton and Monahan (2005), based on the assumption that expected cum-dividend aggregate earnings for two years in the future are sufficient for valuation purposes. The next four proxies are derived from the finite-horizon abnormal earnings growth model by Ohlson and Juettner-Nauroth (2005) and Easton (2004). They are derived by including and relaxing an assumption on no payment of dividends at period t+1 (which gives two of the proxies), and relaxing the assumption that the abnormal growth of earnings is constant in line with Gode and Mohanram (2003) and Easton (2004) (which gives another two proxies). The final two measures follow the residual income valuation model based on Claus and Thomas (2001) and Gebhardt et al. (2001). The two measures in principle differ in the assumption of the long-term growth rate: the first assumes that earnings growth at the analyst consensus rate in until year t+5 and at the rate of inflation thereafter (Claus & Thomas, 2001), while the second assumes that accounting return on equity linearly approaches the industry median between years t+3 and t+12 and remains constant thereafter (Gebhardt et al., 2001). Data for estimation of the ICC measures and cash flow and return news for 1981 to 1998 is obtained from Compustat, IBES and CRSP.

Easton and Monahan (2005) run multivariate regressions of realized returns on the ICC measures and the cash flow and return news proxies and show that none of the ICC measures "has a positive association with realized returns after controlling for changes in expectations about future cash flows and future discount rates" (p. 502). Furthermore, the naïve measure created by the authors for benchmarking purposes (an inverse of price to forward earnings ratio) has a lower measurement error than the remaining expected return proxies. Several extension tests to the model are performed for evaluating the ICC measures: instrumental variables analysis, grouping analyses, and analyses of the relation between the reliability of ICC measures and the long-term forecasts from analysts. The commonly used methods for mitigation of the measurement error (instrumental variables and grouping) do not improve the reliability of the model. While a further analysis shows that the reliability of the ICC measures is increasing, when the consensus analyst growth rates decrease, and the expected return proxy by Claus and Thomas (2001) is reliable for firms with low growth rate forecasts. Overall, the authors conclude that after controlling for the information surprises (cash flow news and return news) ICC estimates have little ability to explain the future realized returns, which might be a result of significant measurement error in analysts' earnings forecasts.

In a simpler framework, Gebhardt et al. (2001) and Gode and Mohanram (2003) check the validity of their ICC measures by regressing them on the future realized returns. They report a positive and significant correlation between expected returns forecasted based on ICC and future realized returns for portfolios of stocks.

Botosan and Plumlee (2011) estimate the expected return based on a number of model specifications applied from other studies measuring ICC (Easton & Monahen, 2005; Guay et al., 2005; Botosan & Plumlee, 2005) as well as Fama and French four factor model and several combined ICC proxies, in total 12 proxies for expected return. They test the validity of these proxies by regressing them on future realized returns while controlling for cash flow news and return news. Authors find strong support for a significant relationship between their ICC proxies and future realized returns. The theoretical specifications of the research framework of Botosan and Plumlee (2011) and Easton and Monahan (2005) are the same, however, the conclusions are clearly contradictive. Botoson and Plumlee (2011) explain this difference in findings by the choice of cash flow news and return news variables in the empirical specification, which is different in the two studies, and argue that Easton and Monahan's (2005) choice of variables is "empirically problematic because it provokes circularity in the empirical model" (p. 1116).

In conclusion, although realized-returns-based tests are common in the literature, it is acknowledged that realized returns are a poor predictor of expected returns. In fact, this is the main driver behind ICC literature – to circumvent the use of noisy estimates based on realized returns. However, for validation purposes the future realized returns (while controlling for information surprises) provide basis for one of the two feasible validation methods that are commonly met in ICC research. Some authors suggest that ICC estimates should differ from expected returns by variables other than only cash flow news and return news. This argument is described in the following section.

3.3.3 Relation between ICC and expected return

As discussed above, the prominent literature in the field views the ICC as a proxy for expected returns. There are different methods to arrive at the estimates of ICC and yet different methods to validate these estimates as reliable (or otherwise) proxies for expected returns. While the empirical results are not yet too persuasive on the reliability of ICC as a measure of expected return, further exploration of ICC (along with certain improvements in the empirical methodology) is highly encouraged as an alternative to commonly used but far from perfect expected return proxies such as average historical returns.

Challenging the fact that ICC is regarded to be equal to expected return in the contemporary ICC literature, Hughes, Liu and Liu (2009) claim that such a relation is grounded in the traditional asset pricing theory assuming constant expected returns. The authors argue that there is sufficient evidence in finance and economics literature to assume that expected returns are stochastic: work by for example Campbell (1991), Jagannathan and Wang (1996) and Fama and French (1997) implies that expected returns are indeed time-varying. Based on the premise that expected returns are stochastic, they perform an analysis of the efficacy of ICC as a proxy for expected returns when the latter are stochastic.

Hughes et al. (2009) start with developing a discounted cash flow valuation model under stochastic expected returns in extension of Ang and Liu (2004). Their initial proposition is that the value of an asset at $t=0$, A_0, shall satisfy the following inter-temporal relation:

$$A_0 = E_0\left(\exp(-\mu_o)\left(\tilde{A}_1 + \tilde{c}_1\right)\right) \tag{10}$$

where $\exp(-\mu_o)$ is the expected gross return for the period between 0 and 1, $\tilde{A}_1$ is the value of an asset at $t=1$, and $\tilde{c}_1$ is the free cash flow to investors for the period between 0 and 1.

Iterating the inter-temporal equation to infinity, assuming a factor structure for logarithms of expected returns and assuming the process for generation of future cash flows, Hughes et al. (2009) arrive at the following asset valuation equation with stochastic expected returns:

$$A_0 = c_0 \frac{\exp\left(g + \frac{1}{2}\sigma_c^2\right)}{\exp(\mu_0)\left(1 - \exp\left(-\left(r_f + \lambda\bar{\beta} - g - \frac{1}{2}\left(\rho\sigma_c - \lambda\sigma_\beta\right)^2 - \frac{1}{2}(1-\rho^2)\sigma_c^2\right)\right)\right)} \tag{11}$$

where r_f is risk free rate, λ is the factor risk premium, g, ρ, $\bar{\beta}$, σ_β and σ_c are constants. Under the constant expected returns, $\tilde{\mu}_t = \bar{\mu}$ for all t, *Equation (11)* reduces to:

$$A_0 = \frac{\exp\left(g + \frac{1}{2}\sigma_c^2\right)}{\exp(\mu_0) - \exp\left(g + \frac{1}{2}\sigma_c^2\right)} c_0 = \frac{c_0}{\exp\left(\mu_0 - g - \frac{1}{2}\sigma_c^2\right) - 1} \tag{12}$$

Further, to show the relationship between ICC and expected return, the authors define ICC as a rate of return that equates the present value of future cash flows to current asset value:

$$A_0 = E_0\left(\sum_{t=0}^{\infty} \exp(-t\mu_0)\, \tilde{c}_{t+1}\right) \tag{13}$$

where μ_0 is the logarithm of ICC at *t=0*.

Applying similar calculations as above, Hughes et al. (2009) use *Equation (13)* to arrive at the following equation expressing firm's value in terms of ICC:

$$A_0 = \frac{\exp\left(g + \frac{1}{2}\sigma_c^2\right)}{\exp(\mu_0) - \exp\left(g + \frac{1}{2}\sigma_c^2\right)} c_0 \tag{14}$$

It is immediately recognisable that *Equations (12)* and *(14)* are identical. This is a theoretical proof that under constant expected returns, ICC should be equal to the expected return.

However, Hughes et al. (2009) argue that given stochastic expected returns, this relationship breaks. They equate the right-hand sides of *Equations (11)* and *(14)* to arrive at the following expression for the difference between expected return and ICC:

$$E\left(\exp(\pi_0) - \exp(\mu_0)\right) = \left(1 - \exp\left(\lambda\sigma_\beta\left(\lambda\sigma_\beta - \rho\sigma_c\right)\right)\right)\exp\left(g + \frac{1}{2}\sigma_c^2\right) \tag{15}$$

Based on the relationship in *Equation (15)*, authors argue that unless the technical condition of $\lambda\sigma_\beta\left(\lambda\sigma_\beta - \rho\sigma_c\right) = 0$ is satisfied (which is unlikely), there will be differences between ICC and expected return. In cases when this condition is violated, the average difference between ICC and expected return will depend on beta volatility, σ_β, cash flow volatility, σ_c, the correlation between expected returns and cash flows, ρ, and growth in cash flows, g. These differences between ICC and expected return arise, as Hughes et al. (2009) explain, from "Jensen's inequality because price is a nonlinear function of the (stochastic) expected returns" (p. 257). The authors then extend their theoretical analysis to include the considerations on leverage as empirical studies on ICC focus on equity valuation rather than asset valuation. Hughes et al. (2009) conclude that "because leverage magnifies the volatility in both expected returns on equity and future dividends, it will in turn magnify the average difference between expected returns and the implied cost of equity capital" (p. 254). Thus, leverage is another variable that should explain the difference between ICC and expected return. To include leverage in the empirical analysis, as one of the approaches authors suggest to use an equity beta (instead of asset beta) and replace cash flows with dividends.

The implications of theoretical findings in Hughes et al. (2009) to the empirical analysis are fourfold. First, the common empirical finding that risk premiums inferred from ICC are lower than those observed in the market (see Claus & Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002) could be explained by the claim that ICC estimates can be expected to be lower than expected returns due to Jensen's inequality. Second, the suggestion following from several studies (see Gebhardt et al., 2001; Gode & Mohanram, 2003) that some variables (e.g. growth, leverage, idiosyncratic risk) might be previously unidentified priced risk factors (as they are significantly correlated with ICC estimates) might not be true, as given stochastic expected returns these variables are correlated with ICC after controlling for beta. Third, the finding of some studies (see Guay et al., 2003; Easton & Monahan, 2005) that ICC becomes efficient in explaining future realized returns after analysts' forecast inefficiency or firm growth are controlled for can be explained by the fact that factors such as growth are correlated to ICC, and the omission of these correlated factors might cause ICC estimates to be biased. Fourth, some scholars (see Botosan, 1997; Botosan & Plumlee, 2002; Hail & Leuz, 2006; Hribar & Jenkins, 2004) argue that characteristics of firm's informational environment (e.g. level of corporate disclosures) might be correlated to ICC, but Hughes et al. (2009) argue that these correlations might be mere artefacts of the difference between ICC and expected return if the variables in question are correlated to cash flow growth. In conclusion, the empirical analyses of ICC and its relation with expected return shall take into account the factors described above causing a difference between ICC and expected return.

3.4 Summary

The concept of ICC is rather simple and intuitively appealing: it is a discount rate, which equates the present value of stock's future cash flows to its current price. Thus, it is a rate of return that investors expect to receive on their capital invested in the stock. It follows that ICC is a proxy for expected return in the market.

Traditionally, empirical asset pricing models, including CAPM, Fama and French three factor model and arbitrage pricing model, have been used to approximate for expected returns. But probably the most common approach in the literature to estimate expected returns has been to use the average realized returns. It has since been shown that such a simplistic approach produces expected return estimates that are biased (see for example Elton, 1999). Hence, an alternative approach of ICC to proxy for expected returns was proposed. ICC shifts the focus from market-oriented view to a firm-oriented view of the stock, draws insight from the firms' accounting data and refrains from equating realized returns to expected returns.

The basic premise of ICC is that the current stock price is equal to the future cash flows discounted at the rate, which approximates expected return. Several different discounting methods having been used in literature to arrive at the present value of future cash flows – dividend discount model and residual income model used most often, and abnormal earnings growth model used less frequently. Dividend growth model relates the current stock price to its future dividends (equity cash flows) discounted at the rate equivalent to implied cost of capital. Residual income model is based on a similar intuition as dividend discount model, but provides a better intuition into the economic profits that drive future cash flows (i.e. residual income) – it is the sum of current book value of equity and present value of future residual income. Abnormal earnings model is in principle derived from the residual income model and relates to the latter in the following way: "abnormal earnings growth for period *t* is equal to the difference between residual income in period *t - 1* and period *t*" (Skogsvik & Juettner-Nauroth, 2013, p. 70).

Once the estimates of ICC are calculated, empirical testing has to be performed to check for validity of ICC estimates as a proxy for expected returns. There are two main approaches towards validating the results of the empirical studies estimating ICC – risk-characteristics-based testing or return-based testing. Risk-characteristics-based tests work on a premise that since ICC is a proxy for expected return, following the empirical asset pricing theory, it should be correlated with commonly identified firm risk characteristics. In testing the validity of estimates, the ICC literature looks at the relation between expected return proxies produced by various ICC measures and firm risk characteristics, such as return volatility, firm size, analyst following, CAPM beta, growth, book-to-market ratio, equity market value, leverage and others. While empirical evidence based on these tests seems inconclusive (some ICC measures shown opposition relationship with risk factors than expected and some are insignificant), risk-characteristics-based tests shall work as a first order approximation even though the true risk factor might remain unknown. Returns-based testing is founded on an idea that expected returns should be related to future realized returns acknowledging the fact that differences may arise due to information surprises (see Elton, 1999). Following this thinking, expected return estimates from various ICC measures are regressed on the future realized returns while controlling for cash flow news and return news (following the return decomposition by Vuolteenaho, 2002). While empirical evidence based on realized-return testing is also rather inconclusive, some research suggests that lack of precision in validation might be attributed to optimism bias in analysts' earnings forecasts. Others claim that there are more factors that should contribute to the difference between ICC and realized returns that cash flow news and return news (see Hughes et al., 2009). Thus, although they are likely not perfect, but risk-characteristics-based tests and returns-based tests are most frequently used for ICC validation.

Optimism bias in analysts' earnings forecasts is only one among several issues in ICC methodology that has been identified in the literature. It has been shown that ICC estimates suffer because of low quality of analysts' earnings forecasts (see Claus & Thomas, 2001; Easton & Monahan, 2005), which results from a measurement error, over-optimism in forecasts and inability to update the forecasts in a timely manner. Furthermore, analysts' earnings forecasted are limited in both time-series and cross-sectional coverage as small and medium firms are under-represented, especially in earlier years. Assumptions on long-run earnings growth rates in models estimating ICC have been identified as another area in ICC empirical research, that is susceptible to criticism. Some studies use a certain assumed long-term growth rate of earnings, while others employ an endogenously-calculated growth rate produced by regression analysis. The assumed growth rates are advantageous as they enable the model to produce firm-specific cost of capital estimates, while endogenously estimated growth rates can generally only be applied on a portfolio level. Furthermore, ICC methodology is sensitive to the assumption that ICC is constant inter-temporally. Based on this weakness, the reliability of ICC as a proxy for expected return has been challenged at the conceptual level: Hughes et al. (2009) claim that given stochastic expected returns ICC should differ from expected return and the difference should be explained by beta volatility, cash flow volatility, the correlation between expected returns and cash flows, growth in cash flows and leverage. Although the authors do not perform any empirical testing of their theoretical conclusions, they encourage that empirical research incorporates the mentioned firm characteristics in analysing the relation between ICC and expected return.

The above-summarized observations on the theoretical and empirical literature on ICC drive the analysis in this thesis in several directions. First, acknowledging the criticisms over the use of realized returns to approximate the expected returns and the lack of consensus on the reliable empirical asset pricing models to produce such proxies, we use ICC – a rather new approach in literature to get expected return estimates. Second, taking into consideration the deficiencies in the analysts' earnings forecasts we employ the cross-sectional earnings model to get the estimates of future earnings for calculation of ICC. Third, we follow the risk-characteristics-based approach to validate the ICC estimates. Lastly, following the conclusions of Hughes et al. (2009) that on average ICC and expected return should differ, and the differences are explained by specific firm characteristics (assuming that expected returns are stochastic) we test these theoretical findings empirically.

3.5 Hypotheses

Based on Botosan et al. (2012), we develop our first hypothesis that concerns the very validity of our model-based ICC measure. Later, in *Section 4.4.1*, we introduce an Expected Return Model with the help of which we test *Hypothesis 1*.

> *Hypothesis 1: The explanatory power of the risk factors (risk-free rate, unlevered beta, leverage, book-to-market ratio, growth in future earnings) in relation to the ICC provides support for validity of implied cost of capital measure.*

Next, the return decomposition framework by Vuolteenaho (2002) is assumed to hold: the "true" expected return is defined as the realized return adjusted by cash flow news and return news. The empirical part of our paper (*Section 4*) explores *Hypothesis 2* inspired by Botosan et al. (2012). In *Section 4.4.2*, we test *Hypothesis 2* by applying the Realized Return Model.

> *Hypothesis 2: After controlling for the cash flow news and expected return news, implied cost of capital should equal realized return.*

One must not forget that the primary aim of this thesis is to investigate the relationship between ICC and expected returns. To reach this goal, we empirically test this relationship in *Section 4.4.3* by applying the framework suggested by Hughes et al.

(2009). Thus, we formulate the main hypothesis of this thesis: *Hypothesis 3* reads as follows:

> *Hypothesis 3: The difference between implied cost of capital and expected return is explained by beta volatility, cash flow volatility, the correlation between expected returns and cash flows, and growth in cash flows.*

4 Empirical Analysis

In this section, our main goal is to test the three hypothesis presented in *Section 3.5*. In the following subsections, we detail each and every step of how we structured our empirical work. We further provide detailed descriptions on the implementation of the empirical testing and describe the results of the empirical models.

4.1 Methodology

First, we construct our base sample by pulling observations from 1960 to 2017 from WRDS' Compustat fundamentals file. The data contains 223,766 unique firm-year observations and the dataset is organized in a panel form. As we construct new variables, manipulate the data and delete missing observations, our sample size decreases to 57,215 unique firm-year observations that will serve as our base sample in the upcoming analyses. For the analyses we use RStudio statistical software.

Second, we estimate future dollar earnings five-years into the future (denoted as $E_t[E_{t+k}]$ where k signals each future period) for each company i at each year t. To obtain such future earnings, we use a Pooled Cross-Sectional Earnings model (in *Section 4.2*) based on the idea of Hou et al. (2012). We estimate the model by a pooled OLS technique at each year t, using a pooled sample from the previous five years. Therefore, we obtain pooled OLS coefficients for each year t with which we can calculate the future earnings ($E_t[E_{t+k}]$) by multiplying the regression coefficients with each companies' corresponding variables. The main result of these calculation is that for each year t, we obtain expected future earnings five years into the future: $E_t[E_{t+1}]$, $E_t[E_{t+2}]$, $E_t[E_{t+3}]$, $E_t[E_{t+4}]$ and $E_t[E_{t+5}]$ for each and every company in our sample.

Third, we construct the individual expected return proxies in *Section 4.3.1* with the use of the expected future earnings mentioned just before. The terms "expected return proxies", "individual ICC measures" and "individual measures" are used synonymously and refer to the individual expected return proxies: R_{oj}, R_{gor}, R_{peg}, R_{pegst}, R_{gm} which are all defined in *Section 4.3.1.*

Fourth, we calculate the composite ICC measure by taking the arithmetic average of the five individual measures. Then, we exemplify the predictive power of our model-based composite ICC in relation to future realized buy-and-hold returns at a portfolio level (see *Table 8*).

Fifth, as a last yet subdivided step, we test the three hypothesis presented in *Section 3.5*. Here, we introduce the Expected Return Model to test *Hypothesis 1*, the Realized Return Model to test *Hypothesis 2*, and the Cash Flow Return Model to test *Hypothesis 3*.

4.2 The Pooled Cross-Sectional Earnings Model

4.2.1 Data Description

To construct our sample, we used WRDS' Compustat fundamentals annual file from 1960 to 2017. The sample consists of unique firm-year observations and their corresponding accounting and financial market information. The unique firm-year observations are comprised of ordinary stocks (i.e. excluding ADRs, closed-end funds, and REITs) listed on NYSE, AMEX and Nasdaq regardless of industry specification. The data from Compustat contains 223,766 unique firm-year observations but as we construct new variables, manipulate and clear the data, observations will be dropped and all descriptive statistics and regressions are conducted on our base sample of 57,215 unique firm-year observations with no missing values. The sample contains both currently active and non-active companies and there are different number of firms each year. Also, variables indicated for each year *t* and for each firm *i* represent the latest values observed at the end of the corresponding calendar year.

Our selection of variables for the cross-sectional regression is based on that of Hou et al. (2012) and includes accounting variables reported in *Table 2*. *Earnings* (E_t, Compustat item *ib*) represent the income of a company after all expenses including special and extraordinary items. *Assets* (A_t, Compustat item *at*) are total assets on the balance sheet of the company. *Dividends* (D_t Compustat item *dvc*) represent the total amount of cash dividends declared and paid on the ordinary stocks of the company. *Accruals* (AC_t) are constructed using the cash flow statement method as the difference between *Earnings* and *Cash Flow from Operations* (Compustat items *ib* and *oancf*). A *Dividend Dummy* (DD_t) is added to the sample that takes the value of 1 if the company has positive *dividends* or 0 otherwise. A *Negative Earnings*

Dummy (*NegE*$_t$) is also created and returns a value of 1 if the company has negative *Earnings* or 0 otherwise.

To account for the missing values and avoid dropping too many rows from our sample, we calculated the means for each variable for each company and replaced the missing variables with these "within group (i.e. within company)" means. All other firm-year observations that contained missing values that cannot be substituted with the "within group" mean were dropped from the sample. All variables in the sample are level variables and measured in millions of US dollars, except the binary variables and ratios (see later). For the very reason we use level variables that may hugely effect and distort the data quality, descriptive statistics and future regressions, we winsorized all variables at the 5th and 95th percentile. This means, in essence, that we replaced all extreme observations in each column that are below the 5th percentile with the value at the 5th percentile and all observations above the 95th percentile with the value at the 95th percentile. This way, we also took care of the outliers.

Table 2. Descriptive Statistics I

The Summary of the Descriptive Statistics of the Variables Used in the Pooled Cross-Sectional Earnings Model. All Figures are Reported in USDm Except for Dummies.

Variables	Mean	5%	25%	Median	75%	95%	STD
E_t	64.61	-14.71	2.02	15.07	70.05	358.00	115.68
A_t	1,707.49	15.38	105.26	412.49	1,727.85	9,097.01	2,972.80
D_t	23.31	0.00	0.39	2.76	21.90	138.18	43.57
DD_t	0.69	0.00	0.45	0.82	1.00	1.00	0.43
$NegE_t$	0.12	0.00	0.00	0.00	0.08	0.63	0.29
AC_t	-253.26	-927.32	-389.36	-136.63	-39.47	5.68	307.42

Table 2 above shows the time-series averages of cross-sectional Mean, Median, Standard Deviation and 5th, 25th, 75th and 95th Percentiles. The format and column headings of *Table* 2 will be applied later on as we introduce new variables for our further empirical work. The timeframe of the sample, after taking care of the missing

values, spans from 1962 to 2012[5] and includes 57,215 unique firm-year observations. According to *Table 2*, firms tend to generate an average annual *Earnings* (E_t) of USDm 64.6 with a relatively high standard deviation of USDm 115.7. Average *Total Assets* (A_t) is USDm 1,708.5 with a standard deviation of USDm 2,972.8 million. The average annual cash *Dividend* (D_t) for a firm is USDm 23.1 with a standard deviation of USDm 43.6. Altogether, *Earnings*, *Total Assets* and *Dividend* variables are heavily positively skewed as their mean value is around the corresponding 75% percentile. The *Dividend Dummy* variable (DD_t) shows that each year, around 69 out of 100 firms paid cash dividends to their common shareholders. The *Negative Earnings* dummy ($NegE_t$) points out that each year, 12 out of 100 firms reported negative Income Before Extraordinary Items. The *Accruals* (AC_t) variable tells us that each year, on average, firms tend to have negative accruals in amount of USDm 253.3 with a standard deviation of USDm 307.4.

4.2.2 Regression Analysis

Our main goal with the pooled cross-sectional earnings model is to obtain coefficients for each year *t* with which we can calculate *Expected Future Earnings* forecasts up to five years in the future ($E[E_{t+1}]$ for *t+1*, $E[E_{t+2}]$ for *t+2*, $E[E_{t+2}]$ for *t+3*, $E[E_{t+4}]$ for *t+4* and $E[E_{t+5}]$ for *t+5*) for every firm in our sample. To do so, we invoke the regression model applied by Hou et al. (2012):

$$\begin{aligned} E_{i,t+k} = \alpha_0^k + \beta_1^k A_{i,t} + \beta_2^k D_{i,t} + \beta_3^k DD_{i.t} + \beta_4^k E_{i,t} + \beta_5^k NegE_{i,t} + \beta_6^k AC_{i,t} \\ + \epsilon_{i,t+k} \end{aligned} \tag{16}$$

where $E_{i,t+k}$ are future realized *Earnings* with $k = (1,2,3,4,5)$ and with *i* representing each firm in the sample, $A_{i,t}$ is *Total Assets* at *t*, $D_{i,t}$ is *Dividends* at *t*, $DDi_{,t}$ is the *Dividend Dummy* at *t*, $E_{i,t}$ is *Earnings* at *t*, $NegE_{i,t}$ is *Negative Earnings Dummy* at

[5] For the pooled OLS estimation, we need future realized *Earnings* five years ahead and this causes the range of the sample to decrease from 1962-2017 to 1962-2012. We also dropped the first two years (1960-1961) in the dataset due to the lack of observations.

t, $AC_{i,t}$ is *Accruals* at *t* and $\epsilon_{i,t+k}$ is the error term. For each year between 1967[6] and 2012, we estimate the above mentioned pooled cross-sectional earnings model by taking pooled samples from the previous five years. It is important to understand that for each year *t*, the pooled OLS regression produces five sets of coefficients. The first set contains the coefficients $\alpha_0^1, \beta_1^1, \beta_2^1, \beta_3^1, \beta_4^1, \beta_5^1$ and β_6^1 corresponding to one-year ahead earnings. The second set contains the coefficients $\alpha_0^2, \beta_1^2, \beta_2^2, \beta_3^2, \beta_4^2, \beta_5^2$ and β_6^2 corresponding to two-year ahead earnings. The third, fourth and fifth sets of coefficients are constructed based on a similar fashion. With the five sets of coefficients for each year, we will be forecasting *Expected Future Earnings* up to five years ($E[E_{t+1}]$ for *t+1*, $E[E_{t+2}]$ for *t+2*, $E[E_{t+2}]$ for *t+3*, $E[E_{t+4}]$ for *t+4* and $E[E_{t+5}]$ for *t+5*) that will later be used to construct the ICC measures. If instead, we used a time-series model to *Expected Future Earnings*, we would evidently create a survivorship bias in the regression. An advantage of our pooled OLS technique is that it "pools" observations across five years and the pooled samples vary from year to year[7]; this way we eradicate the survivorship bias in our samples. To reinforce the predictive power of our model, we ensure that our estimates will be strictly out of sample: coefficients at *t* are obtained by regressing the ex-post future *Earnings* of *t+1*, *t+2*, *t+3*, *t+4* and *t+5* on a pool of variables taken from *t-5*, *t-4*, *t-3*, *t-2*, and *t-1.* Moreover, as we apply a pooled OLS model, our sample size and the significance levels of the coefficients increase dramatically compared to, say, yearly cross-sectional OLS models. As we are pooling the five-year subsamples, we evidently include time-series of firm-year observations in our sample[8]. This, however, may give rise to heteroscedastic errors

[6] Since we estimate the pooled OLS model using a window of observations from the previous five years, the first year we obtain regression coefficients is 1967.

[7] The cross-sectional samples for each year may vary due to new IPO-s, bankruptcies, company de-listings, or simply because we dropped the observation from our sample due to poor data quality.

[8] E.g. if *t* is 2009, the subsample for the pooled OLS regression includes (among many other variables) *Earnings* for Apple Inc. in 2004, 2005, 2006, 2007 and 2008.

in the pooled OLS estimation but we tackle this problem by applying heteroscedasticity robust Newey-West standard errors and we calculate t-values based on such standard errors.

As a last general remark on our model, one may criticize the facts that i) we use level variables in the regressions instead of profitability ratios (e.g. *Earnings* instead of *Earnings/Market Value*) and ii) the pooled cross-sectional coefficients will do a poor job at forecasting earnings for individual firms at each year. However, after having winsorized the data, we believe that even though individual *Expected Future Earnings* forecast may not be that precise as if an analyst would have conducted his equity research, our average earnings forecasts are representative and do not incorporate any bias[9] with regard to future earnings.

Another major advantage of our model is that it generates statistical power and, again, takes care of the survivorship bias that would have been present in time-series models. Also, our model is robust to variable specification[10] just as the model in Hou et el. (2012).

Table 3 shows the output from an "all-sample" OLS regression that uses all 57,215 unique firm-year observations from the period of 1962-2012. In the first column, the left-hand side variables (E_{t+1}, E_{t+2}, E_{t+2}, E_{t+4} and E_{t+5}) are indicated and in each corresponding row, the set of coefficients are listed. For each regression coefficient, its t-statistic calculated from its Newey-West standard error is highlighted in *italics*. From the second to the seventh column, the coefficients of the following variables are stated: *Intercept*, *Total Assets* (A_t), *Dividends* (D_t), *Dividend Dummy* (DD_t), *Earnings* (E_t), *Negative Earnings Dummy* ($NegE_t$) and *Accruals* (AC_t). In the last column, the R-squared of each regression is shown. As *Table 3* is an "all-sample" regression, we can deduct inferences on our broad sample.

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[9] For instance, Hou et al. (2012) reports that analysts' forecasts inherently include a positive, upward bias.

[10] We obtained very similar coefficients when we included other variables to the regresison such as capital expenditures (Compustat item *capx*), market value (Compustat item *mkvalt*) or leverage (LTL/MKVALT, where LTL is long-term liabilities, Compustat item *dltt*).

According to *Table 3*, the one year *Expected Future Earnings* $E(E_{t+1})$ of the average firm stands at USDm 3.806 even if all variables indicated in *Table 3* are set to 0. For each USDm in *Total Assets* on their balance sheet, the one year *Expected Future Earnings* tend to increase by USD 4,000 (=1,000,000 x 0.004). Similarly to the coefficient of *Total Assets*, the coefficients of *Dividends* and *Earnings* both increase one year *Expected Future Earnings* by USD 221,000 (=1,000,000 x 0.221) and USD 723,00 (=1,000,000 x 0.723), respectively. These two coefficients are rationally expected to be positive as firms that pay higher dividends tend to have higher earnings and we expect a positive serial correlation in *Earnings*. The *Dividend Dummy* tells us one year *Expected Future Earnings* are expected to decrease by USD 897,000 (=1,000,000 x 0.897) given that the company pays cash Dividends. This is a counterintuitive finding however, the sign of the *Dividend Dummy* turns positive as we project *Expected Future Earnings* further into the future. The *Negative Earnings Dummy* shows that if today's *Earnings* are negative, next year's *Earnings* tend to be higher than today's by USDm 7.37. The t-statistics are calculated with the Newey-West standard errors and report that all seven coefficients (including the intercept) are significantly different from zero in all five regressions, with the exception of the *Dividend Dummy*, whose t-statistic tells that its coefficient is not significantly different from zero in any of the regressions. However, the insignificance of the *Dividend Dummy* coefficients may be a source of relief as the counterintuitive negative signs may just be zero after all. The R-squared figures tells us that the variables we used in the model capture, at a great extent, the variation in the future earnings. However, as we estimate *Expected Future Earnings* further into the future, we observe a declining trend of R-squares from 78.9% to 60.6%.

Table 3. "All-sample" Cross-Sectional Earnings Model

The Summary of Coefficients and Their Corresponding T-statistics (Calculated Using Newey-West Standard Errors) of the "All-Sample" Pooled Cross-Sectional Earnings Model.

LHS	Intercept	A_t	D_t	DD_t	E_t	$NegE_t$	AC_t	R^2
E_{t+1}	3.806	0.004	0.221	-0.897	0.723	7.370	-0.042	0.789
t-stat	*8.178*	*14.252*	*10.896*	*-1.354*	*66.028*	*9.425*	*-18.005*	
E_{t+2}	7.686	0.005	0.286	-0.884	0.622	10.042	-0.056	0.712
t-stat	*11.171*	*15.077*	*10.269*	*-0.893*	*45.423*	*9.943*	*-18.998*	
E_{t+3}	11.105	0.006	0.258	-0.029	0.595	10.179	-0.061	0.672
t-stat	*13.072*	*14.351*	*7.890*	*-0.024*	*38.717*	*8.987*	*-19.410*	
E_{t+4}	15.208	0.007	0.293	0.234	0.548	8.957	-0.065	0.633
t-stat	*14.858*	*14.493*	*7.944*	*0.161*	*33.690*	*7.026*	*-18.480*	
E_{t+5}	18.830	0.007	0.324	0.756	0.520	8.116	-0.071	0.606
t-stat	*15.931*	*13.655*	*8.084*	*0.459*	*30.737*	*5.829*	*-18.737*	

Table 3 has been useful to understand the dynamics between the variables and the general intuition however, we need to project *Expected Future Earnings* five years into the future for each year *t* in our sample. *Panel A* of *Table 4* shows an excerpt of the yearly pooled OLS regression coefficients from 1967 to 2012, using five-year subsamples to estimate the five sets of coefficients[11] for each year *t*. The t-statistics reported under the coefficients are calculated using Newey-West standard errors. To preserve space, *Panel A* reports the coefficients for only five selected years to exemplify the evolution of the sets of variables: two years in the very beginning (1967, 1968), one year in the middle (1990), and two more years at the very end of our sample (2011 and 2012). The complete table of regression coefficients would contain similar information for all 46 years of data[12]. The coefficients in *Panel A* of *Table*

[11] Seven coefficients (six variables and intercept) for *t+1*, *t+2*, *t+3*, *t+4* and *t+5.*

[12] The full table would include 46 (years) x 10 (coefficients and t-statistics) rows so we excluded it even from the Appendix. All tables are available upon request.

4 are of great importance to our further calculations as we will construct the *Expected Future Earnings* and ultimately the ICC measure based these coefficients.

From *Panel A*, it can be seen that both the absolute value and the signs of the coefficients vary depending on which year we apply our earnings model. The variation in the coefficients does not necessarily show a clearly definable trend however, the significance of the coefficients generally increases as we approach the more recent years. This is partially attributable to the increasing number of unique firm-year observations in the "5-year samples" as we approach 2012: there are 1,045 observations in the subsample for the regression in 1967 as opposed to the 12,955 observations in the subsample for the regression in 2012. The R-squared figures are still very high especially in the early years and a general declining trend in the R-squared figures can be observed on two fronts: the more recent regressions produce lower figures and in each year, regressions on further-ahead ex-post earnings (i.e. going from E_{t+1} to E_{t+5}) also produce lower R-squared figures.

Table 4. Annual Cross-Sectional Earnings Coefficients

Panel A: An Excerpt of the Summary of Coefficients and Their Corresponding T-statistics (Calculated Using Newey-West Standard Errors) of the Annual "5-Year Sample" Pooled Cross-Sectional Earnings Model.

LHS	Intercept	A_t	D_t	DD_t	E_t	$NegE_t$	AC_t	R^2
1967								
E_{t+1}	-0.436	-0.002	0.425	0.743	0.822	3.931	-0.004	0.955
t-stat	*-0.622*	*-0.514*	*2.255*	*1.164*	*8.709*	*1.127*	*-3.787*	
E_{t+2}	-0.632	-0.001	0.590	0.917	0.750	3.714	-0.009	0.936
t-stat	*-0.654*	*-0.218*	*2.512*	*0.884*	*4.802*	*1.083*	*-4.854*	
E_{t+3}	-0.915	0.000	0.771	1.053	0.648	2.791	-0.014	0.919
t-stat	*-0.630*	*0.048*	*2.789*	*0.655*	*3.500*	*0.749*	*-4.816*	
E_{t+4}	-1.717	0.000	0.759	1.465	0.634	2.457	-0.019	0.899
t-stat	*-1.014*	*0.040*	*2.627*	*0.762*	*3.151*	*0.647*	*-5.342*	
E_{t+5}	-2.001	0.000	0.879	0.831	0.589	3.114	-0.022	0.884
t-stat	*-1.123*	*0.042*	*2.897*	*0.399*	*2.663*	*0.787*	*-6.036*	

1968								
E_{t+1}	0.679	0.003	1.005	-0.839	0.528	0.939	-0.003	0.943
t-stat	*0.610*	*1.034*	*1.888*	*-0.690*	*1.946*	*0.399*	*-2.448*	
E_{t+2}	0.652	0.003	1.100	-0.847	0.481	1.041	-0.008	0.929
t-stat	*0.458*	*0.773*	*2.408*	*-0.552*	*2.020*	*0.476*	*-3.372*	
E_{t+3}	-0.153	0.003	1.029	-0.357	0.493	0.903	-0.013	0.911
t-stat	*-0.089*	*0.595*	*2.210*	*-0.192*	*1.910*	*0.343*	*-3.925*	
E_{t+4}	-0.027	0.002	1.192	-1.305	0.436	0.458	-0.017	0.895
t-stat	*-0.014*	*0.406*	*2.682*	*-0.632*	*1.708*	*0.184*	*-4.251*	
E_{t+5}	-0.253	0.000	1.285	-1.497	0.476	1.337	-0.020	0.911
t-stat	*-0.121*	*0.020*	*3.374*	*-0.612*	*2.409*	*0.501*	*-4.364*	
…	…	…	…	…	…	…	…	…
1990								
E_{t+1}	-2.335	0.001	0.523	3.081	0.653	10.678	-0.057	0.831
t-stat	*-1.946*	*1.197*	*5.009*	*1.948*	*13.709*	*4.229*	*-6.737*	
E_{t+2}	-2.448	-0.001	0.612	4.904	0.578	11.920	-0.096	0.757
t-stat	*-1.482*	*-0.552*	*4.826*	*2.036*	*10.664*	*3.788*	*-6.941*	
E_{t+3}	-0.946	-0.001	0.679	5.564	0.496	8.271	-0.122	0.711
t-stat	*-0.475*	*-0.574*	*4.207*	*1.902*	*8.018*	*2.578*	*-7.541*	
E_{t+4}	1.105	0.001	0.645	6.691	0.479	7.952	-0.108	0.695
t-stat	*0.506*	*0.484*	*3.732*	*2.032*	*7.859*	*2.514*	*-6.811*	
E_{t+5}	4.279	0.002	0.577	7.247	0.515	5.453	-0.104	0.695
t-stat	*1.763*	*0.676*	*3.313*	*2.013*	*8.470*	*1.654*	*-6.663*	
…	…	…	…	…	…	…	…	…
2011								
E_{t+1}	6.256	0.001	0.095	-0.525	0.700	5.261	-0.100	0.733
t-stat	*6.003*	*2.719*	*2.850*	*-0.346*	*45.120*	*3.145*	*-11.955*	
E_{t+2}	9.563	0.003	0.167	-1.338	0.578	8.991	-0.116	0.642
t-stat	*6.730*	*4.139*	*3.410*	*-0.622*	*27.073*	*4.289*	*-11.621*	
E_{t+3}	12.498	0.005	0.125	-1.382	0.584	11.205	-0.096	0.655
t-stat	*7.846*	*7.047*	*2.398*	*-0.552*	*27.327*	*5.156*	*-10.332*	

E_{t+4}	18.514	0.007	0.164	0.478	0.558	9.276	-0.088	0.645
t-stat	*9.841*	*8.479*	*2.938*	*0.166*	*26.760*	*3.884*	*-8.935*	
E_{t+5}	20.207	0.008	0.219	3.387	0.503	8.509	-0.080	0.606
t-stat	*9.743*	*9.158*	*3.623*	*1.092*	*22.936*	*3.394*	*-7.918*	
2012								
E_{t+1}	5.948	0.002	0.154	-0.244	0.684	5.279	-0.087	0.727
t-stat	*5.638*	*3.971*	*4.703*	*-0.163*	*43.644*	*3.265*	*-10.583*	
E_{t+2}	10.267	0.005	0.200	-1.109	0.587	9.151	-0.090	0.683
t-stat	*7.277*	*7.522*	*4.525*	*-0.519*	*30.319*	*4.518*	*-9.815*	
E_{t+3}	14.294	0.007	0.182	1.005	0.610	11.126	-0.069	0.689
t-stat	*8.765*	*9.162*	*3.733*	*0.399*	*32.670*	*5.361*	*-7.718*	
E_{t+4}	18.285	0.008	0.245	2.483	0.524	6.994	-0.059	0.632
t-stat	*9.464*	*10.796*	*4.476*	*0.854*	*25.490*	*2.914*	*-5.977*	
E_{t+5}	19.237	0.010	0.315	4.264	0.475	7.566	-0.043	0.598
t-stat	*8.889*	*11.373*	*5.108*	*1.330*	*21.465*	*2.961*	*-4.147*	

Panel B: The Summary of the Time-Series Averages of the Coefficients and Their Corresponding T-Statistics Obtained from the Annual "5-Year Sample" Pooled Cross-Sectional Earnings Regressions from 1967 to 2012.

LHS	Intercept	A_t	D_t	DD_t	E_t	$NegE_t$	AC_t	R^2
E_{t+1}	1.681	0.001	0.369	1.718	0.729	5.449	-0.049	0.854
t-stat	*3.447*	*7.640*	*11.493*	*5.389*	*49.895*	*10.483*	*-10.137*	
E_{t+2}	3.556	0.002	0.502	2.398	0.626	6.228	-0.065	0.794
t-stat	*4.313*	*7.353*	*11.481*	*5.056*	*36.650*	*11.575*	*-11.668*	
E_{t+3}	5.172	0.003	0.571	3.184	0.571	6.448	-0.075	0.759
t-stat	*4.578*	*6.642*	*9.626*	*5.256*	*29.598*	*10.984*	*-12.793*	
E_{t+4}	7.103	0.003	0.581	3.779	0.553	5.601	-0.080	0.731
t-stat	*4.802*	*5.913*	*9.424*	*5.470*	*29.275*	*9.571*	*-14.239*	
E_{t+5}	8.589	0.003	0.565	4.661	0.556	5.621	-0.089	0.709
t-stat	*4.691*	*4.545*	*7.908*	*6.524*	*18.303*	*9.581*	*-14.808*	

Panel B of *Table 4* reports the time-series averages of the coefficients from the annual pooled cross-sectional regressions and the corresponding t-statistic that test the hypothesis whether the average (i.e. mean) coefficients are different from zero. The output from *Panel B* is also reported in Hou et el. (2012) and we find that except for that of the *Intercept*, all coefficients have the same sign and the approximate absolute value. Three general trends can be seen as we regress on ex-post earnings that are farther into the future: i) the intercepts increase, ii) the absolute value of each coefficient increases, iii) average R-squared coefficients drop in value. Lastly, all t-statistics reject the null hypothesis, which means that the coefficients reported on *Panel B*[13] are significantly different from zero and have explanatory power.

4.2.3 Expected Future Earnings Forecasts

As mentioned in the previously, we take pooled cross-sectional regression coefficients for each year and calculate the *Expected Future Earnings* ($E[E_{t+1}]$ for *t+1*, $E[E_{t+2}]$ for *t+2*, $E[E_{t+2}]$ for *t+3*, $E[E_{t+4}]$ for *t+4* and $E[E_{t+5}]$ for *t+5*) by multiplying the said coefficients with the corresponding variables of each company *i* in each year *t* based on *Equation (16)*. To strengthen the argument that our model is robust and free of survivorship bias, we stress that the coefficients at *t* are obtained by regressing future ex-post *Earnings* on pooled samples of the previous five years. Again, these 5-year pooled samples do not necessarily include the same composition of companies. Hence, we allow observations to differ from sample to sample eradicating the survivorship bias our data. After multiplying the variables with the coefficients based on *Equation (16)*, we obtain *Expected Future Earnings* $E[E_{t+1}]$, $E[E_{t+2}]$, $E[E_{t+2}]$, $E[E_{t+4}]$ and $E[E_{t+5}]$ for each firm-year observation in our sample.

[13] We would like to highlight that all upcoming pooled OLS regressions are conducted in a similar way as those whose coefficients are stored in *Panels A* and *B* of *Table 4*: we run the pooled OLS regressions for each year using pooled samples of the previous five years and report the time-series average coefficients and t-statistics.

Panel A of *Table 5* aggregates the mean and median of *Expected Future Earnings* forecasts in 5-year intervals in the whole sample. The mean and median statistics are calculated as the time-series averages of the cross-sectional means and medians, respectively. The first column in *Panel A* shows the calculation period, the second shows the number of unique firm-year observations in the sample, and from the third column onwards, the means and medians of each *Expected Future Earnings* forecasts are stated. Neither the trend nor the evolution of the *Expected Future Earnings* are of great importance in this analysis yet it can be said that in absolute terms, firms tend to generate higher future earnings in the more recent periods.

Table 5. Expected Future Earnings Forecasts

Panel A: The Summary of the Means and Medians of the *Expected Future Earnings* Forecasts, Presented for 5-Year Intervals and for the Whole Sample in USDm.

Period	N	$E[E_{t+1}]$ mean	$E[E_{t+2}]$ mean	$E[E_{t+3}]$ mean	$E[E_{t+4}]$ mean	$E[E_{t+5}]$ mean
1967-1971	1,212	39.919	42.018	44.369	47.162	50.733
1972-1976	1,905	48.144	51.906	56.585	62.787	70.008
1977-1981	2,353	71.236	76.803	81.786	86.060	89.850
1982-1986	2,959	69.868	73.111	76.189	79.438	83.132
1987-1991	4,143	68.659	68.452	68.249	70.136	71.984
1992-1996	6,222	70.42	75.287	81.835	89.291	96.085
1997-2001	10,265	73.717	77.628	80.186	82.672	85.635
2002-2006	12,036	87.641	93.295	98.877	103.128	106.192
2007-2012[14]	15,289	99.478	102.188	105.835	110.094	113.464
1967-2012	56,384	70.541	74.035	77.726	81.825	85.845

Period	N	$E[E_{t+1}]$ median	$E[E_{t+2}]$ median	$E[E_{t+3}]$ median	$E[E_{t+4}]$ median	$E[E_{t+5}]$ median
1967-1971	1,212	12.976	14.631	16.371	18.384	21.109
1972-1976	1,905	14.161	16.744	19.601	23.575	29.016

[14] The last period includes not five but six years of observations.

1977-1981	2,353	21.070	25.219	29.053	32.173	34.423
1982-1986	2,959	16.717	18.746	21.121	23.129	25.572
1987-1991	4,143	13.406	14.334	14.736	17.319	18.866
1992-1996	6,222	18.134	23.134	28.534	35.180	41.747
1997-2001	10,265	20.775	25.906	30.544	34.670	38.605
2002-2006	12,036	27.681	34.074	39.842	44.928	48.749
2007-2012	15,289	31.651	37.547	41.446	46.272	49.737
1967-2012	56,384	19.881	23.679	27.124	30.966	34.540

Panel B: The Correlation Matrix of the Expected Future Earnings Forecasts.

	$E[E_{t+1}]$	$E[E_{t+2}]$	$E[E_{t+3}]$	$E[E_{t+4}]$	$E[E_{t+5}]$
$E[E_{t+1}]$	1.000				
$E[E_{t+2}]$	0.997	1.000			
$E[E_{t+3}]$	0.992	0.998	1.000		
$E[E_{t+4}]$	0.987	0.995	0.998	1.000	
$E[E_{t+5}]$	0.983	0.992	0.996	0.999	1.000

In *Panel B* of *Table 5*, to exemplify the relation between the *Expected Future Earnings* across the 46 years of our sample, we include the correlation matrix of the five measures. Similarly than in Hou et al. (2012), we find that the individual forecasted earnings are strongly and positively correlated amongst each other. The correlations tend to somewhat weaken as the time difference increases between each pair of measures. *Table 15* in the Appendix reports the ex-post future earnings for reference in a similar fashion to *Panel A* of *Table 5*.

4.3 Constructing the Implied Cost of Capital Measure

4.3.1 The Individual ICC Measures

In *Section 4.2.3*, the last step of the calculations was to obtain the *Expected Future Earnings* up to five years for each firm-year observation. With such variables, we then construct the individual expected return proxies that we will combine into, what we call, the composite Implied Cost of Capital (ICC) measure. Due to the fact that we pooled five years of observations to estimate the pooled OLS regressions coefficients, we lost the first five years of observation because the first year for which we can obtain *Expected Future Earnings* is 1967. By the time we constructed the *Expected Future Earnings* and the composite ICC measure, due to the pooled OLS regressions, the range of our sample decreased from 1962-2012 to 1967-2012. Also, the unique firm-year observations decreased from 57,215 to 56,384.

Academic literature broadly covers the topic of expected return proxies or said differently, individual implied cost of capital measures. Previously, *Table 1* summarized the individual ICC measures and their uses. For our analyses, we chose five expected return proxies that are utilized either or both in Hou et al. (2012) and in Botosan et al. (2011). The following five individual measures will comprise our model-based composite ICC measure.

The first is the R_{oj} measure developed in Ohlson and Juettner-Nauroth (2005) and the formula is as follows:

$$R_{oj} = A + \sqrt{A^2 + \frac{E_t[E_{t+1}]}{M_t}\big(g - (\gamma - 1)\big)} \quad ,where\ A = 0.5\left((\gamma - 1) + \frac{E_t[D_{t+1}]}{M_t}\right)\ and\ g = 0.5\left(\frac{E_t[E_{t+3}] - E_t[E_{t+2}]}{E_t[E_{t+2}]} + \frac{E_t[E_{t+5}] - E_t[E_{t+4}]}{E_t[E_{t+4}]}\right) \tag{17}$$

where $E_t[E_{t+k}]$ is the *Expected Future Earnings* at year *t* for year *t+k*, $E_t[D_{t+k}]$ is the expected future dividends at year *t* for year *t+k*, *g* is the short-term Ohlson and Juettner-Nauroth (2005) growth rate, M_t is the market value at year *t*, and γ is the perpetual growth rate beyond the forecast horizon, which is set equal to the risk-free rate minus 3% as in Ohlson and Juettner-Nauroth (2005).

The second expected return proxy is R_{gor}, obtained from the special case of the finite-horizon version of the Gordon Growth model based on Gordon and Gordon (1997). To calculate the measure, we need to solve for R_{gor} in the following equation:

$$M_t = \frac{E_t[E_{t+1}]}{R_{gor}} \tag{18}$$

The third measure is R_{peg}, the price-earnings growth ratio from Easton (2004) that captures the growth in earnings per share at a far-in-the-future date. The formula is as follows:

$$R_{peg} = \sqrt{\frac{(E_t[eps_{t+5}] - E_t[eps_{t+4}])}{P_0}} \tag{19}$$

where $E_t[eps_{t+k}]$ is the k-year ahead earnings per share and P_0 is the current stock price.

The fourth measure is R_{pegst}, the modified price-earnings short term growth based on Easton (2004) and the formula for expected return measure is:

$$R_{pegst} = \sqrt{\frac{(E_t[eps_{t+2}] - E_t[eps_{t+1}])}{P_0}} \tag{20}$$

where P_t is the current share price and $E_t[eps_{t+k}]$ is the k-year ahead earnings per share.

Lastly, the fifth measure is extracted from the modified economy-wide growth model from Gode and Mohanram (2003) and the formula of R_{gm} is:

$$R_{gm} = A + \sqrt{A^2 + \frac{E_t[eps_{t+1}]}{P_0}\left(\frac{E_t[eps_{t+2}] - E_t[eps_{t+1}]}{E_t[eps_{t+1}]} - (\gamma - 1)\right)} \;, \qquad where\ A = \frac{\left((\gamma - 1) + \frac{E_t[dps_{t+1}]}{P_t}\right)}{2} \tag{21}$$

where $E_t[dps_{t+5}]$ and $E_t[eps_{t+k}]$ are the k-year ahead dividend and earnings per share, respectively and γ is the perpetual growth rate beyond the forecast horizon, which is set equal to the risk-free rate minus 3%.

We then calculate the composite ICC measure as the equally-weighted arithmetic average of the five individual ICC measures just as in Hou et al. (2012). Hereafter, we refer to the composite ICC measure as the *ICC* measure (or simply, the ICC) and all the hypothesis tests and regressions will concern this measure, unless otherwise stated. *Table 6* summarizes the variables that were used to construct the individual ICC-s.

Table 6. Descriptive Statistics II

The Summary of Descriptive Statistics of the Variables Used to Create the Individual ICC measures and Ultimately, the Composite ICC measure.

Variables	Mean	5%	25%	Median	75%	95%	STD
M_t	3,588	36.958	405.089	1,472	5,423	14,045	4,495
γ [15]	0.046	0.046	0.046	0.046	0.046	0.046	0.000
g	0.149	-0.168	0.030	0.105	0.212	0.520	4.358
P_t	25.060	3.371	11.499	21.588	35.399	60.683	17.050
$E_t[eps_{t+1}]$	2.157	-0.061	0.948	1.829	2.847	5.326	2.724
$E_t[eps_{t+2}]$	2.528	0.052	1.131	2.068	3.213	6.335	3.075
$E_t[eps_{t+3}]$	2.887	0.101	1.272	2.274	3.579	7.535	3.575
$E_t[eps_{t+4}]$	3.281	0.126	1.438	2.506	3.993	8.881	4.089
$E_t[eps_{t+5}]$	3.684	0.061	1.599	2.749	4.435	10.316	4.629
$E_t[dps_{t+1}]$	0.835	-0.002	0.099	0.383	1.040	2.504	3.702
$E_t[dps_{t+2}]$	0.995	-0.004	0.111	0.426	1.133	2.981	5.274

[15] γ is the risk-free rate minus 3%, where the risk free rate is the annual yield on the five-year constant maturity US Treasury Bond taken at the end of each year *t*. In the sample, the risk-free rate is a cross-sectional constant so the mean, median and selected percentiles will all be the same for each year. Hence, the time-series averages of each statistic will also be the same.

$E_t[dps_{t+3}]$	1.134	-0.004	0.125	0.473	1.225	3.401	6.458
$E_t[dps_{t+4}]$	1.285	-0.005	0.140	0.519	1.327	3.870	7.556
$E_t[dps_{t+5}]$	1.430	-0.005	0.160	0.573	1.435	4.335	8.438
$E_t[D_{t+1}]$	26.602	-0.009	0.256	2.663	22.956	145.410	96.453
$E_t[D_{t+2}]$	28.854	-0.013	0.291	3.148	25.509	147.774	126.595
$E_t[D_{t+3}]$	30.621	-0.014	0.339	3.571	27.878	151.046	145.227
$E_t[D_{t+4}]$	32.517	-0.016	0.383	4.118	30.286	154.587	167.013
$E_t[D_{t+5}]$	34.303	-0.017	0.431	4.646	32.696	157.542	182.984

Table 6 reports all the variables that were used to create the individual ICC-s that are then combined into the composite ICC measure. We would again note that table reports time-series averages of cross sectional statistics. M_t is the total market capitalization (Compustat item *mkvalt*) of a firm at year t and is reported in USDm. γ is the perpetual growth rate beyond the forecast horizon and is calculated as the risk-free rate (CRSPA item *b5ret*) minus 3% based on the idea of Botosan et al. (2011). Our choice of risk-free rate is the annual yield on the five-year US Treasury Bond to match the five-year forecast period for *Expected Future Earnings*. g is the short-term growth rate based on Ohlson and Juettner-Nauroth (2005) and its calculation is indicated in the formula for R_{oj} above. P_t is the close price of the stock (Compustat item *prcc_c*) in USD, taken at the end of each calendar year *t*. $E[eps_{t+k}]$ is the k-year ahead expected earnings per share figures measures in USD. To construct $E[eps_{t+k}]$, we assumed that the common shares outstanding will stay the same in the five-year forecast horizon and applied the formula $E_t[E_{t+k}]/CSHO$, where $E_t[E_{t+k}]$ is the *Expected Future Earnings* for years *t+k* with *k* = (1,2,3,4,5) obtained from our pooled cross-sectional model and CSHO (Compustat item *csho)* is the common shares outstanding. $E_t[dps_{t+k}]$ is the k-year ahead expected dividends per share in USD calculated as $E_t[D_{t+k}]/CSHO$, where $E_t[D_{t+k}]$ is the *Expected Future Dividends* for years *t+k* with *k* = (1,2,3,4,5) in USDm. To obtain $E_t[D_{t+k}]$, we assumed that the current payout ratio stays the same for the forecast horizon or if earnings were negative, we approximated the future payout ratio according to Easton (2004) as $D_t/(0.06A_t)$, where D_t is current *Dividends* (Compustat item *dvc*) measured in USDm and A_t is *Total Assets* (Compustat item *at*) also measured in USDm.

4.3.2 Analyses of the ICC Measure and its Predictive Power

Table 7 summarizes the individual ICC proxies and the composite ICC measure. *Panel A* shows the times-series averages of the cross-sectional statistic at each year *t*. Based on the means of the five individual measure, R_{gor} produces the most conservative expected returns with an average of 4.9% while R_{pegst} gives the highest proxies with an average of 17.6%. Calculated as the simple arithmetic average of the individual expected returns measures, the ICC stands at a whole-sample average of 10.8%. *Panel B* reports the correlation among each measure and the ICC. In general, all correlation coefficients are positive and all individual measures positively (often even strongly) correlate with the ICC. One may expect that as we take the average of the five individual measures to construct our ICC, we would overweight the constituents that are higher in absolute value such as R_{pegst} or R_{peg}. However, the correlations coefficients point out that this is not the case because neither R_{pegst} nor R_{peg} correlate with ICC more than 55%. R_{oj} and R_{gm} share a strong and positive correlation of 89.9% and these two measures correlate with the ICC with the highest coefficients of 88.8% and 93.5%, respectively.

Table 7. The Individual Measures and the ICC

Panel A: Descriptive Statistics of the Individual Measures and the ICC.

Measures	Mean	5%	25%	Median	75%	95%	STD
R_{oj}	0.055	-0.010	0.015	0.031	0.063	0.190	0.167
R_{gor}	0.049	-0.016	0.014	0.029	0.058	0.190	0.091
R_{peg}	0.166	0.034	0.072	0.120	0.206	0.462	0.147
R_{pegst}	0.176	0.033	0.077	0.131	0.224	0.469	0.152
R_{gm}	0.133	0.000	0.054	0.088	0.145	0.392	0.310
ICC	0.108	0.022	0.048	0.073	0.124	0.310	0.146

Panel B: The Correlation Matrix of the Individual Measures and the ICC.

	R_{oj}	R_{gor}	R_{peg}	R_{pegst}	R_{gm}	ICC
R_{oj}	1.000					
R_{gor}	0.269	1.000				
R_{peg}	0.151	0.435	1.000			
R_{pegst}	0.173	0.507	0.821	1.000		
R_{gm}	0.899	0.242	0.270	0.300	1.000	
ICC	0.888	0.479	0.512	0.545	0.935	1.000

Panel C: The Summary of the Evolution of the ICC Measure in our Sample.

Period	N	Mean	25%	Median	75%
1967-1971	1,212	0.057	0.041	0.052	0.065
1972-1976	1,905	0.124	0.071	0.1	0.138
1977-1981	2,353	0.113	0.068	0.09	0.128
1982-1986	2,959	0.07	0.032	0.053	0.084
1987-1991	4,143	0.085	0.034	0.052	0.092
1992-1996	6,222	0.143	0.05	0.088	0.176
1997-2001	10,265	0.146	0.046	0.084	0.177
2002-2006	12,035	0.116	0.045	0.072	0.132
2007-2012[16]	15,289	0.117	0.045	0.069	0.129
1967-2012	56,384	0.108	0.048	0.073	0.124

Panel C of *Table 7* reports the evolution of our model-based ICC in five-year periods. Just as before, the figures are calculated as the time-series averages of the

[16] The last period, again, covers six rather than five years.

yearly cross-sectional statistics. Column N contains the unique firm-year observations in each period. *Panel C* shows a similar outcome than in Hou et al. (2012): the mean ICC fluctuates through each sub-period with peaks around the mid-seventies and mid/early-nineties. The last row in the panel contains the all-sample statistics and contains the same corresponding values as the last row in *Panel A*. Our all-sample ICC averages around 10.8% compared to 14.9%[17] found in Hou et al. (2012).

ICC is the internal rate that equates the present value of the expected future cash flows to the firm's market price. If it is truly a proxy for expected returns, we would expect a positive relation between current ICC and future realized return. To observe such effect, we draft *Table 8* as follows. We sort the model-generated ICC-s into deciles with the lowest ICC stocks allocated to the 1st decile and the highest ICC stocks allocated to the 10th decile. Then, we construct ten portfolios of stocks based on those deciles and calculate the "buy-and-hold" returns of said portfolios. Future realized buy-and-hold returns (R_{t+1}, R_{t+2}, R_{t+3}) are calculated for holding period *t+1*, *t+2* and *t+3* in the following fashion:

$$
R_{t+1} = \frac{P_{t+1}}{P_t} - 1, \qquad R_{t+2} = (1 + R_{t+1})\frac{P_{t+2}}{P_{t+1}} - 1, \\
R_{t+3} = (1 + R_{t+2})\frac{P_{t+3}}{P_{t+2}} - 1 \tag{22}
$$

where P_{t+k} with $k = (0,1,2,3)$ is the future realized price of a stock. Each t-statistic tests the hypothesis whether the time-series averages of the buy-and-hold returns are statistically different from zero.

[17] In Hou et al. (2012), the authors use different individual measures to construct their composite ICC however, their study serves as a benchmark to our analysis.

Table 8. Predictive Power of the ICC

The Summary of the Buy-and-Hold Returns[18] of the Decile Portfolios and Their Corresponding T-statistics.

Deciles	R_{t+1}	*t-stat*	R_{t+3}	*t-stat*	R_{t+3}	*t-stat*
1	0.000	*-0.005*	-0.038	*-1.695*	-0.045	*-2.682*
2	0.053	*1.100*	-0.002	*-0.092*	-0.012	*-0.976*
3	0.027	*1.072*	-0.007	*-0.440*	-0.008	*-0.789*
4	0.041	*1.575*	0.009	*0.563*	0.000	*-0.02*
5	0.063	*2.303*	0.023	*1.342*	0.012	*1.084*
6	0.094	*3.15*	0.037	*1.963*	0.026	*2.187*
7	0.115	*3.356*	0.047	*2.228*	0.032	*2.337*
8	0.160	*3.834*	0.076	*3.041*	0.054	*2.972*
9	0.274	*5.056*	0.138	*5.074*	0.100	*5.455*
10	0.243	*4.629*	0.15	*4.852*	0.113	*4.569*
All	0.105	*3.426*	0.045	*2.341*	0.03	*2.222*

Table 8 reports the future realized earnings of the ten decile portfolios. Concerning the one-year ahead returns, only the 2nd and the 9th decile portfolio produce a "higher-than-expected" realized return. Moreover, the 3rd decile generates a somewhat lower two-year return than we would anticipate. With regard to three-year returns, the decile portfolios produce an excellent prediction of future realized return. According to the returns' t-tests, however, the first five deciles do not generate returns that are significantly different from zero. From the 6th to the 10th percentile, the portfolio returns (in all three horizons) are positive and significantly different from zero. Except for the three exceptions mentioned before, the deciles portfolios generate higher returns as we move from the first portfolio to the last one. Hence,

[18] The sample ranges from 1967 to 2009 instead of 1967 to 2012. This is because we required P_{t+3} as an input in R_{t+3} to calculate portfolio returns and we dropped all observations for 2010, 2011 and 2012 in which we cannot calculate P_{t+3} and ultimately R_{t+3}.

we can say that our model-based ICC performs well at explaining future realized returns and that ICC can indeed be used as expected returns proxy.

4.4 Hypothesis Tests on the ICC Measure

In observing the predictive power of ICC based on *Table 8* in *Section 4.3.2*, we implicitly assumed that market participants are always right about future returns or said differently, expected returns always explain future realized returns. One must not forget that in this paper, we strive to explain the relationship between the ICC and expected returns. According to *Table 8*, ICC-s explain future realized returns (and not expected returns) at a portfolio level. Would this really mean that ICC is a good proxy for Expected Returns? Because of our implicit assumption that expected returns correctly forecast future returns, we may conclude that our model-based ICC does indeed a great job at explaining expected returns. However, even with the visible relationship between ICC and realized returns as shown in *Table 8* (or in *Figure 3* in the Appendix), the picture is not that simple. In the following subsections, we intend to test our three hypotheses first presented in *Section 3.5*. With the help of an Expected Return Model and a Realized Return Model based on Botosan et al. (2011), we empirically test *Hypothesis 1* and *Hypothesis 2*, respectively. Lastly, we introduce a Cash Flow Return Model inspired by Hughes et al. (2009) with which we see whether *Hypothesis 3* holds.

4.4.1 Expected Return Model

4.4.1.1 Description and Hypothesis

To examine the validity of our model-generated ICC measure, we first turn to our *Hypothesis 1*:

> *The explanatory power of the risk factors (risk-free rate, unlevered beta, leverage, book-to-market ratio, growth in future earnings) in relation to the ICC provides support for validity of implied cost of capital measure.*

We invoke the Expected Return Model from Botosan et al. (2011) to test *Hypothesis 1. Equation (23)* gives the regression model that we estimate for each year using a pooled OLS technique.

$$ICC_{i,t} = \alpha_0 + \beta_1 Rf_t + \beta_2 UBeta_{i,t} + \beta_3 Lev_{i.t} + \beta_4 LMV_{i,t} + \beta_5 LBM_{i,t} + \beta_6 gEPS_{i,t} + \epsilon_{i,t} \tag{23}$$

In *Equation (23),* Rf is the yield on the five-year constant maturity US Treasury bond (CRSPA item *b5ret*) which serves as the risk-free rate in our analysis. UBeta is the unlevered market beta calculated as b_mkt(1+D/E), where b_mkt is the levered market beta (Calculated using Compustat Beta Suite[19]), D is long-term liabilities (Compustat item *dltt*) and E is common equity (Compustat item *ceq*). Lev stands for leverage and is calculated as D/MV, where D is long-term liabilities (Compustat item *dltt*) and MV is the market capitalization (Compustat item *mkvalt*). LMV is the natural log of the market capitalization (Compustat item *mkvalt*). LBM is the natural log of book-to-market value, calculated as (BVPS x CSHO)/MV where BVPS is the book value per share (Compustat item *bkvlps*), CSHO is common shares outstanding (Compustat item *csho*) and MV is the market capitalization (Compustat item *mkvalt*). Even though we winsorized the dataset (detailed in *Section 4.2.1*), we include market capitalization and book-to-market variables as logs to take care of their inherent skewness. gEPS is the growth in forecasted earnings per share calculated as $E_t[eps_{t+5}]/\ E_t[eps_{t+4}]-1$. *Table 9* summarizes the descriptive statistics of the variables used in *Equation (23).*

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[19] With the help of Compustat Beta Suite, we obtained the monthly beta for each company in our sample. The betas were calculated as the CAPM regression of each stock's monthly return on the excess market portfolio. Ideally, we calculated the betas based on the past 60 monthly returns for each stock however, we set the lower bound at 24 monthly returns. We took only the latest value in each year for each company to represent its "annual" beta. We dropped all stocks from our sample that did not have at least 24 historical monthly returns.

Table 9. Descriptive Statistics III

Descriptive Statistics of the Variables Used in the Expected Return Model.

Variables	Mean	5%	25%	Median	75%	95%	STD
ICC	0.108	0.022	0.048	0.073	0.124	0.310	0.146
Rf	0.076	0.076	0.076	0.076	0.076	0.076	0.000
UBeta	0.812	0.110	0.421	0.706	1.088	1.910	0.576
Lev	0.242	0.000	0.005	0.074	0.218	0.877	0.867
LMV	6.909	3.479	5.626	7.062	8.410	9.549	1.841
LBM	-1.993	-4.101	-2.604	-1.880	-1.209	-0.241	1.291
gEPS	0.061	-0.302	0.032	0.102	0.194	0.553	3.096

4.4.1.2 Regression Analysis

To test *Hypothesis 1*, we introduced the Expected Return Model. The estimation method is similar than in *Section 4.2.2*: we apply *Equation ((23))* and estimate the pooled OLS coefficients in every year *t*, using an observation window of the previous five years. Then, we take the time-series averages of the pooled OLS coefficients and report their t-statistics for the test whether such average coefficients are statistically different from zero. The output of our calculations is presented in *Table 10* below.

Table 10. Expected Return Model

The Summary of the Average Coefficients and Their Corresponding T-statistics of the Expected Return Model.

LHS	Intercept	Rf	UBeta	Lev	LMV	LBM	gEPS	R^2
ICC	0.304	-0.030	-0.018	0.031	-0.034	-0.018	-0.039	0.211
t-stat	*9.8*	*-1.255*	*-14.731*	*5.9*	*-9.179*	*-7.058*	*-2.993*	

Table 10 reports a quite high and significant coefficient of 0.304 for the Intercept. Even though the risk factors explain, on average, 20% (from R-squared) of the

variation in the ICC, we suspect that some amount of variation is not captured by the Expected Return Model due to the high coefficient of the Intercept. The coefficient of the risk-free rate (Rf) is the only one that is insignificant out of all coefficients presented in the table. This finding may justify Monahan and Easton (2010) who suggest that because the risk-free rate is a cross-sectional constant, it captures no variation in risk in a general sense.

One would expect that higher unlevered beta results in higher expected return for a stock. Based on our empirical analysis, UBeta produces a negative and highly significant coefficient that based on the previous presumption, seems counterintuitive. However, Botosan et al. (2011) also document cases where the individual expected return proxies (such as R*oj* in our paper) have a significant and negative loading on unlevered beta.

From the positive and significant coefficient of leverage (Lev) we see that firms in our sample generated higher expected returns given their use of leverage. This result corresponds with our expectations and also with the findings of Botosan et al. (2011). The coefficients on the log variables, LMV and LBM, and that of gEPS are negative and statistically significant. We included these variables based on Botosan et al. (2011) to capture any source of risk that has not been accounted for by the risk-free rate, unlevered beta or leverage.

To sum up, *Hypothesis 1* stated that the existence of the correlation between the risk factors (Rf, UBeta, Lev, LMV, LBM and gEPS) and the ICC measure provides support for the validity of the ICC measure. With this in mind, we observed in *Table 10* that our model-generated ICC does indeed correlate (i.e the regression coefficients are significant) with all the risk-factors except for the risk-free rate. This is a similar finding[20] to that of Botosan et al. (2011) and we conclude we found evidence that justifies the use and validity of our model-generated ICC.

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[20] Botosan et al. (2012) concluded that only a few individual expected return proxies (among which was our R_{oj}) passed their hypothesis test. Our results are similar to only those cases for which the authors found a “valid” ICC proxy.

4.4.2 Realized Return Model

4.4.2.1 Description and Hypothesis

Hypothesis 2 in *Section 3.5* concerns the relationship between ICC and realized returns and reads as follows:

> *After controlling for the cash flow news and expected return news, implied cost of capital should equal realized returns.*

A similar hypothesis was also researched in Botosan et al. (2011) in which the authors test the relationship of different expected returns proxies and realized return. With the introduction of the so-called Realized Return Model, we decompose the future realized returns (R_{t+1}) according to *Equation (24)*.

$$R_{i,t+1} = \alpha_0 + \beta_1 ICC_{i,t} + \beta_2 CFN\_C_{i,t+1} + \beta_3 CFN\_TV_{i.t+1} + \beta_4 EWRN_{i,t+1} + \beta_5 FSRN_{i,t+1} + \epsilon_{i,t} \tag{24}$$

where *i* denotes each company in the sample and *t+k* with *k* = (0,1) specifies the timing of the variables. In *Equation (24),* ICC_t is our model-based implied cost of capital measure for year *t*. CNF_C_{t+1} and CFN_TV_{t+1} are the current and terminal value cash flow news respectively, both taken at one-year ahead of year *t*. $EWRN_{t+1}$ and $FSRN_{t+1}$ are the economy-wide and firm-specific expected return news respectively, both measured at one-year ahead of current year ICC_t. Timing is of great importance in *Equation (24)*, we ensured that both the cash flow and expected returns news influence the ex-post realized return one period after we have accounted for the ICC measure at time *t*.

Table 11 reports the time-series averages of the descriptive statistics of the variables used in the Realized Return Model. $R_{i,t+1}$ is the one-year buy-and-hold returns of each stock calculated as $P_{t+1}/P_t - 1$, where $P_{i,t+k}$ (Compustat item *prcc_c*) is the future realized stock price with *k* = (0,1). $ICC_{i,t}$ is our model-generated composite ICC measure. CFN_C_{t+1} is the one-year ahead "positive current cash flow news" constructed as $(E_{t+1}[eps_{t+1}]–Et[eps_{t+2}])/Pt$, where $E_{t+k}[eps_{t+k+1}]$ is the earnings per share for year *t+k+1* forecasted at year *t+k*, with $k = (0,1)$. The idea behind the CFN_C*t+1* variable is to capture the surprise in next period's earnings per share forecast. We would mention that both $E_t[eps_{t+2}]$ and $E_{t+1}[eps_{t+1}]$ refer to the same measure in time however, $E_t[eps_{t+2}]$ is computed one year before $E_{t+1}[eps_{t+1}]$. CFN_TV_{t+1} is the one-year ahead "positive terminal value news" calculated in a similar fashion to CFN_C_{t+1}: $(E_{t+1}[eps_{t+4}]–Et[eps_{t+5}])/Pt$. As presented in *Section 4.2.3*, we forecasted future earnings ($E_t[E_{t+k}]$) up to five period and hence obtained future earnings per share ($E_t[eps_{t+k}]$) up to five periods by assuming constant shares outstanding (Compustat item *csho*). In our case, "terminal value" refers to the last earnings per share forecast period i.e. $Et[eps_{t+5}]$. In sum, CFN_TV_{t+1} captures the surprise in earnings per share in the last forecast period. $EWRN_{t+1}$ is the economy-wide expected return news calculated as Rf_{t+1}-Rf_t, where Rf_{t+k} (CRSPA item *b5ret*, the yield on the five-year US Treasury Bond) is the risk-free rate for the year *t+k* with $k = (0,1)$. $FSRN_{t+1}$ is the firm-specific expected return news and is defined as b_mkt_{t+1} - b_mkt_t, where b_mkt_{t+k} is the levered market beta obtained from Compustat Beta Suite.

Table 11. Descriptive Statistics IV

The Summary of the Descriptive Statistics of the Variables Used in the Realized Return Model.

Variables	Mean	5%	25%	Median	75%	95%	STD
R_{t+1}	0.125[21]	-0.535	-0.177	0.016	0.270	0.982	0.692
ICC_t	0.115	0.025	0.049	0.080	0.138	0.325	0.140
CFN_C_{t+1}	-0.060	-0.332	-0.067	-0.013	0.015	0.097	0.260
CFN_TV_{t+1}	-0.025	-0.240	-0.043	-0.008	0.010	0.133	0.318
$EWRN_{t+1}$	0.000	-0.034	0.000	0.000	0.000	0.033	0.022
$FSRN_{t+1}$	-0.009	-0.455	-0.152	-0.009	0.133	0.436	0.310

[21] The reason why the mean R_{t+1} is different in *Table 8* and *Table* 11 is because we have a slightly smaller sample in *Table 8*. Please refer to *Footnote 18*.

4.4.2.2 Regression Analysis

Having established and described the variables in *Equation (24)* and *Table* 11, we now turn to testing *Hypothesis 2* to discuss the empirical link between the ICC and future realized returns. To explore such relationship, we run a pooled OLS regression shown based on *Equation (24)* for each year *t*, using variables of the previous five years. The output of our regressions takes a similar form than the regression output presented in Panel A of *Table 4*: we obtain six coefficients for each year between 1968 to 2012. Then, just as in Panel B of *Table 4,* we take the time-series averages of the pooled OLS coefficients and test whether such average coefficients are statistically significant from zero. *Table 12* reports the average coefficients of the Realized Return Model and the corresponding t-statistics.

Table 12. Realized Return Model

The Summary of Average Coefficients and Their Corresponding T-statistics of the Realized Return Model.

LHS	Intercept	ICC	CFN_C	CFN_TV	EWRN	FSRN	R^2
R_{t+1}	0.117	0.128	-0.018	0.006	0.050	-0.003	0.003
t-stat	*42.074*	*4.636*	*-1.083*	*0.825*	*1.161*	*-0.597*	

The coefficient of the Intercept is positive and seemingly high (compared to the mean of R_{t+1} of 0.125). It is paired with a very low R-squared figure of 0.3% which may point to the fact that the variation in future realized returns are, in general, not well explained by our variables. This "uncaptured" variation may be also the reason that the coefficient of the Intercept stands at such a high and statistically significant value.

In theory, the coefficient of ICC should be positive and equal to one. That is, after having accounted for the cash flow news and expected return news, ICC should explain a one-to-one variation in future realized returns. Based on our pooled OLS model, we see that future realized returns indeed increase in ICC however, the ICC coefficient stands at a significant level of only 0.128.

CFN_C and CFN_TV are the cash flow variables and capture near-term and longer-term surprises in the cash flows. One would logically expect that the future returns increase in positive future cash flows news so we expect the coefficients of CFN_C and CFN_TV to be positive. According to *Table* 12 however, the pooled OLS regressions produce mean coefficients of -0.018 and 0.006, respectively. The coefficients are very close to zero in absolute value and based on their t-statistic, one cannot reject the null hypothesis that these coefficients would be indeed different from zero. This finding contradicts previous studies such as Vuolteenaho (2002) and Botosan et al. (2011) where positive and significant coefficients of cash flow news are reported.

To continue, we turn to the expected return news variables EWRN and FSN. EWRN captures economy-wide expected return news and its coefficient has a positive yet statistically insignificant loading. FSN captures firm-specific expected returns news and our results point to a negative and also insignificant regression coefficient. In our case, the findings are only partially in line with Vuolteenaho (2002) in which the author concluded that firm-specific news (i.e. FSN in our case) is a poor proxy for expected returns news. We also found that macroeconomic news (i.e. EWRN with a positive and insignificant coefficient) is also not a great driver of expected returns news. The latter finding contradicts previous studies such as Vuolteenaho (2002) or Botosan et al. (2011) in which authors report a significant and negative coefficient for economy-wide expected return news.

In sum, we observe a positive and significant coefficient of 0.128 for the ICC after controlling for factors that capture cash flow news and expected return news. This finding in itself provides only weak evidence that ICC explains the variation in ex-post realized returns. However, from *Table 8*, we witnessed that our model-based ICC performs well at predicting future ex-post realized returns on a portfolio level. We suspect that the somewhat poor results of Realized Return Model are induced by our use of the model-generated forecasted earnings: the pooled OLS method based on *Equation ((*16*))* estimates coefficients for each year *t*, which essentially means that all companies in a given year *t* have the same coefficients with which we forecast future earnings. This way, for the individual firm, we may have less precise forecasted earnings[22] however, on a portfolio (or aggregate) level, the forecasted earnings perform well. As a reminder,

Table 15 in the Appendix reports the ex-post future earnings in a similar fashion to *Panel A* of *Table 5* that reports our model-generated future earnings. From these two tables, we see that on an aggregate level, there are but only slight differences between forecasted earnings and future realized earnings.

4.4.3 Cash Flow Return Model

Here, we empirically test the theoretical proposition by Hughes et al. (2009) that given the stochastic nature of expected returns they should systematically differ from implied cost of capital and that difference can be explained by a host of cash flow related risk characteristics. In other words, we check the robustness of the results from realized return model – can the significant relationship between implied cost of capital and expected return be a mere result of omitted variable bias – by including the identified firm risk characteristics. Having been inspired by Hughes et al. (2009), we developed our *Hypothesis 3* in *Section 3.5* and it stated:

> *The difference between implied cost of capital and expected return is explained by beta volatility, cash flow volatility, the correlation between expected returns and cash flows, and growth in cash flows.*

Up until this point, we used ICC as a proxy for expected return however, we now endeavour to explain the difference between the two measures, if there is any. To be able to test our hypothesis above, we use the Realized Return Decomposition from *Equation (24)* based on Vuolteenaho .

[22] Less precise than, for instance, analysts' forecasts.

4.4.3.1 Description and Hypothesis

We now introduce a new model that we call the Cash Flow Return Model with which we test *Hypothesis 3*. The equation reads as follows:

$$\begin{aligned} ICC_{i,t} = \alpha_0 + \beta_1 Vol_{\beta_{i,t}} + \beta_2 Vol_{CF_{i,t}} + \beta_3 Cor\_E[R]\_CF_{i,t} + \beta_4 g_{CF_{i,t}} + E[R\ ] \\ + \epsilon_{i,t}\ where \\ E[R] = \beta_5 R_{i,t+1} - \beta_6 CFN_{C_{i,t}} - \beta_7 CFN_{TV_{i.t}} - \beta_8 EWRN_{i,t} - \beta_9 FSRN_{i,t} \end{aligned} \tag{25}$$

where i stands for each firm i and t indicates the timing of the variables.

The volatility of market betas (*Vol_β*) is calculated as the standard deviation of annual firm betas (computed with Compustat Beta Suite) for each firm *i*. The volatility of cash flows (*Vol_CF*) is calculated as the standard deviation of the annual cash flows (Compustat item *oancf*) of each firm *i*. Cor_E[R]_CF is the correlation between expected return and cash flows, where we substituted ex-post realized returns in the place of expected returns. The last item on the right-hand side of the equation is expected returns, E[R]. Following the logic and assumption made in *Section 2.2.1.1,* we substituted expected returns with ex-post realized returns adjusted by cash flow and expected return news. We utilized the components of the Realized Return Model in *Equation (24),* rearranged and plugged into the place of expected returns in *Equation (25). Table 13* summarizes the new variables introduced in *Equation (25).*

Table 13. Descriptive Statistics V

Descriptive Statistics of the Variables Used in the Cash Flow Return Model.[23]

Variables	Mean	5%	25%	Median	75%	95%	STD
Vol_β	0.454	0.196	0.304	0.405	0.555	0.865	0.221

[23] Only those variables are included that have not been shown in any of the descriptive statistics tables before.

Vol_CF	102.871	2.583	15.972	55.461	150.881	362.602	117.934
Cor_E[R]_CF	-0.003	-0.385	-0.140	-0.014	0.140	0.386	0.233
g_CF	-0.001	-1.056	-0.203	-0.011	0.195	1.064	0.496

4.4.3.2 Regression Analysis

Similarly than in the case of the Realized Return Model in *Section 4.4.2*, we run a pooled OLS regression for each year *t*, using variables from the previous five years. The output of this regression is, again, similar to that of *Panel A* of *Table 4*. Then, we take the time-series averages of the pooled OLS coefficients and summarize the results in *Table 14*. We also indicate the t-statistics to determine whether each average coefficient is significantly different from zero.

Table 14. Cash Flow Return Model

The Summary of Average Coefficients and Their Corresponding T-statistics of the Cash Flow Return Model.

LHS	Intercept	Vol_β	Vol_CF	Cor_E[R]_CF	g_CF	R^2
ICC	0.1004	0.0142	-0.0002	0.0033	-0.0025	0.302
t-stat	*31.639*	*6.983*	*-8.817*	*2.992*	*-1.526*	
	R_{t+1}	CFN_C	CFN_TV	EWER_N	FSER_N	
ICC	0.0004	-0.2910	-0.0323	-0.0076	-0.0001	
t-stat	*1.561*	*-17.91*	*-8.674*	*-0.513*	*-0.041*	

Table 14 reports the time-series average coefficients from the pooled OLS regression described in *Equation* (25). The Intercept, again, stands at a very high and significant level of 0.1. However, compared to that of the Realized Return Model, the mean R-squared of the Cash Flow Return Model regressions is substantially higher (30% compared to 0.2%).

The statistically significant and positive coefficient of *Vol_β* serves as evidence that there may be differences between ICC and expected returns, given high volatility in market betas. Also, the negative coefficient on Vol_CF is significant, which may point out the difference between ICC and expected returns if cash flows of a company are more volatile. The significant factor loading on Cor_E[R]_CF tells that correlation between expected return and cash flows also widens the gap between ICC and expected returns. The only coefficient inspired by Hughes et al. (2009) that is not significant is on g_CF, the growth rate in cash flows. From our empirical analysis, this is the only variable that does not contribute to widening said gap.

In theory, the factor loading on the ex-post realized returns (R_{t+1}) should be equal to one. From *Table 14*, we can see that the coefficient is neither close to one nor statistically significant.

The two cash flow news variables (CFN_C, CFN_TV), unlike in the Realized Return Model, show significant and negative coefficients while the expected returns news variables (EWER_N, FSER_N) are still insignificant. We included these variables due to the substitution based on the rearrangement of the Realized Return Model (see *Equation (24))* however, their main job was to pick up variation in the ICC that may be unexplained by the other factors.

To sum up, given our assumption in *Section 2.2.1.1* in testing our *Hypothesis 3*, we can conclude that the Cash Flow Return Model coefficients provide empirical evidence for the existence of the difference between our model-based ICC and expected returns. This difference is mainly explained by market beta volatility, cash flow volatility and the correlation of expected returns and cash flows.

5 Findings

In *Section 4*, we conducted our empirical analysis which was mainly focused on testing the three hypothesis established in *Section 3.5*. By doing so, we noted a few important deductions from our calculations and analyses which we would like to highlight.

First, we introduced the Expected Returns Model based on Botosan et al. (2011) to test *Hypothesis 1*. The Model helped us understand which risk factors contribute to the variation of ICC measure. *Hypothesis 1* stated that significant correlation of the risk factors with the ICC validates the use of such ICC measure. We found that all risk-factors (unlevered beta, leverage, book-to-market ratio, growth in future earnings) except the risk-free rate correlated with the ICC. Therefore, we justified the use and validity of our model-generated ICC in the upcoming analyses.

Second, we turned to the relationship between the ICC and realized returns. In *Table 8*, we already asserted the explanatory power of the ICC in relation to ex-post realized returns on a portfolio level. In *Table 8*, we sorted all the stocks into deciles portfolios based on their ICC: stocks with the lowest ICC were included in the 1st portfolio while stocks with the highest ICC were allocated to the 10th portfolio. Based on our calculations, we found that the higher ranking portfolios (i.e. higher ICC), produced higher ex-post buy-and-hold returns on one, two and three-year horizons. To further examine the ICC's explanatory power in relation to realized returns, we introduced the Realized Return Model in *Section 4.4.2* to test *Hypothesis 2*, which stated that after controlling for cash flow and expected return news, ICC should equal realized return. The pooled OLS regression produced a positive and significant coefficient for the ICC however, the R-squared figure was very low. We concluded that even having controlled for cash flow and expected return news, the Model provides only weak evidence in support of *Hypothesis 2*.

Third, having been inspired by Hughes et al. (2009), we introduced *Hypothesis 3* and we defined the Cash Flow Return Model to test it. We endeavoured to explain the difference between ICC and expected returns, if there is any. For the empirical test, we imposed an assumption that realized returns adjusted by information surprise factors can be used as a proxy for expected returns (described in *Section 2.2.1.1*). After running the pooled OLS regression based on the Cash Flow Return Model, we observed significant loadings on beta volatility, cash flow volatility, and correlation between expected returns and cash flows. Due to these significant loadings, we concluded that, given the assumption on realized return decomposition, our model-based ICC differs from the hypothetical expected return measure.

6 Conclusions

In this thesis, we investigate the relationship between the implied cost of capital and expected return. We computed five different implied cost of capital (ICC) measures based on earnings forecasts from a cross-sectional earnings model. Then, we introduced the composite ICC measure, which was in the very focus of our empirical work. Expected return is a key element for a vast array of research in economics, finance and asset pricing as well as multiple practical applications. Yet, it is extremely difficult to measure expected returns and the reliability of current firm-level proxies for expected return suggested by the classical asset pricing models or historical realized returns is highly debated. We use an alternative expected return proxy – implied cost of capital – which looks at the expected return from firm's perspective rather than capital market's perspective. Implied cost of capital is the rate of return that equates the present value of firm's future cash flows to its current stock price. Thus, implied cost of capital derives expected return estimates using cash flow forecasts and current stock price instead of relying on any particular asset pricing model or noisy realized returns.

In the empirical part of our thesis, we created a sample of 56,384 unique firm-year observations and corresponding variables for the period of 1967-2012 taken from WRDS' Compustat annual fundamental files. We introduced a pooled cross-sectional earnings model inspired by Hou et al. (2012) and we asserted that our results are robust to the variable specification. With this model, we forecasted earnings up to five years into the future for each firm in our sample. Having obtained said forecasted earnings, we introduced five individual ICC measures with which we calculated our model-generated composite ICC, defined as the arithmetic average of the five individual measures. Then, in well-defined steps, we tested *Hypothesis 1* to *3* by applying the Expected Return Model from Botosan et al. (2011), the Realized Return Model based on Botosan et al. (2011) and Cash Flow Return Model inspired by Hughes et al. (2009), respectively. These models are estimated for each year in the sample by a pooled OLS technique using a pooled sample of the previous five years. We then took the time-series averages of the pooled OLS coefficients and reported their t-statistic to test whether such mean coefficients have explanatory power. The regression inferences are drawn from such aggregated tables and the finding are detailed below.

First, we invoked the Expected Return Model from Botosan et al. (2011) to justify the use and the validity of our ICC measure. We found that because the regressions produced highly significant coefficients on risk factors such as unlevered beta, leverage, book-to-market ratio and growth in future earnings, the use and validity of our model-based ICC was justified in the upcoming analysis.

Second, we used our ICC measure to evaluate the relationship between implied cost of capital and ex-post realized returns. We did so by applying the Realized Return Model from Botosan et al. (2011) based on which we regressed the ex-post realized returns on the ICC and on information surprise factors (i.e. cash flow news and expected return news) as Vuolteenaho (2002) suggested. The results showed a positive and significant coefficient for the ICC however, the R-squared figure was very low. We concluded that the Realized Return Model only gives a weak evidence that our model-based ICC predicts future realized returns. In spite of the seemingly weak evidence, we asserted that ICC indeed has predictive power in relation to future realized returns on a portfolio level. We suspect that the somewhat poor evidence from the Realized Return Model was a by-product of our use of model-generated forecasted earnings. That is because the pooled cross-sectional model created the same sets of coefficients for all the firms in a given year and we forecasted the earnings for each firm based on these coefficients. As a result, earnings may not be that precise for individual firms however, they perform well on an aggregate level.

Third, we introduced our Cash Flow Return Model inspired by Hughes et al. (2009). Having imposed an assumption that ex-post returns adjusted for information surprises can be a proxy for expected returns, we investigated the possible difference between ICC and expected returns. For the empirical test, we created new variables such as beta volatility, cash flow volatility, correlation between expected return and cash flows, and growth in cash flows based on the ideas of Hughes et al. (2009). Also, we utilized the Realized Return Model, rearranged and plugged it into the Cash Flow Return Model to obtain the regression equation. We estimated the model by, again, a pooled OLS technique which produced significant average loadings for beta volatility, cash flow volatility, and correlation between expected returns and cash flows. Due to these significant loadings, we concluded that, given our assumption, our model-based ICC differs from the hypothetical expected return measure. This difference is mainly explained by market beta volatility, cash flow volatility and the correlation of expected returns and cash flows.

Our empirical work was limited by data availability. We believe if we had obtained analysts' earnings forecasts from the IBES database, we would have been able to give the reader a more thorough insight into the quality of our model-generated forecasted earnings and explore why the Realized Return Model produced the somewhat weak evidence in support of the realized returns' explanatory power in relation to ICC. Ultimately, we would have been able to compare our model-generated ICC measure with the analyst-based ICC, similarly than in Hou et al. (2012), and draw inferences regarding the predictive power of the two.

There are multiple possible extensions to our analysis in this thesis as well as many topics for future work in the area of implied cost of capital. In an attempt to explain the differing empirical results in implied cost of capital studies, a comparison between the different modelling approaches could be made, e.g. investigating if implied cost of capital measures based on dividend discount model or abnormal earnings growth model provide more reliable expected return estimates. Also, one may investigate the model-based individual ICC-s (instead of the composite ICC measure) using the three return models presented in this paper. Furthermore, additional research might be useful in evaluating how reasonable the assumptions on long-term earnings growth rate are and if it has significant effect on implied cost of capital estimates. Lastly, as many existing studies focus on the cross-sectional validation of implied cost of capital estimates, a closer look at the time-series variation of these estimates could be a promising endeavour.

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Appendices

Appendix A. Additional Figures and Tables

Table 15. Ex-Post Future Earnings

Panel A: The Summary of the Means and Medians of the *Ex-Post Earnings*, Presented for 5-Year Intervals and for the Whole Sample in USDm.

Period	N	E_{t+1} mean	E_{t+2} mean	E_{t+3} mean	E_{t+4} mean	E_{t+5} mean
1967-1971	1,212	40.41	44.059	48.638	53.785	60.915
1972-1976	1,905	50.961	56.871	64.563	72.624	79.744
1977-1981	2,353	68.918	72.488	75.724	78.226	79.123
1982-1986	2,959	71.279	76.063	79.459	83.173	85.35
1987-1991	4,143	71.075	72.589	76.013	82.153	91.302
1992-1996	6,222	75.79	82.423	88.131	93.296	93.719
1997-2001	10,265	68.695	71.379	75.947	81.206	90.911
2002-2006	12,036	93.626	94.972	93.074	94.845	95.845
2007-2012	15,289	98.524	106.013	111.617	113.528	116.011
1967-2012	56,384	71.629	75.876	79.945	84.298	88.709

Period	N	E_{t+1} median	E_{t+2} median	E_{t+3} median	E_{t+4} median	E_{t+5} median
1967-1971	1,212	12.755	14.241	16.225	18.335	21.877
1972-1976	1,905	14.724	16.589	19.103	23.097	26.08
1977-1981	2,353	17.807	19.788	21.305	22.006	21.777
1982-1986	2,959	15.453	16.946	17.713	18.507	19.465
1987-1991	4,143	13.372	13.828	15.015	17.384	20.78
1992-1996	6,222	16.41	18.855	21.049	22.935	23.364
1997-2001	10,265	13.179	13.655	15.382	17.528	21.651
2002-2006	12,036	23.11	22.524	20.113	20.349	20.257
2007-2012	15,289	23.384	27.484	30.441	31.503	32.889
1967-2012	56,384	16.834	18.414	19.83	21.516	23.339

Table 15 reports the ex-post future earnings for reference in a similar fashion to *Panels A* of *Table 5*. Comparing *Table 15* with *Table 5,* we can assert that our forecasted future earnings perform well on an aggregate level.

Figure 3. Realized Buy-and-Hold Returns of the Decile Portfolios

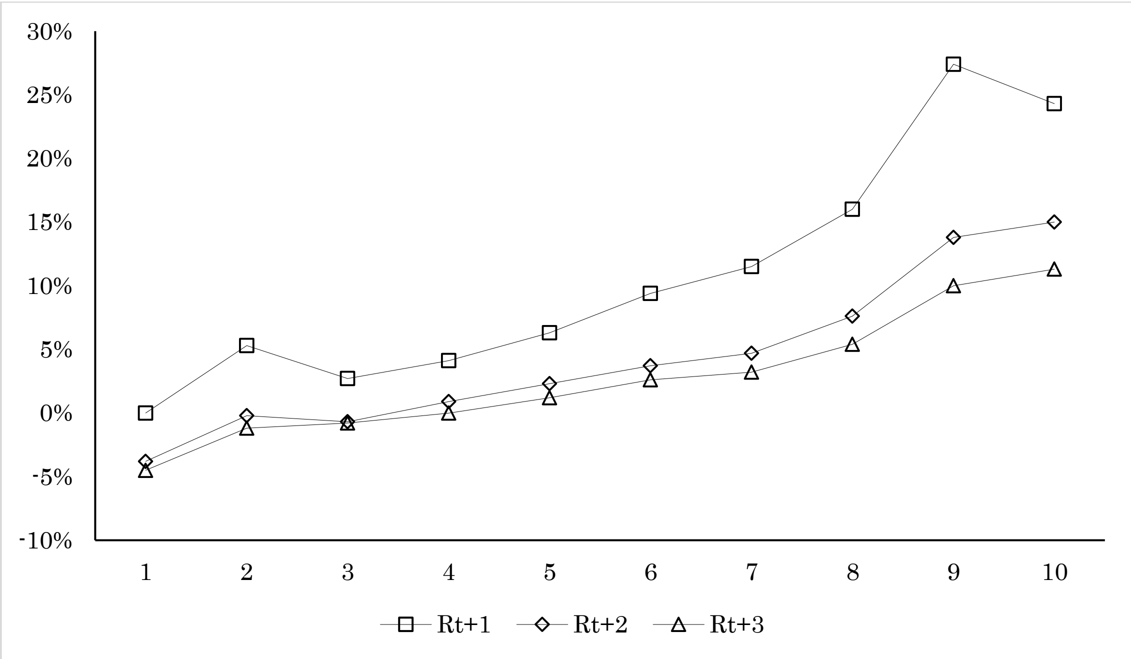

Figure 3 plots the one, two and three-year realized buy-and-hold returns (vertical axis) of the decile portfolios (horizontal axis). The source of the graph is the content of *Table 8* that examines the predictive power of the ICC. We concluded that ICC is a good proxy for expected returns and hence we would expect that increasing ICC of the decile portfolios results in an increasing trend in the portfolio returns. In essence, we expected the individual lines on the chart to have a positive slope.