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**Systematic Risk and the Implied Cost of Equity:
Evidence from Eurozone Firms**

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ABSTRACT:

This thesis analyses the relationship between systematic risk and the implied cost of equity using a sample of publicly listed Eurozone firms over the period of 2010-2024. Prior empirical research has studied the relationship between risk and expected returns, especially with traditional models such as the CAPM. However, the strength of the correlation between beta, a measure of systematic risk, and expected returns has been challenged regarding realized returns. To address the issue, this study uses the Eston (2004) model for estimating the implied cost of equity. The implied cost of equity is a forward-looking proxy for expected returns and avoids the mechanical link between beta and cost of equity estimates that are based on traditional models such as the CAPM.

The study employs pooled OLS and fixed effects regressions using firm-level panel data. As the baseline models depend on betas provided by DataStream, the robustness of the results is checked by estimating firm-level betas using a rolling 60-month regression of monthly returns against the STOXX Europe Total Return Index.

The findings demonstrate a positive and statistically significant relationship between beta and the implied cost of equity across all models, which indicates that a higher systematic risk is associated with a higher cost of equity. Firm size and leverage show significant effects, whereas profitability and liquidity have less influence. On the whole, the results of the study are consistent with the theoretical predictions that suggest systematic risk plays a key role in determining the cost of equity by providing empirical evidence from the Eurozone with the use of a forward-looking measure of expected returns.

KEYWORDS: Systematic risk, Beta, the Implied cost of equity, the Cost of Capital, CAPM, Asset pricing, Eurozone

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TIIVISTELMÄ:

Tämän tutkielman päätavoitteena on tarkastella systemaattisen riskin, betalla mitattuna, ja implisiittisen oman pääoman kustannuksen välistä suhdetta käyttämällä otoksena euroalueen julkisesti noteerattuja yrityksiä ajanjaksolla 2010–2024. Rahoitusteorian mukaan riskin ja tuottojen välillä on positiivinen yhteys. Aiempi empiirinen tutkimus on kuitenkin kyseenalaistanut kyseisen yhteyden todellista voimakkuutta, erityisesti toteutuneisiin tuottoihin perustuvissa analyyseissä. Tämän ongelman ratkaisemiseksi tässä tutkimuksessa käytetään implisiittistä oman pääoman kustannusta käyttäen Eastonin (2004) mallia. Kyseinen malli on tulevaisuuteen suuntautuva odotettujen tuottojen mittari, joka myös auttaa mekaanisen yhteyden kumoamista betan ja oman pääoman kustannuksen välillä tilanteissa, joissa kustannusarviot perustuvat perinteisiin rahoitusmalleihin, kuten CAPM:iin.

Empiirisessä analyysissä hyödynnetään yritystason paneeliaineistoa ja sovelletaan pooled OLS-sekä kiinteiden vaikutusten malleja. Perusmallien lisäksi tulosten luotettavuutta tarkastellaan toteuttamalla robustiustestejä estimoimalla vaihtoehtoiset betat liukuvan 60 kuukauden regressiolla, jossa verrataan yritysten tuottoja STOXX Europe 600 Total Return -indeksiin.

Tutkielman tulokset viittaavat siihen, että betan ja implisiittisen oman pääoman kustannuksen välillä on positiivinen ja tilastollisesti merkitsevä yhteys. Tämä tarkoittaa sitä, yrityksen systemaattisen riskin kasvaessa kasvaa myös yrityksen implisiittinen oman pääoman kustannus. Tulokset osoittavat lisäksi, että yrityksen koko ja velkaantuneisuus ovat tilastollisesti merkitseviä tekijöitä, kun taas kannattavuuden ja maksuvalmiuden vaikutukset ovat huomattavasti pienempiä. Kokonaisuudessaan tulokset tukevat rahoitusteorian ennusteita ja osoittavat, että systemaattisella riskillä on tärkeä rooli oman pääoman kustannuksen määräytymisessä.

KEYWORDS: systemaattinen riski, beta, implisiittinen oman pääoman kustannus, pääoman kustannus, CAPM, varojen hinnoittelu, euroalue

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1 Introduction

The cost of capital is an essential concept in corporate finance as it serves as the basis for capital structure, investment decisions, valuation processes, and financial performance assessment. The cost of capital can be divided into the cost of equity and the cost of debt, and together they determine a firm's overall cost of capital (Gunawan, 2025, p. 136). From an investor perspective, the cost of capital determines the expected return required to bear risk, whereas from a firm perspective, it reflects the minimum return needed to preserve firm value (Pitera & Gnap, 2021, p. 140).

The relationship between risk and expected returns is a central principle in finance. Modern Portfolio Theory (MPT), proposed by Markowitz (1952, pp. 77-78), explains that investment decisions are influenced by expected returns and risk factors. Moreover, asset diversification is significant to achieve optimal expected returns for a specific level of risk. Following this framework, the Capital Asset Pricing Model (CAPM) creates a relationship between market risk and expected returns (Fama & French, 2004, p. 25). Market risk, also referred to as systematic risk, affects all assets and cannot be avoided through asset diversification (Eldomiaty et al., 2011, p. 290). Systematic risk is typically measured by beta, and it evaluates the sensitivity of an asset's returns to market movements (Eldomiaty et al., 2011, p. 290).

Despite theoretical foundations, empirical evidence has questioned CAPM's ability to explain expected returns. Fama and French (2004, p. 25) indicate that the CAPM's empirical evidence has been weak in proving that beta alone is enough to capture cross-sectional variations within expected returns. Similarly, Black et al. (1972, pp. 4-6) note that empirical tests have shown that the relationship of beta and expected returns is weaker than the CAPM predicts. They point out that high-beta assets do not automatically generate higher returns. These findings indicate that traditional approaches may not be effective when measuring expected returns.

The limitations need to be considered when estimating the cost of equity. Hou et al. (2012, p. 505) explain that traditional approaches use realized returns or asset pricing models like the CAPM to estimate the cost of equity. However, they highlight that the use of realized returns is an insufficient measure of expected returns and may not reflect the return required by investors. As an alternative, an implied cost of equity measure, which is forward-looking, has been developed (Hou et al., 2012, p. 505). The implied cost of equity (ICOE) is the discount rate, or the internal rate of return, that equates current asset prices to the present value of expected future cash flows (Pastor & Swaminathan, 2008, p. 2860). This approach does not rely on historical return data or any specific asset pricing model.

An additional advantage of using the implied cost of equity is that it helps avoid a mechanical relationship between beta and the cost of capital. When the CAPM is used to estimate the cost of equity or the weighted average cost of capital (WACC), beta is directly incorporated into the calculation of the dependent variable. This may lead to biased results when analyzing the relationship between beta and the cost of capital. Since the implied cost of equity does not incorporate beta, a clearer empirical analysis is possible.

This study aims to examine the relationship between systematic risk, using beta as a measure, and the implied cost of equity for firms in the Eurozone during the period 2010-2024. By focusing on a forward-looking measure of expected return, this study offers a stronger empirical test of whether systematic risk is reflected in firms' cost of capital. In addition, this study contributes to the literature by providing evidence from the Eurozone, which, compared to the United States, has received less attention. Moreover, the use of the implied cost of equity provides an alternative solution for the methodological issue regarding the mechanical relationship between beta and cost of equity measures. Accurately measuring systematic risk and the cost of equity is extremely important, as they influence a firm's financing, investment, and other important decisions (Phuouc & Pham, 2020, p. 1).

1.1 Purpose of the study

The purpose of this study is to analyze how systematic risk is reflected in firms' implied cost of equity in the Eurozone over the period of 2010-2024. In addition, firm-specific characteristics are applied to examine their individual effects on the variation in the implied cost of equity. The study aims to explore how strong the impact of systematic risk is in explain the cost of equity.

Asset-pricing theory suggests a positive relationship between systematic risk and expected return, a relationship that has been questioned empirically (Fama & French, 2004, p. 25). To address the issue, this thesis uses the implied cost of equity as a proxy for the expected return. The benefit of the implied cost of equity, unlike other traditional approaches based on historical stock return data, is that it is based on asset prices and expected future cash flows and thus provides a direct measure of expected return. This allows for a cleaner and more reliable evaluation of whether systematic risk is reflected in firms' cost of equity.

1.2 Research Questions

The main research question of this study is:

RQ1: Does systematic risk, as measured by beta, impact the implied cost of equity capital for Eurozone firms?

In addition, to explore this relationship on a deeper level, the study aims to answer the following sub-questions:

RQ2: Is the relationship between beta and the implied cost of equity robust to alternative beta estimation approaches?

RQ3: Do firm-specific characteristics such as size, leverage, profitability, and liquidity influence the implied cost of equity?

1.3 Hypotheses

The hypotheses for this study are grounded on the basis of asset pricing theory, which establishes a direct relationship between expected return and risk. The CAPM predicts that investors demand compensation for the systematic risk they must take, since it cannot be diversified away (Fama & French, 2004, pp. 25-26). According to the CAPM, the relationship between systematic risk and expected risk is linear and positive, which leads to the assumption that higher exposure to market risk is translated into higher expected returns (Sharpe, 1964, pp. 425-426).

However, empirical evidence indicates that the relationship between systematic risk, captured by beta, and expected return is not always as strong as the CAPM predicts. Black et al. (1972, pp. 4.6) indicate that based on empirical results, the relationship between risk and expected return is flatter than theoretically predicted, and that beta alone may not be sufficient to explain variation in expected returns.

Mixed findings make it important to dive deeper into examining the effect of systematic risk in forward-looking measures of expected returns, such as the implied cost of equity. Additionally, the implied cost of equity is an estimate based on the market's expected returns, not historical data, which allows it to eliminate the mechanical link to beta.

Taking the theoretical and empirical results into consideration, the following hypotheses are formulated:

The first hypothesis is based on the asset pricing theory, which says that higher systematic risk leads to a higher expected return requirement by investors.

H1: Systematic risk, measured by beta, has a positive relationship with the implied cost of equity.

The second hypothesis minimizes the measurement error risk and ensures that the results remain reliable even if another model is used for beta estimation.

H2: The positive relationship between systematic risk and the implied cost of equity stays robust even when estimated with alternative beta estimation models.

The third hypothesis follows multifactor asset pricing models, which predict that, in addition to systematic risk, firm characteristics also affect expected returns (Fama & French, 2015, pp. 1-2).

H3: Firm-specific factors such as size, leverage, profitability, and liquidity significantly impact the implied cost of equity.

1.4 Structure of the study

This thesis is structured into seven chapters. Chapter 1 introduces the topic, purpose of the study, the main research question, the hypotheses, and the structure of the study. Chapter 2 presents the theoretical background on the cost of capital. It defines the cost of capital, reflects its components, and shows estimation methods for it, especially focusing on the implied cost of equity. Chapter 3 continues with introducing the concept of systematic risk and presents its measure through beta. In addition, the empirical evidence of the relationship between risk and expected returns is discussed. Chapter 4 outlines the data and methodology used in the empirical analysis, as well as variable selection and regression models. Chapter 5 illustrates the empirical results and robustness analyses. Chapter 6 analyzes the findings, relates them to the existing literature, and highlights their implications. Chapter 7 concludes thesis's key findings and discusses potetial future research directions.

2 The Cost of Capital

This chapter introduces the main concepts of the cost of capital. The cost of capital is important in corporate finance as it shows the return that is required by investors for managing risk and is reflected in how firms make their investment and financing decisions. Gunawan (2025, p. 135) defines the cost of capital as the minimum return earned by a firm on its investments to satisfy equity and debt investors and maintain or increase a firm's value.

2.1 Definition of Cost of Capital

Modigliani and Miller (1958, p. 261) describe the cost of capital as a fundamental issue for corporate finance specialists, managerial economists, and economic theorists since firms must fund their assets with uncertain returns using a variety of sources, including debt and equity. Earlier, it was assumed that assets generate a certain amount of returns, and therefore the cost of capital was treated as equal to the market interest rate, and firms must invest until the return on assets equals this rate (Modigliani & Miller, 1958, p. 262). Modigliani and Miller (1958, p. 263-264) argue that this framework is not realistic because firms face uncertainty, and investment decisions should be made based on increasing the market value of the firm.

Another key aspect of the cost of capital is that it reflects the actual cost to firms when they use financing sources. These costs can include payments such as dividends paid to shareholders and interest paid to lenders, as well as other financing costs associated with obtaining capital (Yuliah et al., 2023, p. 342). The cost of capital is also defined as the cost of lost profits or as the opportunity cost of capital, which represents the return that is lost when capital is invested in a particular project rather than another (Pitera & Gnap, 2021, p. 140).

Pitera and Gnap (2021, p. 140) explain the investor perspective, which holds that the cost of capital is the expected rate of return required for investing in a firm. Pitera and

Gnap (2021, p. 141) divide it into three elements. First, the actual rate of return, which is the amount an investor receives for investing. Second, expected inflation, describes the expected decline in the value of money and the loss in purchasing power. And thirdly, risk, referring to the uncertainty of a return from an investment (Pitera & Gnap, 2021, p. 141). Therefore, the cost of capital is an important benchmark for assessing corporate performance and investment decisions.

Financial theory highlights the link between risk and expected return in determining the required rate of return. Fama and Miller (1972, pp. 276-278) state that investors require higher expected returns when they take on higher levels of risk. As a result, investments with higher uncertainty must offer higher returns to attract investors. Higher risk increases investor' demand for higher returns, ultimately increasing the firm's cost of capital.

In economic practice, the cost of capital is used in many corporate finance functions. For example, it can be used as a discount rate for converting expected future cash flows into present values and as a benchmark for assessing investment projects (Pitera & Gnap, 2021, p. 140). In addition, it is used in calculating the company's economic profit and as the minimum required rate that new investments must achieve to take place (Pitera & Gnap, 2021, p. 140).

2.2 Components of Cost of Capital

The two main components of the cost of capital are the cost of equity and the cost of debt (Gunawan, 2025, p. 136). Gunawan (2025, p. 136) explains that the cost of equity is the compensation investors demand for managing the systematic risk associated with holding a firm's stock. It is typically estimated using models such as the Capital Asset Pricing Model (CAPM). Gunawan (202, p. 136) describes the cost of debt as the interest rate that a firm must pay on its borrowed funds. These components are weighted by their share in the company's capital structure, and the Weighted Average Cost of Capital

(WACC) is then calculated, which reflects the overall cost of a firm's financing (Gunawan, 2026, p. 136).

2.2.1 Cost of Equity

The cost of equity represents the expected return that shareholders require for holding a company's stock (Balakrishnan et al., 2021, p. 2). Gupta et al. (2018, p. 102) note that shareholders are residual claimants; they face higher risk than others who provide funds, which leads them to require a higher expected return as compensation. In other words, the cost of equity is the company's "price" for using shareholders' funds and reflects the expected rate of return offered to investors for the time value of risk and money. The cost of equity ultimately influences investment and financing decisions (El Ghoul, 2023, p. 1). Similarly, Arhinful et al. (2024, p. 5) note that the cost of equity measure somewhat demonstrates the appeal of a firm's financial health to investors.

The five-factor asset-pricing model by Fama and French (2015, p. 2) is one of the main tools used to estimate the cost of equity as it demonstrates how firms' characteristics, such as size, investments, and profitability, shape investor requirements and expected returns. However, calculating the cost of equity can be complex because financial markets do not directly provide observable expected returns. As a result, empirical studies tend to rely on proxies like stock returns or implied cost of equity estimates, which use market information (Balakrishnan et al., 2021, p. 2). This study will use the implied cost of equity as a measure of the cost of equity.

2.2.2 Cost of Debt

The cost of debt is the cost of borrowing funds and the return lenders require for providing capital (Calce, 2025, p. 160). In addition, it reflects current interest rates and shows how investors evaluate the risk of default, meaning how risky the firm is considered (Calce, 2025, p. 160). The cost of debt determines a firm's interest payments and influences its value (Konieva, 2021, p. 177). Konieva (2021, p. 177) also notes that

the cost of debt can work as an economic indicator of financial problems, especially in countries where firms rely heavily on debt financing. Baule (2019, p. 722) states that while the cost of equity represents the expected return to stockholders, the cost of debt represents the expected return to bondholders.

Compared with those who hold equity, debt holders face lower risk because they have a prior claim on the firm's assets in financial distress (Binsbergen et al., 2010, p. 2089). In addition, debt financing also benefits from the tax deductibility of interest payments, which lowers the cost of lending. However, debt financing has its costs too, including agency conflicts among stakeholders due to the costs associated with financial distress (Binsbergen et al., 2010, p. 2090). The cost of debt is often estimated using a corporate bond's yield to maturity and it is calculated as the value between the bond's yield to maturity and the risk-free interest rate (Baule, 2019, p. 722). The cost of debt and the cost of equity form the company's cost of capital, which is measured through the weighted average cost of capital (WACC).

2.2.3 Weighted Average Cost of Capital (WACC)

The weighted average cost of capital (WACC) reflects the firm's overall financing costs through equity and debt financing and represents the return demanded by investors who provide the firm with capital (Frank & Shen, 2016, p. 300-301). Yuliah et al. (2023, p. 342) list debt, preferred stock, and common equity as WACC components. Modigliani and Miller (1958, p. 261-262) state that WACC plays a crucial role in corporate finance, since it determines the minimum rate of return that companies must earn on their investments to be able to keep their creditors and shareholders. Similarly, Arhinful et al. (2024, p. 6) note that since WACC reflects a firm's overall financing cost, it is an important measure for investors.

Frank and Shen (2016, p. 300) explain that empirical evidence shows that a higher cost of capital leads to lower corporate investment, which also confirms the Q-theory of investment. Carluccio et al. (2023, p. 86) similarly note that according to standard q-

theory, there is a negative correlation between corporate investment and the WACC, meaning that firms reduce investment when their cost of capital increases. For this reason, the WACC affects corporate investment decisions because higher financing costs increase the required return on investments (Carluccio et al, 2023, p. 87).

WACC is measured as the weighted average of the cost of equity and the cost of debt, and adjusted for the corporate tax rate (Frank & Shen, 2016, p. 303).

The WACC formula is:

$$WACC = \frac{E}{V}r_E + \frac{D}{V}r_D(1 - T_C),$$

where E and D are the market values of equity and debt, V is the total market value of capital, and r_E and r_D are the cost of equity and the cost of debt, and T_C is the corporate tax rate (Frank & Shen, 2016, p. 303).

The theoretical foundation of WACC comes from Modigliani and Miller (1958, pp. 268.269) who demonstrate that the average cost of capital is independent of capital structure under perfect market conditions. Frank and Shen (2019, p. 303) state that WACC is not always directly observable and therefore must be estimated using different proxies for its components, which may result in different empirical outcomes. In particular, measuring the cost of equity is essential, as various proxies, such as the CAPM or the implied cost of equity, can lead to different WACC estimates (Frank & Shen, 2016, p. 300).

2.3 Estimation of the Cost of Equity

The cost of equity refers to the return that investors expect for holding a firm's equity, and it impacts firm valuation and financial decision-making (Kirby, 2019, p. 105). Therefore, estimating the cost of equity accurately is important as it affects capital budgeting and the valuation of a firm.

There are typically two main approaches to estimating the cost of equity. Kirby (2019, p. 105) explains that the first approach uses valuation models, in which the cost of equity is defined as the internal rate of return that matches the current stock price to the present value of expected future cash flows, also referred to as the implied cost of equity. In the second approach, expected returns are estimated through empirical asset pricing models using historical data and the risk and return relationship, also known as the expected cost of equity (Kirby, 2019, p. 105).

Asset pricing theory forms the theoretical foundation for these models by linking expected returns to risk factors. For example, according to the CAPM, expected returns are determined by the covariance of a stock with the market portfolio, capturing systematic risk (Mishra & O'Brien, 2019, p. 74). Empirical asset pricing models extend this framework by including firm characteristics in order to better explain the differences among stock returns (Kiry, 2019, p. 110).

As there are many ways to estimate the cost of equity, the choice of model can significantly influence the results of the estimates. CAPM, multi-factor models, and implied cost of equity may yield varying results regarding the relationship between expected return and risk (Mishra & O'Brien, 2019, pp.73-74).

2.3.1 Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) provides a theoretical foundation for understanding the relationship between risk and expected returns. It is used widely to estimate the cost of equity. The model was developed by Sharpe (1964), Treynor (1962), Lintner (1965), and Mossin (1966) when they tried to find how risk is priced in financial markets (Perold, 2004, p. 3). The CAPM builds on modern portfolio theory by pricing assets depending on their sensitivity to market risk (Fama & French, 2004, p. 25). Fama and French (2004, p. 25) state that the CAPM is widely used in the estimation of firms' cost of capital and for portfolio evaluation.

Perold (2004, p. 3) explains that the key idea of CAPM is that not all risks should affect asset prices; therefore, not all types of risk are relevant for defining expected returns. He continues stating that, for example, firm-specific risk, also called unsystematic risk, can be eliminated by investors through diversification, and only systematic risk should be included with expected returns. Perold (2004, pp. 6-7) explains that this idea is based on modern portfolio theory, which demonstrates that diversification can reduce portfolio risk but cannot eliminate it entirely due to asset returns being imperfectly correlated, and concludes that even with diversified portfolios, there is risk.

Sharpe (1964, p. 425) highlights this relationship and notes, that in equilibrium, there is a trade-off between risk and return for investors, meaning that higher expected returns can be achieved by taking on greater risk. In this framework, investors can choose a portfolio along the capital market line, which includes the set of optimal risk-return combinations available the market (Sharpe, 1964, pp. 425-426). The model further shows that investment decisions consist of a combination of risky assets and risk-free assets, which reflects the role of diversification in portfolio choice (Sharpe, 1964, p. 426).

The CAPM relates an asset's expected return to its systematic risk exposure, which is measured by beta.

The model can be represented as: $E(R) = R_f + \beta x (R_m - R_f)$

Where $E(R)$ is the expected return of asset I, R_f is the risk-free rate, R_m is the expected return of the market portfolio, and β beta measures the sensitivity of the asset's returns to market movements (Sharpe, 1964; Perold, 2004, pp. 3-4).

Assets that have higher beta values are more prone to market sensitivity, which leads to investors requiring higher expected return as compensation for the additional risk (Perold, 2004, pp. 3-4). Similarly, Frank and Shen (2016, p. 303) state that expected returns arise when exposure to systematic risks increases. To conclude, the CAPM links an asset's expected return to its systematic risk and thus provides a way to price risky assets and estimate the cost of equity.

While CAPM is widely used for estimating the cost of equity, it has its limitations, too. Empirical research has shown that the model can't fully explain stock return variations, leading to the development of multifactor models such as the Fama- French three-factor model (Fama & French, 2015, p. 1). Additionally, when the cost of equity is computed by using CAPM, beta becomes mechanically incorporated in the dependent variable, which cause create identification concerns in empirical analysis.

This limitation is also relevant for this study. Since the main objective is to analyze the impact of systematic risk on the implied cost of equity, using a CAPM-based cost of equity will result in a mechanical relationship between beta and the dependent variable.

2.3.2 Implied cost of equity (ICOE)

To estimate the cost of equity, the implied cost of equity approach is used to address the limitations of the CAPM. The implied cost of equity captures the return required by investors, which is estimated from current market price of a firm's stock and expected future cash flows instead of historical return data (Kirby, 2019, p. 105). It is a way of estimating the cost of equity, and it is used in capital budgeting, valuation and other corporate finance-related practices (Kirby, 2019, p. 105). Hou et al. (2012, p. 505) similarly describe the implied cost of capital as the internal rate of return that matches the firm's stock price with the present value of expected future cash flows, and they emphasize that it represents the discount rate implicitly used by the market.

The implied cost of equity differs from traditional asset pricing models such as the CAPM. While the CAPM estimates expected returns using historical market data and beta, the implied cost of equity model derives expected returns directly from prices and forecasts of future fundamentals. Hou et al. (2012, p. 505) argue that estimates of expected returns based on realized returns or asset pricing models are often noisy and imprecise, whereas the implied cost of equity does not rely on any specific asset pricing model. Echterling et al. (2015, p. 236) note that the cost of equity estimation models relied mainly on historical data before the implied cost of capital models were established.

Over the years, the academic literature has developed several valuation-based approaches for estimating the implied cost of equity. Claus and Thomas (2001, pp. 1630-1631) suggest that forward-looking discount rates can be obtained by aligning stock prices with expected future cash flows. Then they propose the abnormal earnings approach as an alternative to the traditional dividend growth model (Claus & Thomas, 2001, pp. 1632-1635). They further argue that this model can incorporate current information better and reduce the need for strong long-term assumptions (Claus & Thomas, 2001, p. 1637). Easton (2004, p. 81) presents an alternative approach where expected returns can be estimated from expected earnings growth against the current level of prices (Easton, 2004, p. 81).

In practice, the implied cost of equity can be estimated using valuation models like the dividend discount model or the residual income model, which is based on abnormal returns. Claus and Thomas (2001, pp. 1632-1635) say that in the model of abnormal earnings, a firm's stock price can be defined by its current book value and the value of its expected future abnormal earnings. Abnormal earnings refer to the part that is left after subtracting the cost of equity. Gebhard et al. (2001, pp. 140-141) state the cost of equity can be estimated using the residual income model by finding the discount rate that aligns the current price of a stock within the value of expected future earnings and book values.

The implied cost of equity offers several advantages compared to CAPM-based estimates. Firstly, as mentioned, it avoids the mechanical relationship between expected returns and beta since beta is not used directly in the calculations. Secondly, analyst forecast information included in these estimates gives more insights into firms and help differentiate between them. Finally, it reflects the forward-looking nature of expected returns in financial markets since it does not depend on historical data. As the objective of this study is to analyze the impact of systematic risk on the implied cost of equity, using a forward measure is better to study the empirical association of the variables.

2.4 Empirical Evidence on the Implied Cost of Equity

Empirical research has increasingly used the implied cost of equity as a proxy for expected returns since traditional approaches based on realized returns are often viewed as unclear (Hou et al., 2012, p. 505). Previous literature highlights that expected returns are not directly observable, which is why earlier studies have used average realized returns to estimate the cost of capital and to test asset pricing models (Gebhardt et al., 2001, p. 136). However, this has faced critique because of difficulties in estimation of factor loadings and risk, which result in unreliable cost of capital estimates (Gebhardt et al., 2001, p. 136).

These limitations have led researchers to turn to valuation-based measures such as the implied cost of equity. Hou et al. (2012, p. 505) demonstrate that implied cost of capital estimates that are taken from prices and expected cash flows provide a direct measure of expected returns that is not dependent on historical return data. This is why the implied cost of equity is useful in empirical studies when studying the relationship of firm characteristics and expected returns (Hou et al., 2012, p. 504). Similarly, Easton et al. (2004, pp. 73-74) show that implied expected returns can be calculated using earnings forecasts and current stock prices, and that valuation models then convert the forward-looking data into discount rates.

Gebhardt et al. (2001, p. 135) find that the implied cost of equity varies systematically in different companies and industries. Book-to-market, growth expectations, and forecast dispersion are firm characteristics that illustrate the variation in the implied cost of equity, even accounting for about 60% of future cost of capital variation (Gebhardt et al., 2001, p. 135). They further indicate that industry- and firm-specific impacts are reflected better in implied risk premia than in realized returns. This further confirms that implied cost of equity provides a more forward-looking and reliable measure of expected returns. In addition, empirical studies that compare asset pricing models using the implied cost of equity data have found that multifactor models perform better than the CAPM in

explaining the variation in expected returns. Mishra and O'Brien (2019, p. 73) suggest that, instead of the CAPM model, the Fama-French three-factor model is a better fit for the implied cost of equity.

Overall, according to previous empirical research, the implied cost of equity is a reliable and increasingly used proxy for expected returns, as it explains cross-sectional differences in risk better than realized returns. For this thesis, the empirical findings are relevant as they support the idea of using the implied cost of equity as the dependent variable. By using the implied cost of equity as a forward-looking measure which is not mechanically linked to beta, this approach enables reliable empirical analysis on if systematic risk impacts the cost of equity.

3 Systematic Risk and Beta

This chapter presents the concept of systematic risk and its measurement using beta, the main explanatory variable in this thesis. Systematic risk is a risk that cannot be eliminated through diversification, which makes understanding it extremely essential.

Sidiq et al. (2024, p. 1398) define systematic risk as a portion of total risk that impacts all assets and cannot be diversified away. They further note that this risk is grounded on the basis of macroeconomic factors such as inflation, interest rates, recessions, and other economic conditions, which influence the entire market. On the other hand, unsystematic risk is firm-specific and can be eliminated through asset diversification (Sidiq et al., 2024, p. 1398). In other words, expected returns depend majorly on the exposure to systematic risk rather than unsystematic risk.

Systematic risk is typically measured by beta coefficient (β), which reflects the sensitivity of a financial instrument's returns to movements in the overall market (Błoński, 2025, p. 1). Fama and French (2004, p. 28) describe the theoretical connection between systematic risk and expected return by stating that, according to the CAPM, assets with greater exposure to market risk demand higher expected returns. This thesis focuses on beta as a measure of systematic risk and analyzes how it is reflected in firms' cost of equity. Similarly, Sarmiento-Sabogal and Sadeghi (2014, p. 91) note that systematic risk has been an important topic in finance since the CAPM, as it establishes a relationship between systematic risk and a firm's cost of equity.

3.1 Risk in financial markets

Risk is an important concept in financial markets since investment decisions are often made in uncertainty. In finance, risk is possibility that actual returns might differ from expected returns. Markowitz (1952, p. 77) describes risk as a variance of returns and demonstrates that investors assess risk and expected returns together. Markowitz (1952, p. 79) adds that portfolio risk depends not only on the asset's variance but also on the

covariance between assets, meaning that diversification can reduce risk when securities do not move together. In effective diversification, securities are chosen based on low covariances instead of just adding more holdings (Markowitz, 1952, p. 89). Modern financial markets highlight the importance of risk management and the role of financial intermediaries in facilitating risk transfer (Allen & Santomero, 1998, p. 1462). Diversification is not the only way to reduce risk but managing and transferring it through financial intermediaries (Allen & Santomero, 1998, p. 1462).

There are various types of risks that affect both firms and investors. (Stulz, 2008, pp. 42-44) list market risk, credit risk, and operational risk as the main categories of risk used within financial institutions. These categories reflect different sources of risk that bring uncertainty, which firms must manage. In addition, they say that risk in financial markets can come from broader system-wide interactions. Lin et al. (2018, pp. 580-581) describe systemic risk as financial instability that can spread all over institutions and impact how financial systems operate. Although this thesis examines the systematic risk at the firm level and not systemic risk in a regulatory way, this perspective explains that some risk can arise from economic factors and not be understood at the firm level. To conclude, risk in financial markets can arise from both firm-specific and market-wide sources.

3.2 Systematic vs Unsystematic Risk

In financial markets, total risk is divided into systematic and unsystematic risk. Systematic risk is caused by external factors and market movements and impacts all investments. Eldomiaty et al. (2011, p. 290) define systematic risk to reflect the sensitivity of a stock's returns to market changes and therefore can be referred to as market risk or beta. Singh and Bhatia (2014, p. 17) state that systematic risk arises from economic, political, social, and cultural factors impact the prices of all assets. Eldomiaty et al. (2011, p. 290) explain that, in contrast, unsystematic risk is associated with firm-specific or industry-specific risk. According to Singh and Bhatia (2014, p. 17) unsystematic risk arises from factors that are unique to a company or a sector.

The distinction between systematic and unsystematic can be explained by the concept of diversification in portfolio theory. Gagliardini and Gourieroux (2013, p. 718) explain that the impact of unsystematic risk can be eliminated with the diversification of portfolio assets, because firm-specific shocks do not affect all assets altogether. They also add that the more assets are added in a portfolio, the less impact unsystematic risk has. On the other hand, Singh and Bhatia (2014, p. 17) note that systematic risk cannot be eliminated with diversification since it is caused by market factors and impacts all assets. This implies that even if a portfolio is well diversified, it can face market-wide risks. Singh and Bhatia (2014, p. 17) state that systematic risk is referred to as non-diversifiable risk, while unsystematic risk is called diversifiable risk.

Another relevant distinction concerns asset pricing. Eldomiaty et al. (2011, p. 290) state that the CAPM implies that investors are not rewarded for bearing unsystematic risk since it can be eliminated through diversification, whereas systematic risk is rewarded. This means that when the exposure to systematic risk is higher, the expected returns will be higher too. Eldomiaty et al. (2011, p. 290) conclude that expected returns depend on systematic rather than firm-specific risk. They add that this is the principle that is the core of modern asset pricing models, where only risk that cannot be diversified away is priced in equilibrium.

In addition to firm-level and market-level risk, financial markets face broader system-wide risks, too. Lin et al. (2018, pp. 580-581) describe systemic risk as financial instability that can affect all institutions and, as a result, the whole financial system. This risk is characterized by contagion and interdependence among these institutions, meaning that when one part faces a shock, it will affect the others too (Lin et al., 2018, pp. 580-581). Even though systemic risk is different from systematic risk, both involve common factors that influence many entities simultaneously.

Overall, separating total risk into systematic and unsystematic risk offers a framework for understanding the financial market better. While diversification can effectively

reduce firm-specific risk, it cannot remove the effect of systematic risk, which in the end, remains a major source of uncertainty even in diversified portfolios (Sing & Bhatia, 2014, p. 17). This distinction is important for assessing the relationship between risk and expected returns.

3.3 Beta as a Measure of Systematic Risk

In financial markets, beta is the standard measure of systematic risk, and it plays a major role in asset pricing theory (Eldomiaty et al., 2011, p. 290). Systematic risk presents the sensitivity of a security's returns to market movements, and the beta coefficient captures this sensitivity (Eldomiaty et al., 2011, p. 290). Drobetz et al. (2016, p. 129) explain that in modern finance, beta is a central concept in assessing systematic risk. As this is the only risk that cannot be eliminated through diversification, it becomes extremely essential for investors. Beta estimation is used in the cost of capital calculations, firm valuations, portfolio constructions, and risk management strategies (Brailsford & Josev, 1997, p. 358).

Fama and French (2004, p. 26) state that beta originates from the Capital Asset Pricing Model (CAPM), which builds on the portfolio theory of Markowitz. Perold (2004, p. 3) argues that the CAPM suggests that investors care more about market-wide factors and risk than about firm-specific fluctuations when holding diversified portfolios. He adds that this is one of the reasons only systematic risk is priced in equilibrium and remains relevant for expected returns, whereas diversifiable risks are not priced in equilibrium. This also supports earlier portfolio theory, which assumes that diversification can reduce, but not eliminate, risk due to interdependence among the assets (Perold, 2004, p. 6).

Within the CAPM, beta measures the amount of contribution of an individual asset to the total risk of the portfolio (Fama & French, 2004, p. 28). Fama and French (2004, p. 28) further explain that beta is defined as the covariance between the return of an asset and the return of the market portfolio, divided by market portfolio's variance. This definition suggests that beta captures the extent to which an asset moves in relation to

the market, rather than just its volatility. Fama and French (2004, p. 28) state that the higher a beta of an asset is, the more sensitive it is to market fluctuations and the riskier it is considered in the context of systematic risk. Roy et al. (2025, p. 1) also highlight that firms with higher betas are perceived as riskier compared to firms that have lower betas.

In addition, the CAPM creates a direct relationship between beta and expected returns. Fama and French (2004, p. 29) explain that a security's expected return is equal to the risk-free rate plus a risk premium that depends on the beta of the asset. This further confirms Eldomiaty et al. (2011, p. 290) statement of investors getting compensation for bearing systematic risk. Similarly, Sharpe (1964, pp. 425-426) demonstrates, that in equilibrium, for investors to achieve higher returns, they must take higher levels of risk.

In practise, the CAPM is used to assess the relationship between risk and return and to estimate the cost of capital for firms (Fama & French, 2004, p. 25). By connecting expected returns to systematic risk, the model offers a framework for evaluating investment decisions and analyzing how risk is priced in the financial markets.

Overall, beta provides a measure of systematic risk that is consistent with asset pricing models and portfolio theory. It explains how securities are affected by market-wide risk factors, and it plays a central role in discovering expected returns. Beta is a key variable in financial research, and it is the main measure of systematic risk, and in this thesis serving as the main independent variable.

3.4 Empirical Evidence on Beta and Returns

The CAPM suggests that assets with higher systematic risk earn higher expected returns. However, empirical research has given mixed evidence about beta giving enough explanation for stock returns. Fama and French (2004, pp. 25-26) indicate that although the CAPM does predict the relationship between risk and expected returns, the empirical record has been rather poor for this model, to the point that it can invalidate the way it is used in applications. Fama and French (2004, p. 25) add that the empirical problems

of the CAPM may reflect failings of the assumptions of the theory. Black et al. (1972, pp. 3-4) tests show that the relationship between expected returns and beta is not fully consistent with the prediction. They find out that the high-beta assets earn lower expected excess returns than the CAPM suggests, whereas expected excess returns on low-beta assets are higher than predicted (Black et al., 1972, pp. 4-6). This shows that the empirical evidence on the risk and return relationship is flatter than what the CAPM implies.

Black et al. (1972, pp. 5-6) argue that the linear relationship between risk and return is more consistent with a two-factor model in which the return on a zero-covariance portfolio also plays a role. They further find that the mean of this beta-related factor was significantly higher than the average risk-free rate in their sample, which further implies that the standard CAPM does not fully capture how risk is priced empirically. This finding shows that even though beta is important, it may not be as significant as the CAPM suggest.

Later empirical research became even more critical of beta as the core explanation of expected returns. Fama and French (1992, p. 427) summarize prior evidence by demonstrating that size and book-to-market equity together explain the effect that beta was previously thought to have on average stock returns. In their analysis, they form portfolios sorted by beta and size and find that, even though beta and returns have a positive relationship in univariate tests, this relationship weakens when size is considered as well. These results indicate that the positive linear relation between beta and average return is weaker than predicted.

Fama and French (2004, p.31; p. 35) note that time-series tests confirm that low-beta assets are inclined to have positive intercepts while high-beta assets are inclined to have negative intercepts. Fama and French (2004, p. 36) use a cross-section regression approach and conclude that later empirical research discovered several variables like size, earning-to-price, debt-equity, and book-to-market ratios to contribute more to the

interpretation of expected stock returns beyond beta. Even more recent empirical evidence argues that investment and profitability help explain average stock returns in addition to market, size, and value factors (Fama & French, 2015, pp. 1-2). They emphasize that the three-factor model is incomplete as it leaves out investment and profitability, which have significant effects on average returns. The five-factor model performs better in asset pricing tests compared to the three-factor model and produces lower GSR statistics and smaller average portfolio pricing errors (Fama & French, 2015, pp. 9-10). This evidence indicates that the empirical relation of risk and return is broader than what the CAPM beta-return serves alone.

To conclude, the empirical evidence suggests three main conclusions. First, earlier evidence shows that there is a positive relationship between beta and return, meaning that systematic risk remains important in asset pricing (Black et al., pp.4-6). Second, the association between beta and return appears weaker than the traditional CAPM predicts, especially when other characteristics are taken into account (Fama & French, 2004, p. 42). Third, additional factors such as size, book-to-market, and profitability provide a better explanation of average returns and indicate that beta alone is not enough to interpret the expected returns (Fama & French, 1992, pp. 440-442; Fama & French, 2015, pp. 2-3).

For this thesis, the literature is essential, as it confirms that beta is a relevant measure of systematic risk, while also suggesting that it is not alone enough to explain expected returns. This is relevant since the study uses the implied cost of equity instead of a CAPM-based measure which will allow the analysis to assess if beta influences firms' cost of equity in the Eurozone.

4 Data and Methodology

This chapter introduces the empirical approach used to examine the relationship between systematic risk and the implied cost of equity. It includes data description, sample selection, and the explanation of estimating the key variables. In addition, the empirical model and regressions applied to test the hypotheses are discussed. Finally, robustness checks are conducted to make sure the results of main models are reliable.

4.1 Data Description and Sample Selection

This study uses firm-level data from publicly listed non-financial firms in Eurozone countries. The countries include Finland, Germany, Belgium, Austria, Ireland, Slovakia, Italy, the Netherlands, Portugal, Spain, Greece, Slovenia, Estonia, Latvia, Lithuania, Luxembourg, Cyprus, and Malta. Financial firms are not included in the analysis because their capital structures, regulatory frameworks, and accounting data are different compared to non-financial firms. The sample period is 2010-2024, as this time period consists of different economic conditions, such as the aftermath of the financial crisis, low-interest rate environments, and more recent conditions.

The dataset is built by combining firm-level financial data and analyst forecast information which are obtained from different sources including DataStream, WorldScope, and IBES. The data are created as a panel of firm-year observations, meaning that each observation refers to a specific firm and year. The initial dataset is subjected to a series of filtering steps in order to ensure of data consistency and reliability. Data points that have missing values for the main variables are excluded from the analysis. The final sample therefore, consists only of observations with data values for the main and the control variables. The procedure for sample selection is shown in Table 1 below.

Table 1. Sample Construction

Step	Observations	Firms
<i>Initial dataset</i>	257,057	15,121
<i>After restricting to beta availability</i>	183,253	13,506
<i>After restricting to ICOE availability</i>	57,533	7,629
<i>After restricting to beta and ICOE</i>	55,181	7,339
<i>Final estimation sample (ICOE, beta, and controls)</i>	51,552	6,844

Table 1 presents the initial dataset that consists of 257,057 firm-year observations from 15,121 firms, including both active and delisted firms. After filtering out observations with no available beta estimates, 183,253 observations remain. After estimating the implied cost of equity (ICOE), the sample reduces to 57,533 observations with 7,629 firms. The reason for this drastic sample reduction is missing values in earnings forecasts and price data required for ICOE estimation. Further restricting the sample to observations that include both beta and ICOE estimates, the observations reduce to 55,181. Finally, observations with missing values for control variables are excluded, and the final sample used in the regressions consists of 51,552 observations across 6,844 firms.

The final sample consists of both active and delisted firms to avoid survivorship bias. Taking delisted firms along helps make sure that the sample represents all cross-sectional firms over time and thus, offers a true measure of the relationship impact between systematic risk and the implied cost of equity. The distribution of active firms and delisted firms is shown in Table 2.

Table 2. Active and Delisted Firms in the Final Sample

Firm Status	Observations	Firms	Percentage (observations)
<i>Active firms</i>	37,777	4,689	73.28%
<i>Delisted firms</i>	13,775	2,155	26.72%
<i>Total</i>	51,552	6,844	100%

Table 2 shows that the final estimation sample is dominated by active firms contributing 73.28% of the observations. On the other hand, delisted firms account for 26.72% to the final sample. The distribution is due to active firms providing more complete data than delisted firms, especially for beta and analyst forecasts.

4.2 Measurement of Variables

This section explains how the variables of this study, such as the independent variable beta, the main dependent variable, the implied cost of equity, and control variables, are constructed.

4.2.1 Beta Estimation

Beta is widely used in empirical finance in asset pricing as a measure of systematic risk. It shows the extent of market risk that cannot be diversified. Beta captures the sensitivity of the firm's stock returns to changes in the overall market.

For this study, beta is provided by Refinitiv Datastream (variable 897E), which offers pre-estimated historical betas for all firms. These pre-defined betas are estimated as a time series, typically using a 60-month (5-year) window of monthly returns. DataStream estimates this value by regressing a firm's total return index against its local market index. As beta estimates are obtained from DataStream, a robustness check is conducted by estimating an alternative beta measure, which is constructed through regression analysis

on firm returns against STOXX EUROPE 600 market index. By employing the regression with self-estimated betas, the reliability of the results is tested.

4.2.2 Implied Cost of Equity Estimation

The implied cost of equity (ICOE), the dependent variable of this study, is estimated by using the model proposed by Easton (2004, p. 81), which is based on the current stock prices and analyst earnings forecasts.

The implied cost of equity is estimated with using the following formula:

$$ICOE = \sqrt{\frac{EPS_2 - EPS_1}{P_0}}$$

Where P is the current stock price provided by DataStream, while analyst forecasts of earnings are provided by IBES. EPS1MN and EPS2MN reflect one- and two-year-ahead earnings per share forecasts. According to this model, expected returns can be estimated from expected earnings growth relative to the current price level (Easton, 2004, p. 81). In other words, firms that have higher expected earnings growth are expected to have a higher cost of equity. Overall, the model predicts that expected returns equate the current stock price to the present value of expected future earnings, thereby allowing the estimation of the company's cost of equity.

4.2.3 Control Variables

Control variables are chosen to be included in the regression to ensure that other characteristics don't influence the implied cost of equity. Firm size is reflected as market capitalization and is measured as the natural logarithm to eliminate the effect of skewness in firm size. Previous literature suggests that smaller firms are riskier, and therefore demand higher expected returns on investments, which indicates a negative relationship between size and the cost of equity (Fama & French, 1992, pp. 428-429). Leverage is calculated as the ratio of total debt to total assets, showing how much a

company uses debt for financing. Higher leverage is associated with higher risk exposure, which in turn increases return requirements on equity. Profitability is indicated as the return on equity (ROE). Generally, more profitable firms are perceived as less risky. And finally, liquidity is estimated by using the current ratio, which is calculated by dividing current assets with current liabilities. Firms with higher current ratios are considered less risky, reducing the cost of equity.

Table 3 provides variable descriptions where the variables are defined, the sources of data are given, and the expected relationships of the variables are presented. The variables are constructed from the data collected from IBES, DataStream, and Worldscope. The expected signs reflect the theoretical predictions based on the literature for each individual variable and the implied cost of equity.

Table 3. Variable Description

Variable	Definition	Source	Expected Sign
<i>ICOE</i>	Implied cost of equity, calculated as $\sqrt{\frac{EPS_2 - EPS_1}{P_0}}$	IBES, Datastream	+
<i>Beta</i>	Systematic risk measure	Datastream	+
<i>Size</i>	Natural logarithm of market capitalization	Worldscope	-
<i>Leverage</i>	Total debt divided by total assets	Worldscope	+
<i>Profitability (ROE)</i>	Net income divided by shareholder's equity	Worldscope	-
<i>Liquidity (Current Ratio)</i>	Current assets divided by current liabilities	Worldscope	-

4.3 Empirical Model and Regression

The baseline regression model used to analyze the relationship between systematic risk and the implied cost of equity is the following:

$$ICOE_{it} = \alpha + \beta_1 Beta_{it} + \beta_2 Size_{it} + \beta_3 Leverage_{it} + \beta_4 Profitability_{it} + \beta_5 Liquidity_{it} + \gamma_t + \varepsilon_{it} \quad (1)$$

where:

$ICOE_{it}$ = the implied cost of equity,

$Beta_{it}$ = systematic risk

$Size_{it}$ = firm size, measured as ln of market capitalization

$Leverage_{it}$ = total debt / total assets

$Profitability_{it}$ = return on equity ROE

$Liquidity_{it}$ = current ratio, current assets / current liabilities

γ_t = year fixed effects

ε_{it} = error

Additionally, i refers to firms and t refers to time in years.

This empirical model is first estimated using pooled ordinary least squares (OLS) alongside year fixed effects and robust standard errors. The main panel regression model is later estimated incorporating firm fixed effects and year fixed effects, using firm-clustered standard errors:

$$ICOE_{it} = \alpha_i + \beta_1 Beta_{it} + \beta_2 Size_{it} + \beta_3 Leverage_{it} + \beta_4 Profitability_{it} + \beta_5 Liquidity_{it} + \gamma_t + \varepsilon_{it} \quad (2)$$

where α_i accounts for firm fixed effects and γ_t accounts for year fixed effects.

The fixed-effect regression model is the main model used in the analysis of this study, as it adjusts for unobservable firm-specific heterogeneity that might otherwise show bias

in the estimation of the beta and cost of equity relationship. Moreover, standard errors in this model are clustered at the firm level. The main coefficient of the model is β_1 , which demonstrates the association between systematic risk and the implied cost of equity. Control variables are included to account for potential issues of firm characteristics that may influence the implied cost of equity.

4.4 Robustness Checks

In order to ensure the reliability of results, the following robustness checks are performed. The results of the robustness checks indicate whether the findings align with the baseline findings.

The first robustness check is done through alternative beta estimation. An alternative beta estimate is created using return data for the STOXX EUROPE 600 market to address concerns about betas provided by DataStream. The second robustness check involves winsorizing the implied cost of equity (ICOE) at the 1st and 99th percentiles. This approach is used to reduce the effects of outliers that could be caused by extreme analyst forecasts or stock prices. The third robustness check is creating a stricter ICOE by giving extra attention to the analyst forecasts. This includes excluding the observations where $EPS_2 \leq EPS_1$ as such cases lead to negative expected growths which are inconsistent with the assumptions of the Easton (2004) model. In addition, non-positive ICOE values are eliminated. The fourth and final robustness check involves the winsorization of all the variables, so the effects of any outliers concerning betas or control variables are addressed, too. These robustness models aim to confirm the reliability and validity of the main regression findings.

5 Empirical Results

This chapter provides the empirical results of the study. Firstly, the descriptive statistics are presented, followed by the regression results and robustness checks.

5.1 Descriptive Statistics

Table 4. Descriptive Statistics

Variable	N	Mean	Std Dev	Median	Min	Max
<i>ICOE</i>	51,552	0.147	0.130	0.111	0.000	1.000
<i>Beta</i>	51,552	0.672	1.377	0.660	-123.260	111.312
<i>Size (ln Market Capitalization)</i>	51,552	13.854	2.353	13.827	3.258	19.719
<i>Leverage</i>	51,552	0.271	0.210	0.255	0.000	9.350
<i>Profitability (ROE)</i>	51,552	0.006	0.491	0.031	-90.856	16.246
<i>Liquidity (Current Ratio)</i>	51,552	1.817	6.771	1.359	0.023	709.500

This table reports descriptive statistics of the variables used in the regression analysis. ICOE describes the implied cost of equity. Size is measured as the natural logarithm LN of market capitalization. Leverage is measured as the ratio of total debt to total assets. Profitability is measured as return on equity (ROE), and liquidity as the current ratio.

Table 4 of the descriptive statistics shows that the mean of the implied cost of equity (ICOE) is about 0.147, while its median is 0.111. This indicates that ICOE distribution is right-skewed. It suggests that there is variance in ICOE among firms, which implies different expected returns across firms. The mean of beta is 0.672, which reflects that the firms included in the sample have a lower level of systematic risk compared to the

market portfolio, which has a beta of one (Sharpe, 1964). This means the firms in the sample are less sensitive to market movements than the market benchmark. However, the standard deviation of beta is 1.377, which suggests that there is relatively large variation in systematic risk across firms of the sample.

The mean of firm size is 13.854, and the median of firm size is 13.827, which indicates that the sample consists mainly of medium to large firms. The minimum 3.258 and maximum 19.719 values have a large gap, which shows that there are differences in size across the firms. Leverage is reported to have a mean of 0.271, meaning firms fund about 27% of their assets with debt. Profitability (ROE) has a mean of 0.006 and a median of 0.031, indicating a lower level of average profitability across the selected sample firms. Liquidity shows a mean of 1.817 and a median of 1.359, which suggests that the companies have enough short-term assets to pay their liabilities. The more detailed information on descriptive statistics is presented in Appendix 1.

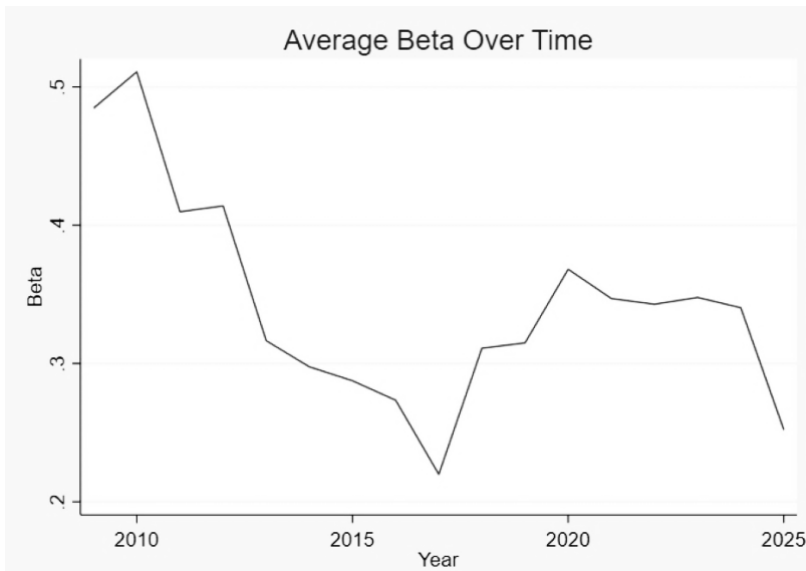


Figure 1. Average Beta

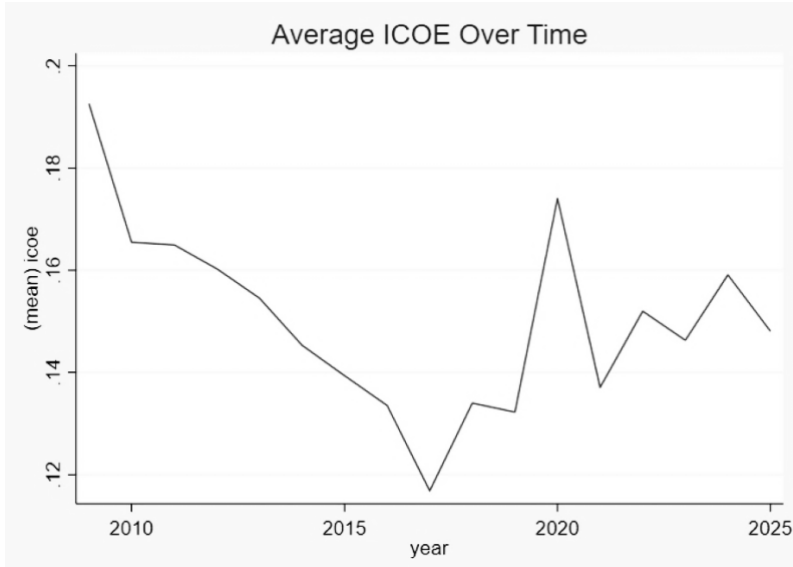


Figure 2. Average Implied Cost of Equity

Figure 1 and Figure 2 show the average of beta and the average of the implied cost of equity in the years 2010-2024. The figures show how the market and risk factors have impacted both the variables over these years. The implied cost of equity shows greater fluctuations than beta, which remains more stable over the sample period.

Table 5 represents the correlation matrix based on the main variables used in the regression analysis. The detailed version of the results with p-values is presented in Appendix 2.

Table 5. Correlation Matrix

Variable	ICOE	Beta	Size	Leverage	Profitability	Liquidity
ICOE	1.000					
Beta	0.067***	1.000				
Size	-0.384***	0.024***	1.000			
Leverage	0.148***	-0.002	-0.028***	1.000		
Profitability	-0.091***	0.001	0.004	-0.010***	1.000	
Liquidity	-0.003	-0.007**	-0.022***	-0.000	0.000	1.000

The table reports pairwise correlations between the variables. ***, **, and * are indicators of statistical significance at the 1%, 5%, and 10% levels.

According to Table 5, the correlations between variables are low to moderate, suggesting there is no multicollinearity concern as such. The results demonstrate a positive correlation between the implied cost of equity, as well as, between the implied cost of equity and leverage. The correlation of the implied cost of equity is shown to be negative with profitability and liquidity. These findings are consistent with the regression results presented in the following sections.

5.2 Regression Results

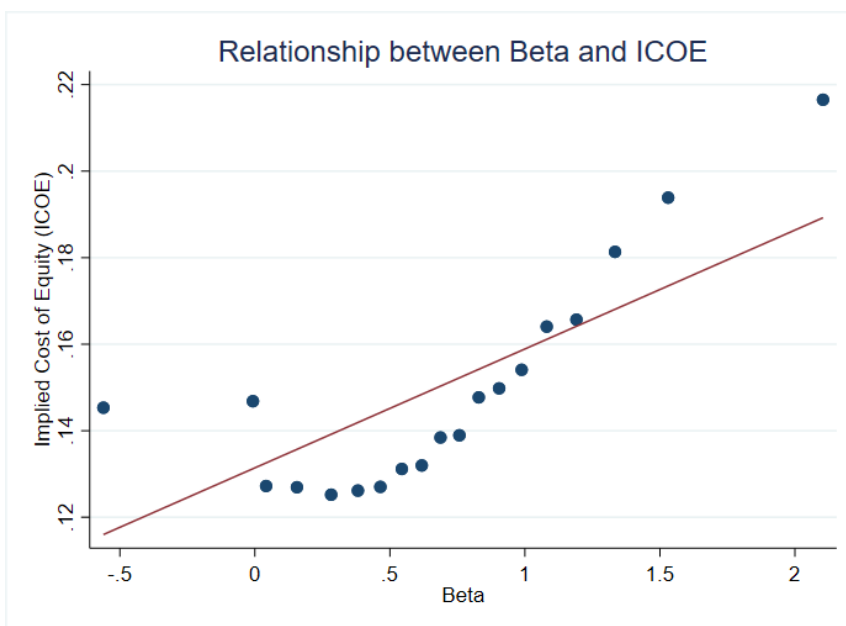


Figure 3. Relationship between Beta and the Implied Cost of Equity

Figure 3 demonstrates the positive correlation between beta and the implied cost of equity. The figure includes binned averages from the sample to reduce noise across all observations and better illustrate the relationship. The visual graph shows consistency with the regressions findings, as explored in the following sections.

5.2.1 Pooled OLS Regression

First, a pooled OLS regression is employed using year fixed effects. Year fixed effects are added to capture time-specific factors impacting all firms. The regression gives initial

insights into how the relationship between systematic risk and the implied cost of equity looks.

Table 6. Pooled OLS regression

Variables	(1) OLS
<i>Beta</i>	0.005*** (0.001)
<i>Size (ln Market Capitalization)</i>	-0.021*** (0.000)
<i>Leverage (Debt / Assets)</i>	0.093*** (0.008)
<i>Profitability (ROE)</i>	-0.016 (0.012)
<i>Liquidity (Current Ratio)</i>	-0.0002*** (0.000)
<i>Constant</i>	0.429*** (0.005)
<i>Observations</i>	51,552
<i>R-squared</i>	0.187
<i>Year Fixed Effects</i>	Yes
<i>Firm Fixed Effects</i>	No

The dependent variable is the implied cost of equity (ICOE). Year fixed effects are included. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5 provides pooled ordinary least squares (OLS) regression results with year fixed effects. Beta serves as the main explanatory variable while the implied cost of equity (ICOE) is the main dependent variable. Additionally, the regression includes firm-level control variables. The detailed version of the results with year specifications is presented in Appendix 3.

The beta coefficient 0.005 is positive and statistically significant at the 1% level. This confirms that higher systematic risk does increase the implied cost of equity. This finding aligns with prior literature and theories, as asset pricing models predict a positive correlation between risk and expected returns. The result is also consistent with the study's hypotheses.

Table 5 reports a negative and statistically significant coefficient of -0.021 for firm size. This finding indicates that bigger firms have a lower level of cost of equity. Leverage has a positive and significant coefficient related to the implied cost of equity. This finding suggests that higher debt increases the cost of equity. Profitability, measured by return on equity (ROE), has a negative coefficient and is statistically insignificant. The negative coefficient confirms that more profitable firms reduce the cost of equity. The insignificance means a weaker role in explaining the variation the implied cost of equity in the sample. Liquidity, measured by the current ratio, has a negative and statistically significant coefficient. This means that firms with efficient financial health lower the cost of equity, and the significance level shows its strong ability to explain the variation of depended variable.

The OLS regression has 0.187 as its R-squared value, which demonstrates that the model accounts for 18.7% of total variance in the implied cost of equity. Year dummy variables control for year-specific factors that may have influenced the firms during the sample period. Overall, the OLS regression results indicate a positive relationship between systematic risk and the implied cost of equity.

5.2.2 Fixed Effects Model

The results of the OLS model can be biased by unobservable firm-specific characteristics, which are addressed in the following model by including firm fixed effects.

Table 7. Fixed Effects Regression Results

Variables	(1)
<i>Beta</i>	0.001** (0.001)
<i>Size (In Market Capitalization)</i>	-0.052*** (0.002)
<i>Leverage (Debt / Assets)</i>	0.095*** (0.015)
<i>(Profitability (ROE)</i>	-0.007 (0.006)
<i>Liquidity (Current Ratio)</i>	-0.0001 (0.000)
<i>Constant</i>	0.846*** (0.024)
<i>Observations</i>	51,552
<i>Number of Firms</i>	6,844
<i>R-squared (within)</i>	0.148
<i>Year Fixed Effects</i>	Yes
<i>Firm Fixed Effects</i>	Yes
<i>Clustered Standard Errors (Firm-Level)</i>	Yes

The dependent variable is the implied cost of equity (ICOE). Firm fixed effects and year fixed effects are included. Standard errors are clustered at the firm level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6 summarizes the findings from fixed effects regression model. Fixed effects help control for time invariant firm-level characteristics, while year fixed effects allow for controlling macroeconomic impacts in the firms across the sample. The detailed version of the results with year and firm specifications is presented in Appendix 4.

The beta coefficient 0.001 is positive and statistically significant at the 5% level, confirming that an increase in systematic risk leads to an increase in the implied cost of equity. The magnitude of the coefficient is lower compared to the OLS model, suggesting that some of the impact in the OLS results is affected by firm-specific factors. However, the significance level is similar, and the relationship remains robust after accounting for firm-level heterogeneity.

Many of the control variable coefficients remain similar in terms of significance in the fixed effects model. The coefficient of the size variable -0.052 is negative and highly statistically significant at the 1% in relation to the implied cost of equity. This result further proves that size increase in firms reduces the cost of equity. Similarly, leverage remains positive and statistically significant, confirming that, an increase in debt increases the implied cost of equity. Profitability remains negative and insignificant. Liquidity coefficient, however, is not statistically significant in the fixed-effects model, unlike in the OLS results. This indicates that firm-level differences could make the relationship statistically significant rather than changes within companies over time.

The R-squared value is 0.148, indicating that the model accounts for approximately 14.8% of the variation in the implied cost of equity across firms over time. On the whole, the findings of the fixed effects model show that the positive correlation between systematic risk and the implied cost of equity is indeed robust.

5.3 Robustness Analysis

Robustness checks are employed to ensure the results of the main regressions are reliable and not affected by specifications in the sample data.

5.3.1 Alternative Beta Estimation

The first robustness check involves estimating alternative firm-level betas and performing the fixed effects regression with the new estimated betas to compare with

the main fixed effects regression that uses DataStream betas. Firm-level betas are calculated and regressed using a rolling 60-month window of monthly firm returns on the STOXX Europe 600 Total Return Index. This approach helps capture how beta changes over time, showing the variation in systematic risk. The estimated monthly beta values are annualized to match the main dataset's time scale. The sample size is reduced because of the need for at least 60 monthly observations for calculating the betas, which is why firms with missing or short return histories are eliminated. This robustness check ensures that the baseline findings do not depend on the usage of betas from Datastream. The main results are presented in Table 7. The detailed regression with year specifications is reported in Appendix 5.

Table 8. Fixed Effects Regression Results: Baseline vs. Estimated Beta

Variables	(1) FE Baseline	(2) Estimated Beta
<i>Beta</i>	0.001** (0.001)	-
<i>Estimated Beta</i>	-	0.00515** (0.00250)
<i>Size (In Market Capitalization)</i>	-0.052*** (0.002)	-0.0396*** (0.00312)
<i>Leverage (Debt/Assets)</i>	0.095*** (0.015)	0.0892*** (0.0208)
<i>Profitability (ROE)</i>	-0.007 (0.006)	-0.251*** (0.0569)
<i>Liquidity (Current Ratio)</i>	-0.0001 (0.000)	0.000464 (0.00117)
<i>Constant</i>	0.846*** (0.024)	0.674*** (0.0430)
<i>Observations</i>	51,552	6,572
<i>Number of Firms</i>	6,844	595
<i>R-squared (within)</i>	0.148	0.249

<i>Year Fixed Effects</i>	Yes	Yes
<i>Firm Fixed Effects</i>	Yes	Yes
<i>Clustered SE (Firm-level)</i>	Yes	Yes

The dependent variable is the implied cost of equity (ICOE). Firm fixed effects and year fixed effects are applied. Standard errors are clustered at the firm level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The findings of the table 7 show the robustness of the baseline results. The estimated beta has a positive, statistically significant coefficient at the 5% level, which is similar to beta coefficient provided by DataStream in the main baseline fixed effects regression. The results confirm that higher beta, or systematic risk, is associated with a higher implied cost of equity. Table 7 shows that this finding is consistent across both models, as the Datastream beta and estimated betas exhibit a positive and significant relationship. The only difference is in the magnitude of the estimated beta coefficient, which is slightly larger and is 0.00515, while Datastream beta coefficient is 0.001. The difference can be explained by the estimation approach and the much smaller size of the sample. The need for at least 60 monthly observations to calculate rolling betas is the reason the sample size was reduced in the new estimation approach.

Control variables coefficients in the new regression model remain mostly similar, further confirming the robustness of the baseline findings. Firm size continues with its negative and highly significant coefficient, and leverage coefficient remains positive and significant. However, in contrast to the baseline regression, profitability becomes significant in the robustness model, while maintaining its negative effect. Liquidity coefficient is statistically insignificant in both models.

On the whole, the robustness model suggests that the main conclusions of the baseline model are not affected by the selection of the beta measure. The positive association of

systematic risk and the implied cost of equity remain robust to alternative beta calculation method.

5.3.2 Winsorization of ICOE

In order to make sure that the results of the main regressions are not affected by extreme values of the implied cost of equity, winsorization approach is used. It reduces the impact of outliers. The dependent variable is winsorized at the 1st and 99th percentiles. The results of this approach are demonstrated in table 7. The detailed version of the regression with year specifications is presented in Appendix 6.

Table 9. Winsorized ICOE

Variables	(1) (Winsorized)
<i>Beta</i>	0.001** (0.000)
<i>Size (In Market Capitalization)</i>	-0.050*** (0.002)
<i>Leverage (Debt / Assets)</i>	0.091*** (0.014)
<i>Profitability (ROE)</i>	-0.006 (0.005)
<i>Liquidity (Current Ratio)</i>	0.000 (0.000)
<i>Constant</i>	0.820*** (0.022)
<i>Observations</i>	51,552
<i>Number of Firms</i>	6,844
<i>R-squared (within)</i>	0.151
<i>Year Fixed Effects</i>	Yes
<i>Firm Fixed Effects</i>	Yes

Clustered Standard Errors

Yes

The dependent variable is the winsorized implied cost of equity (ICOE), where extreme values are winsorized at the 1st and 99th percentiles. Firm and year fixed effects are included. Standard errors are clustered at the firm level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7 shows that the winsorized model findings are consistent with the main regression results, which means that the results are not driven or affected by extreme values regarding the implied cost of equity. The coefficient of beta after this robustness check still remains positive and statistically significant at the 5% level, confirming that higher systematic risk increases the implied cost of equity.

Firm size continues with a negative and highly significant coefficient, while leverage maintains a positive and statistically significant coefficient. These results align with the main regression findings and show that a firm's size and capital structure affect the implied cost of equity. The profitability and liquidity coefficient, in return, do not show a significant effect in the relationship with the implied cost of equity. This indicates that their impact is rather weak and possibly sensitive to the presence of extreme values in the sample. The R-squared value shows that the model explain 15,1% of the variation.

In conclusion, the findings of this winsorized model confirm that the main results are not driven by extreme values in the sample. highlights that the association of beta and the implied cost of equity is not affected by outliers in the sample, confirming the reliability of the results.

5.3.3 Forecast Cleaning and Economic Restrictions

In order to further test the validity and reliability of the main results, the next robustness check is done by employing even a stricter specification of the implied cost of equity by applying economic restrictions on the forecasts of the analysts. More specifically, all observations with negative expected earnings growth ($EPS_2 \leq EPS_1$) and negative ICOE

values are removed. The results of this robustness model are presented in Table 8. The detailed version with year specifications is presented in Appendix 7.

Table 10. Cleaned ICOE

Variables	(1) (Cleaned)
<i>Beta</i>	0.001* (0.001)
<i>Size (ln Market Capitalization)</i>	-0.056*** (0.002)
<i>Leverage (Debt / Assets)</i>	0.086*** (0.022)
<i>Profitability (ROE)</i>	-0.011 (0.010)
<i>Liquidity (Current Ratio)</i>	0.000 (0.000)
<i>Constant</i>	0.846*** (0.024)
<i>Observations</i>	50,109
<i>Number of Firms</i>	6,788
<i>R-squared (within)</i>	0.171
<i>Year Fixed Effects</i>	Yes
<i>Firm Fixed Effects</i>	Yes
<i>Clustered Standard Errors</i>	Yes

The dependent variable implied cost of equity (ICOE) is calculated using a restricted sample where observations with non-positive expected earnings growth ($Eps2 < EPS1$) and non-positive ICOE values are eliminated. Firm and year fixed effects are included. Standard errors are clustered at the firm level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8 presents the findings from the fixed effects regression utilizing the cleaned ICOE sample. After applying stricter economic restrictions, the sample size is reduced. The

number of observations decreased from 51,552 to 50,109, and the number of firms decreased from 6,844 to 6,788. The robustness model shows that the coefficient of beta remains positive, however, its significance level has decreased to the 10% level. This indicates that the correlation between systematic risk and the implied cost of equity is still present, but it is weaker when stricter conditions for analyst forecasts are applied.

Firm size coefficient remains negative and highly statistically significant, and leverage similarly maintains its coefficient, which is positive and significant. Profitability and liquidity persist in similar insignificance and thus are aligned with the fixed effects findings.

In all, the results demonstrate that the main findings remain robust in the major level, even after employing stricter conditions to the implied cost of equity values. However, the model highlights that the relationship of systematic risk and the implied cost of equity is sensitive on some level to the estimation of the implied cost of equity, which is proven with the decrease in statistical significance of beta and the reduced amount of observations. On the other hand, as the coefficients remain broadly similar to the baseline models, it is safe to say that the main regression results are reliable and the correlation of beta and implied cost of equity is indeed positive and significant.

5.3.4 Full Winsorization of Variables

In addition to winsorizing the implied cost of equity, the next robustness model expands the winsorization to all the variables to address the possible effects of any outliers impacting DataStream betas or the control variables. All of the variables, including the implied cost of equity, beta, and control variables are winsorized at the 1st and 99th percentiles to control for the potential impact of extreme values. The results are reported in Table 11 below. The detailed version of the results are presented in Appendix 8.

Table 11. Fixed Effects Regression Results: FE Baseline vs Winsorized Model

Variables	(1) FE Baseline	(2) Winsorized
<i>Beta</i>	0.001** (0.001)	0.0098*** (0.002)
<i>Size (ln Market Cap)</i>	-0.052*** (0.002)	-0.038*** (0.002)
<i>Leverage</i>	0.095*** (0.015)	0.077*** (0.008)
<i>Profitability (ROE)</i>	-0.007 (0.006)	-0.290*** (0.013)
<i>Liquidity (Current Ratio)</i>	-0.0001 (0.000)	-0.002** (0.001)
<i>Constant</i>	0.846*** (0.024)	0.651*** (0.021)
<i>Observations</i>	51,552	51,552
<i>Number of Firms</i>	6,844	6,844
<i>R-squared (within)</i>	0.148	0.220
<i>Year Fixed Effects</i>	Yes	Yes
<i>Firm Fixed Effects</i>	Yes	Yes
<i>Clustered Standard Errors</i>	Yes	Yes

The dependent variable is the implied cost of equity (ICOE). Firm and year fixed effects are included. Standard errors are clustered at the firm level and reported in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11 reports a comparison of the baseline fixed effects regression model with the fully winsorized model. The winsorized model of all the variables shows that findings remain robust with the baseline findings. The beta coefficient remains positive and significant further confirming the main hypothesis of the study; a higher systematic risk is associated with a higher cost of equity. Furthermore, it increases in significance level.

Firm size and leverage continue with similar outcomes, positive and statistically significant coefficients. Profitability and liquidity, however, report significant coefficients in the winsorized model opposite to the baseline model, suggesting that outliers or extreme values could have influenced their estimations in the fixed effects model. Overall, the results increase the reliability of the study's main hypotheses.

5.4 Model Comparison Table

Table 12 presents a comparison of the results of all regression models used in the study.

Table 12. Comparison of All Regression Model Results

Variables	(1) OLS	(2) FE Baseline	(3) Estimated Beta	(4) Winsorized
<i>Beta</i>	0.005*** (0.001)	0.001** (0.001)	-	0.0098*** (0.002)
<i>Estimated Beta</i>	-	-	0.00515** (0.00250)	-
<i>Size</i>	-0.021*** (0.000)	-0.052*** (0.002)	-0.0396*** (0.00312)	-0.038*** (0.002)
<i>Leverage</i>	0.093*** (0.008)	0.095*** (0.015)	0.0892*** (0.0208)	0.077*** (0.008)
<i>Profitability</i>	-0.016 (0.012)	-0.007 (0.006)	-0.251*** (0.0569)	-0.290*** (0.013)
<i>Liquidity</i>	-0.0002*** (0.000)	-0.0001 (0.000)	0.000464 (0.00117)	-0.002** (0.001)
<i>Constant</i>	0.429*** (0.005)	0.846*** (0.024)	0.674*** (0.0430)	0.651*** (0.021)
<i>Observations</i>	51,522	51,552	6,572	51,552
<i>Number of Firms</i>	6,844	6,844	595	6,844
<i>R-squared (within)</i>	0.187	0.148	0.249	0.220

<i>Year Fixed Effects</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effects</i>	No	Yes	Yes	Yes
<i>Clustered</i>	No	Yes	Yes	Yes
<i>Standard Errors</i>				

The dependent variable is the implied cost of equity (ICOE). Firm and year fixed effects are included. Standard errors are clustered at the firm level and reported in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 12 presents a comparison of all models used in the study. The beta coefficient remains positive and significant across all models, confirming that a higher systematic risk indeed increases the implied cost of equity. While the magnitude of the coefficients differs across the models, the direction remains the same. On the other hand, the significance level increases when alternative beta estimation is used, and when the effect of outliers is removed. The findings of all the models are mainly consistent, confirming the study's main hypotheses.

6 Discussion

This chapter discusses the empirical findings of the study and links them to theoretical aspects and existing literature. It begins with an interpretation of the main results, followed by a comparison with prior literature. Finally, economic implications are discussed. The chapter aims to explore the significance of the findings beyond the empirical analysis.

6.1 Interpretation of Main Findings

The empirical results confirm that there is a positive relationship between systematic risk and the implied cost of equity. The coefficient of beta remains positive and significant across all the models, including the pooled OLS, fixed effects, and robustness tests. This finding reveals that firms with greater market risk face higher expected rates of returns for investors.

According to the fixed effect regression model, which serves as the main model of this study, the positive effect between systematic risk and the implied cost of equity still holds even after including unobserved firm-specific factors into the regression model. Even though the value of the coefficient beta decreases compared to the OLS model, it still remains positive and significant. It can be explained that a part of the correlation in the baseline model is driven by firm-level heterogeneity. In the bigger picture, the strong evidence of the positive relationship confirms that systematic risk impacts the implied cost of equity.

The robustness checks findings also support the main conclusions of baseline models. The first robustness model applied with self-estimated betas using a rolling window of 60 months and STOXX Europe 600 Total Index returns, confirms the main findings of the baseline models with a positive and significant coefficient of beta. The coefficient, however, shows an increased magnitude, which is explained by the reduction in sample size due to the shortage of firms with shorter return histories. The winsorized model

demonstrated that the main results are not affected by extreme values of the implied cost of equity, while the cleaned ICOE model findings support the positive significance of the relationship as well. The cleaned ICOE model, however, highlighted that when strict economic restrictions are kept in mind, the significance level becomes weaker, indicating that although the results are stable and reliable, they may be a little sensitive to the construction of the implied cost of equity.

In terms of the control variables, firm size shows a negative, statistically significant relationship with the implied cost of equity across the models, supporting the idea that larger companies have lower risk and face lower required returns from investors. Leverage is positive and significant in relation of the implied cost of equity, indicating that higher debt increases financial risk, which in turn impacts the cost of equity due to the demand of higher expected returns by investors. Profitability is insignificant in the models, except in the model that uses estimated betas. In the robustness model with estimated betas, profitability is negative and significant, which may reflect differences in sample size and the use of a restrictive calculation approach. The regression models indicate that more profitable firms tend to have a lower implied cost of equity. Liquidity does not show statistical significance in the models, which suggests that it has a weaker role in explaining the variation in the implied cost of equity. However, the full winsorized model shows, that after removing extreme values, all the control variables increase in terms of significance, and have strong relationship with the implied cost of equity. This suggests that extreme values may have affected the control variables in the baseline model, especially with profitability and liquidity variables.

To conclude, the findings support the main hypotheses by providing empirical evidence that higher systematic risk is associated with higher implied cost of equity. This relationship remains aligned across all models. Regarding the the hypotheses on control variables having a significant effect, the hypotheses is partly supported. Firm size and leverage have significant impact on the implied cost of equity, while profitability and liquidity do not. However, the full winsorized model suggests, that these two variables

also have a strong relationship with the implied cost of equity when extreme values are removed.

6.2 Comparison with Existing Literature

The main findings of the study align with both theoretical and empirical literature regarding how systematic risk is associated with expected returns. The CAPM suggests that higher systematic risk, as measured by beta, leads to higher expected returns (Sharpe, 1964; Fama & French, 2004). This is supported by the empirical results of this study, which present a positive and statistically significant relationship between beta and the implied cost of equity across different models. Therefore, the primary finding of the main empirical model is consistent with the prior literature and thus confirms the main hypotheses of the study as well.

However, earlier studies have questioned the effect and the strength of this correlation. Black et al. (1974, pp. 4-6) note that the association between beta and expected returns is weaker than the CAPM predicts. Likewise, Fama and French (1992, pp 427-429) challenge the strength of the relationship between beta and expected returns and propose that firm characteristics such as size can work better in explaining cross-sectional variation in returns compared to beta alone. This is also aligned with the findings of Barroso and Maio (2024, pp. 1-2) that argue that the strength of the risk-return trade-off varies across market segments, indicating that expected returns are influenced by more than market beta alone. Hail and Leunz (2006, pp. 486-487) also take an international view, noting that the cost of equity may vary across countries due to institutional and regulatory differences and further highlighting that expected returns are influenced by factors beyond firm-level risk. The regression results demonstrate this argument as well; across all the models, the coefficient beta is on the smaller side while the other firm-variables, especially size and leverage, have highly significant coefficients in explaining the variation in the implied cost of equity.

The results with the control variables are further consistent with previous research. The relationship between firm size and the implied cost of equity is negative which supports the argument of larger companies facing less risk due to high diversification and cash flow (Fama & French, 1992, p. 427). The positive effect of leverage is also consistent with earlier studies: debt levels increase, financial risk rises, which in turn leads to higher returns demanded by equity investors. On the other hand, the regression findings show that profitability and liquidity are not significant factors when it comes to the implied cost of equity. This aligns with the theoretical aspects of multifactor models, which indicate that the effect of firm-level characteristics depends on the measurement technique and the empirical setting (Fama & French, 2015, pp. 3-5).

The utilization of the implied cost of equity as a forward-looking measure of expected returns is a fundamental contribution of the study. According to Easton (2004, pp. 73-74) when the implied cost of equity is measured with the information of current stock prices and analyst earnings forecasts, the estimates provide a direct view of investor expectations. This model does not depend on historical data and also helps avoid the mechanical relationship between returns and beta that would be caused in terms of the CAPM model. Other studies support this approach of the implied cost of equity measurement. For instance, Gebhart et al. (2001, pp. 135-136) note that the estimates of the implied cost of equity differ systematically across firms based on their characteristics, while Hou et al. (2012, p 13) highlight the ability of these estimates to be useful sources of information looking into expected returns.

All in all, the regression model results confirm the significant impact of systematic risk as a determinant of the cost of equity, as well as highlighting the previous empirical literature regarding the role of firm-specific factors in influencing the expected returns.

6.3 Economic Implications

There are several economic implications arising from this study's findings. For firms, the positive association between systematic risk and the implied cost of equity indicates that

market risk remains to be a crucial determinant of a firm's cost of capital. For investors, firms with higher risk are required to generate higher returns, highlighting the importance of portfolio allocation decisions.

For firms, it is crucial to manage both systematic and financial risk. Based on the results, a higher level of debt leads to more demand for expected returns from investors, therefore firms need to balance their capital structure to ensure leverage remains lower, which would reduce their financing costs. The negative relationship of firm size and the implied cost of equity indicates that bigger firms benefit from lower risk, suggesting that firms should focus on more diversification. The mixed findings on profitability and liquidity suggest that not all firm-level factors affect the cost of capital in the same way, emphasizing the importance of focusing on risk-related factors, for both firms and investors.

Overall, the study highlights that while systematic risk maintains its essential role, the cost of equity depends on a combination of market risk and firm-level characteristics.

7 Conclusion

This chapter presents a summary of the main findings of the study along with possible limitations. Finally, suggestions for future research are discussed.

7.1 Summary of Findings

This study analyses the impact of systematic risk on the implied cost of equity using a sample of Eurozone firms for the time period of 2010-2024. The pooled OLS and the fixed effects regression model results confirm the presence of a positive and significant relationship between beta and the implied cost of equity. The main results indicate that the more a firm is exposed to market risk, the more investors demand expected returns, which is consistent with the asset pricing theories. The correlations of beta and the implied cost of equity stay robust even after applying several robustness checks, including a robustness model with self-estimated betas and comparing to the baseline regressions, winsorization of the implied cost of equity, and lastly, cleaning the implied cost of equity by applying more restrictions on the implied cost of equity values, especially regarding analyst forecasts.

In terms of the control variables, firm size arises a negative and highly significant firm-specific characteristic impacting the implied cost of equity, while leverage shows a positive relationship. In contrast, profitability and liquidity seem to have no significance related to the implied cost of equity, which reflects their weaker role in explaining the variation in the implied cost of equity. However, profitability shows significance in the robustness model with self-estimated betas. In contrast to baseline models, all control variables, including profitability and liquidity, show stronger significance once the outliers are controlled.

In conclusion, the findings align with the study's main hypothesis by providing evidence that systematic risk increases the cost of equity, and that firm-level factors also play an important role in the equation.

7.2 Limitations

This study is exposed to a few limitations that should be kept in mind when interpreting the results. For instance, the implied cost of equity estimation follows the Easton (2004) model, which is based on the analyst's earnings forecasts and stock prices. This model gives a forward-looking measure of expected returns. The limitation comes from the availability of earnings forecast data. This could affect the estimates of the implied cost of equity. The sample is limited since it includes only European publicly listed non-financial firms, which can impact the results, as there may be variations in terms of other countries or private firms. Different countries have varying regulatory frameworks, market structures, and investor behaviour, which all have their own influence on the relationship of risk and return.

Finally, the study mainly concentrates on systematic risk by a beta measure and a limited number of control variables. Other crucial firm-specific factors or other risk measures are not included in the analysis. Adding more control variables or other risk measures could show different insights into the relationship between beta and the implied cost of equity.

7.3 Suggestions for Future Research

The study could be extended in many ways. For example, the implied cost of equity can be estimated using different models. This study uses the Easton (2004) model, while there are many other approaches that could offer varying perspectives on expected returns. Another way the study could be extended is by adding other risk factors or firm characteristics. For instance, multifactor asset pricing models or alternative risk measures may reveal further insights into the correlation with the cost of equity.

Future studies could also extend the analysis by including international markets or employing cross-country comparisons. This would address the generalization of the results. Finally, the relationship of systematic risk and the cost of equity could be

explored within different economic conditions or interest rates, which could offer evidence in understanding asset pricing models or other theories.

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Appendices

Appendix 1. Descriptive Statistics

```
. tabstat icoe beta ln_mktcap leverage roe current_ratio if reg_sample == 1, st
> ats(n mean sd min p25 median p75 max) columns(statistics)
```

variable	N	mean	sd	min	p25	p50
icoe	51552	.1474776	.1296598	0	.0724725	.1107065
beta	51552	.6717972	1.376931	-123.26	.231	.66
ln_mktcap	51552	13.8544	2.352999	3.258096	12.09024	13.82745
leverage	51552	.2712387	.2096469	0	.140672	.2546193
roe	51552	.0064902	.4906819	-90.85597	.0032068	.0308078
current_ratio	51552	1.817308	6.770615	.0228991	1.019111	1.359242

variable	p75	max
icoe	.1777047	1
beta	1.03805	111.312
ln_mktcap	15.62682	19.71935
leverage	.3738678	9.350064
roe	.0592358	16.24628
current_ratio	1.898073	709.5

Appendix 2. Correlation Matrix

	icoe	beta	ln_mktcap	leverage	roe	current_ratio
icoe	1.0000					
beta	0.0672 0.0000	1.0000				
ln_mktcap	-0.3835 0.0000	0.0235 0.0000	1.0000			
leverage	0.1484 0.0000	-0.0024 0.4791	-0.0278 0.0000	1.0000		
roe	-0.0909 0.0000	0.0010 0.7596	0.0041 0.1580	-0.0101 0.0003	1.0000	
current_ratio	-0.0030 0.4911	-0.0072 0.0340	-0.0218 0.0000	-0.0003 0.9083	0.0003 0.9114	1.0000

Appendix 3. OLS Regression

Linear regression	Number of obs	=	51,552
	F(21, 51530)	=	353.35
	Prob > F	=	0.0000
	R-squared	=	0.1874
	Root MSE	=	.1169

icoe	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
beta	.0054559	.0014727	3.70	0.000	.0025694	.0083424
ln_mktcap	-.0206389	.0003658	-56.42	0.000	-.0213559	-.0199219
leverage	.0929737	.007517	12.37	0.000	.0782402	.1077071
roe	-.0155833	.0122495	-1.27	0.203	-.0395925	.0084258
current_ratio	-.0002271	.0000694	-3.27	0.001	-.0003631	-.000091
year						
2010	-.0221489	.0036706	-6.03	0.000	-.0293434	-.0149544
2011	-.0239929	.0039968	-6.00	0.000	-.0318267	-.0161591
2012	-.0238193	.0038852	-6.13	0.000	-.0314343	-.0162044
2013	-.0237124	.0037348	-6.35	0.000	-.0310326	-.0163922
2014	-.0243272	.0036316	-6.70	0.000	-.0314452	-.0172092
2015	-.0299972	.003614	-8.30	0.000	-.0370807	-.0229138
2016	-.0358352	.0035231	-10.17	0.000	-.0427405	-.0289298
2017	-.0440694	.0033663	-13.09	0.000	-.0506675	-.0374714
2018	-.0320019	.0035038	-9.13	0.000	-.0388693	-.0251344
2019	-.0360286	.0035138	-10.25	0.000	-.0429158	-.0291415
2020	.0010878	.0037348	0.29	0.771	-.0062325	.0084082
2021	-.030275	.0034756	-8.71	0.000	-.0370873	-.0234627
2022	-.0257545	.0035797	-7.19	0.000	-.0327708	-.0187383
2023	-.0302543	.0034683	-8.72	0.000	-.0370523	-.0234563
2024	-.0131579	.0034617	-3.80	0.000	-.0199429	-.006373
2025	-.0188249	.0034954	-5.39	0.000	-.0256759	-.011974
_cons	.4294756	.0053904	79.67	0.000	.4189105	.4400408

Appendix 4. Fixed Effects Regression

```

Fixed-effects (within) regression      Number of obs   =   51,552
Group variable: firm_id              Number of groups =    6,844

R-sq:                                Obs per group:
    within = 0.1475                    min =           1
    between = 0.2382                   avg =           7.5
    overall = 0.1681                   max =          17

corr(u_i, Xb) = -0.6260                F(21,6843)     =    92.48
                                        Prob > F       =    0.0000

```

(Std. Err. adjusted for 6,844 clusters in firm_id)

icoe	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
beta	.0010743	.0005347	2.01	0.045	.0000262	.0021225
ln_mktcap	-.052229	.0017036	-30.66	0.000	-.0555686	-.0488893
leverage	.0946017	.0152301	6.21	0.000	.0647459	.1244575
roe	-.0066084	.0056175	-1.18	0.239	-.0176204	.0044036
current_ratio	-.0000994	.0001191	-0.84	0.404	-.0003328	.0001339
year						
2010	-.0176876	.0024989	-7.08	0.000	-.0225863	-.0127889
2011	-.0259443	.003081	-8.42	0.000	-.0319839	-.0199046
2012	-.0219352	.0030121	-7.28	0.000	-.0278399	-.0160305
2013	-.0143481	.0029235	-4.91	0.000	-.0200791	-.008617
2014	-.0118035	.0030125	-3.92	0.000	-.0177089	-.0058982
2015	-.0101366	.0030912	-3.28	0.001	-.0161963	-.004077
2016	-.0153659	.0031897	-4.82	0.000	-.0216186	-.0091131
2017	-.0132163	.0031752	-4.16	0.000	-.0194406	-.006992
2018	-.0074551	.0032437	-2.30	0.022	-.0138139	-.0010964
2019	-.0088704	.0031196	-2.84	0.004	-.0149857	-.0027551
2020	.0342719	.0034578	9.91	0.000	.0274935	.0410503
2021	.0097699	.0034147	2.86	0.004	.003076	.0164638
2022	.0082876	.0033855	2.45	0.014	.0016509	.0149243
2023	.007875	.003346	2.35	0.019	.0013158	.0144343
2024	.0173352	.0032961	5.26	0.000	.0108739	.0237966
2025	.0148666	.0034247	4.34	0.000	.0081532	.02158

Appendix 5. Estimated Beta

```

Fixed-effects (within) regression      Number of obs   =   6,572
Group variable: firm_id_num           Number of groups =   595

R-sq:                                  Obs per group:
    within = 0.2489                    min =           1
    between = 0.3784                   avg =          11.0
    overall = 0.2542                   max =           16

corr(u_i, Xb) = -0.5484                F(20,594)       =   24.80
                                         Prob > F         =   0.0000

```

(Std. Err. adjusted for 595 clusters in firm_id_num)

icoe_w	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
beta_hat	.005153	.0025014	2.06	0.040	.0002405	.0100656
ln_mktcap	-.0395765	.0031168	-12.70	0.000	-.0456978	-.0334552
leverage	.089169	.0208477	4.28	0.000	.0482249	.1301131
roe	-.2514298	.0568971	-4.42	0.000	-.3631738	-.1396858
current_ratio	.000464	.0011708	0.40	0.692	-.0018353	.0027633
year						
2011	-.0080945	.0047873	-1.69	0.091	-.0174966	.0013077
2012	-.0084954	.004644	-1.83	0.068	-.017616	.0006253
2013	.0016133	.0041977	0.38	0.701	-.0066308	.0098575
2014	.0035474	.0041846	0.85	0.397	-.004671	.0117658
2015	.0016279	.0042018	0.39	0.699	-.0066243	.0098801
2016	-.0021249	.0040329	-0.53	0.598	-.0100454	.0057955
2017	.0004329	.004255	0.10	0.919	-.0079237	.0087896
2018	.0089928	.0042858	2.10	0.036	.0005755	.01741
2019	-.0011854	.0044844	-0.26	0.792	-.0099926	.0076217
2020	.0410075	.005378	7.63	0.000	.0304454	.0515697
2021	.024327	.0052864	4.60	0.000	.0139447	.0347093
2022	.0178031	.0053179	3.35	0.001	.0073589	.0282473
2023	.0121956	.0045859	2.66	0.008	.0031891	.0212021
2024	.0195547	.0051449	3.80	0.000	.0094504	.0296591
2025	.0213096	.0049768	4.28	0.000	.0115353	.0310839
_cons	.6742242	.0429992	15.68	0.000	.5897754	.7586731
sigma_u	.06888984					
sigma_e	.06140214					
rho	.55727941	(fraction of variance due to u_i)				

Appendix 7. Cleaned ICOE

Fixed-effects (within) regression	Number of obs	=	50,109
Group variable: firm_id	Number of groups	=	6,788
R-sq:	Obs per group:		
within = 0.1708	min =		1
between = 0.2703	avg =		7.4
overall = 0.1894	max =		17
	F(21,6787)	=	102.13
corr(u_i, Xb) = -0.6454	Prob > F	=	0.0000

(Std. Err. adjusted for 6,788 clusters in firm_id)

icoe	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
beta	.0009775	.0005196	1.88	0.060	-.0000411	.0019961
ln_mktcap	-.0555252	.0017754	-31.28	0.000	-.0590055	-.0520449
leverage	.0857939	.0218933	3.92	0.000	.0428763	.1287116
roe	-.011232	.0099703	-1.13	0.260	-.0307769	.0083128
current_ratio	-.0001208	.0001175	-1.03	0.304	-.0003511	.0001094
year						
2010	-.0189924	.0024258	-7.83	0.000	-.0237477	-.0142371
2011	-.0235941	.0029391	-8.03	0.000	-.0293556	-.0178326
2012	-.0203463	.002883	-7.06	0.000	-.0259979	-.0146947
2013	-.0146826	.0028257	-5.20	0.000	-.0202218	-.0091433
2014	-.0126727	.0028917	-4.38	0.000	-.0183414	-.007004
2015	-.0105399	.0029697	-3.55	0.000	-.0163616	-.0047183
2016	-.0151869	.0030387	-5.00	0.000	-.0211437	-.0092301
2017	-.0108127	.0030169	-3.58	0.000	-.0167267	-.0048987
2018	-.0045894	.0030539	-1.50	0.133	-.0105761	.0013972
2019	-.0069342	.003165	-2.19	0.028	-.0131386	-.0007297
2020	.0379808	.0035236	10.78	0.000	.0310734	.0448882
2021	.0148433	.0034001	4.37	0.000	.0081779	.0215086
2022	.0119672	.0033813	3.54	0.000	.0053388	.0185957
2023	.0129638	.0033175	3.91	0.000	.0064605	.0194671
2024	.0194849	.0033319	5.85	0.000	.0129534	.0260164
2025	.0175315	.00345	5.08	0.000	.0107685	.0242945

