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Study of Capital Asset Pricing Model in Nordic Stock Market

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Abstract

This study focused on studing the impacts of using CAMP in estimating the performance of the Nordic stock market. Random sampling was used and a total of 35 companies were selected for the case study. CAPM formula, as formualted by previous studies, was used to estimate the performance of these companies and various anayses has done on the data including regression, t-test and Jensen alpha tests.

From the descriptive statistics, it was found that the average beta was 0.0191 while the maximum beta was 0.759. This implies that the selected Nordic stocks had a systematic risk of 99% lower than the index. Further, Jensen Alpha analysis showed that the Nordic stock has outperformed the market's expected return based on CAPM productions. However, looking at the t-test values, there has been a significant change in the systematic risk in Nordic stocks and at the same time, there has been a significant change in the unsystematic risk of this market. The regression analysis shows that there was a positive association betwen beta and daily returns with an increase in beta leading to a possible increase in actual return. Therefore, the finding was not statistically significant. The expected return was also calculated. The finding showed that beta is not the only factor to be considered when making investments in the Nordic stock markets.

In conclusion, the study finds that CAPM is not an accurate model to be used in measuring the expected returns of investments in the Nordic markets.

Keywords/tags
Risk and return, CAPM, Jensen Alpha, Regression, t-Test, Nordic stock market

Miscellaneous

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1. INTRODUCTION

Capital Asset Pricing Model (CAPM) is one of the most significant concepts in finance. The model argues that the required return on asset is influenced by its systematic risk. The model is applied in estimating returns on assets, including stocks. However, several researchers have argued that the CAPM does not hold in stock markets. This thesis examines the relationship between risk and return of Nordic stocks, thereby assessing the validity of the CAPM in the Nordic Stock Market. It analyses the returns on 35 stocks to determine whether the Nordic Stock Market has underperformed or outperformed, based on the CAPM expected returns. It also tests whether systematic risk of Nordic stocks has changed between 2009 and 2019.

1.1 Background

The primary motivation for most investors is making a return on their investments. Nearly everything an investor doesin relation to their investment is geared towards ensuring that an investment that is making profits continues to make the same profit at the very least, and if possible, that the investment starts to make even more profit. By the same token, investors are as well likely to divest away from an investment if it is only returning losses with no potential for profit. While, it is clear what investors hope for, the reality is that some investors still make losses sometimes, even if this is not what they hoped for. Markowitz (2016) argues that his happens because of the challenges associated with making predictions about future profits. While technologies, historical financial data analysis skills, and investment models can be used to predict the behavior of stocks, the risks of losses cannot be eliminated entirely. Thus, investors always have to accept some level of risk when making their investments.

The question therefore shifts from whether the investor can eliminate all risks while making investment decisions, to how the investors can manage the risks associated with their investments.

By shifting the question, the focus therefore turns to the relationship between risk and return, a concept that has been examined at length by both scholars and investors. Brealey, Myers and Allen (2011) rightly points out that risk-return relationship is one of the most significant aspects considered in various investment decisions. According to Gitman, Joehnk & Smart (2015), the risk associated with an investment determines the investor's expected return, whereby the higher the risk, the more chances are of a higher return. This is the basis of the tradeoff theory, and what this means for investors is that they always have to choose between the two conflicting goals: minimizing risk ormaximising returns. Brigham & Houston (2016) further notes that most investment managers know this, and for that reason, they employ the use of various models to help predict the estimated risks and the expected returns of their portfolio. One popularly used model is the capital asset pricing model (CAPM).

The CAPM is applied in determining the relationship between risk and return on an investment. According to Watson and Head (2016), unsystematic risk is ignored in portfolio management and other investment decisions, since it can be eliminated through diversification. The concept of CAPM is also applied in estimating the cost of capital, which is used in investment appraisal decisions. This is vital in assessing the viability of projects using the net present value (NPV) criterion. Long-term investments such as purchase of fixed assets, expansion, and introduction of new products, among others are appraised using NPV. The NPV discounts all the expected cash flows at the company's cost of capital.

The CAPM lays the foundation for the relationship between risk and return (Brealay, Myers, and Allen 2011). It argues that investors are risk-averse and require a higher return on an asset associated with a high risk. It implies that if an investment has a high risk, it must generate a high return to attract investors. The CAPM posits that risk can be divided into systematic and unsystematic risk. Systematic risk relates to market-wide factors and cannot be eliminated by diversification, while unsystematic risk is due to firm and industry-specific factors. Systematic risk is measured by beta, which measures an asset's risk relative to the market risk. The model assumes that investors can eliminate all the unsystematic risk by establishing well-diversified portfolios. Therefore, they base their investment decisions solely on systematic risk. The model is widely used in estimating required returns on stocks and other investments. This thesis investigates the relationship between risk and return of Nordic stocks to assess the validity of the CAPM. It also uses the CAPM to compare the performance of the Nordic stocks with the CAPM's estimated required returns.

Despite is usefulness, questions have emerged regarding the usefulness of CAPM to predict the relationship between risk and return, with some researchers concluding that it does not offer any meaningful estimations of risk and return. The CAPM assumes that returns on an investment depend on the investment's systematic risk since unsystematic risk is irrelevant in investment decisions. However, various researchers have questioned the validity of CAPM and challenged its application in pricing assets. For instance, Dempsey (2013) argues that the empirical evidence against CAPM is so compelling that the model should be abandoned. Östermark (1991) also found evidence against the validity of CAPM in the Finish and Swedish stock markets. The conflicting findings in the various studies that exist so far make it a challenge for managers and investors to know whether CAPM can benefit them or not. Beyond the conflicting findings, fewstudies discuss the significance of CAPM within the Nordic Stock Market, which lead to information gap. This background show why a furtherstudy of CAPM and its usefulness in the Nordic Stock Market is important.

1.2 Research Objective and Questions

The goal of this research is to determine whether CAPM beta (systematic) and total risk explain the cross-section variation in returns on stocks listed on the Nordic Stock Market. To achieve this goal, the following research questions have been deduced:

i. What is the nature and extent of risk in the last 10 years?
ii. Has the Nordic stock market underperformed or outperformed the expected return (CAPM) in the last 10 years?
iii. Is there any change in systematic, unsystematic and total risks in Nordic stock market in the last 10 years between 2009 and 2019?

iv. What is the relationship between risk and return of stocks listed on the Nordic Stock market?

In the first question, CAPM is used to estimate beta and calculate systematic risk. This will help determine the proportion of total risk (standard deviation) that is accounted for by systematic and unsystematic risks. For the second question, Jensen alpha is used to determine the difference between the actual returns on the stocks and the estimated required returns (CAPM returns). Studying the relationship between risk and return helps determine whether the CAPM is valid or not.

1.3 Motivation for the Research

This study is motivated by two reasons, one being a practical justification, and the second being a theoretical justification. The theoretical justification is inspired by the gaps observed in the extent studies as shown in the background. As it is, a number of studies have shown that CAPM can be used to help in estimating risk and return. At the same time, contrasting studies have shown that CAPM is not a sufficient approach to estimate risk and return. Thus, by making an additional study, a review of extant literature is made, which critically examines the findings of previous studies and makes a critical review why CAPM is considered inadequate. The study also presents an updated review of literature, which is far from the authority in the subject, but provides a relevant additional information to both researchers and students of finance management. However, CAPM is a major area of finance which helps investors to know the risk and return. According to ACCA (2019), CAPM was published by William Sharpe in the year 1986. Watson & Head (2016) states that unsystematic risk can be ignored but systematic risk plays a very important role.

Secondly, on a practical level, the resulting controversy on the significance of CAPM makes it harder for managers to make decisions on whether they will adopt the model when making their investment decisions. This thesis may contribute to the knowledge necessary in making investment decisions as it focuses specifically on the relationship between risk and return on Nordic stocks to assess the validity of data. The research determines whether CAPM beta is a significant determinant of the variations in cross-section returns of the Nordic stocks using more recent data from 2009 to 2019. The findings of this thesis can help investors and companies listed on the stock markets of Finland, Denmark and Sweden to better understand the relationship between risk and return.

1.4 Structure of the Thesis

The study is organized into six different chapters. Chapter one discusses the background, aims, and objectives, as well as the justification for studying the CAPM in the Nordic Stock Market. Chapter two reviews theoretical background of CAPM, including its assumptions and its limitations. Chapter three reviews empirical studies on the CAPM and relationship between risk and return, identifying gaps in research. Chapter four of the study explains the research methodology, including a description of the data used and how it is collected, as well as a discussion of the statistical methods applied. The chapter also includes a justification for the models used. Chapter five presents the findings of data analysis, implications of the findings, and links to findings to existing empirical studies. Finally, Chapter six is conclusion of the study, including a summary of the research, limitations of the study, and areas for further research.

2. THEORETICAL BACKGROUND

2.1 Introduction

This chapter discusses the theoretical literature on CAPM and the relationship between risk and return. The first section, theoretical background, defines return, risk, CAPM, expected return and Jensen alpha. The section also highlights the different types of risk, as well as measures for risk and return.

2.2 Return

Brealey, Myers and Allen (2011) define return as the profit or loss on any investment activity. Return includes profit, interest, or dividend earned on an investment, plus capital gains (Watson & Head, 2016). Capital gain or loss refers to the change in the value of the investment over a period. Mayo (2012) identifies three types of return; realized, expected, and required returns.

Realized return is the measure of how much an investor has gained or lost on an investment over the period the investment was held. The realized return on a stock is calculated as follows:

$$\text{Realized return} = \frac{(\text{Ending Price} - \text{Initial Price}) + \text{Dividends}}{\text{Initial Price}} \times 100\%$$

Expected return is the gain or loss an investor anticipates from an investment, based on its historical performance (Mayo 2012). For instance, the expected return on a stock is the historical average return of the return. Under uncertainty, the expected return is calculated as follows:

Expected return $=\sum R_i P_i$, where R_i is the return and P_i is the probability of the condition.

Required return is the minimum return expected on an investment. It is the opportunity cost of capital, that is, the amount an investor would earn on other available market securities. According to Gittman and Zutter (2015), a rational investor cannot commit on an investment if its expected return is lower than the required return. In efficient markets, the expected return is equal to the required return (Ilmanen 2012).

2.3 Risk

According to Yang (2014), the risk which is involved in an investment can indirectly explained with some specific concepts.

2.3.1 Types of Risk

Risk- Here, in the case of investment, the return always remains uncertain because nobody knows the situation of market as well as what will be the situation in the future so there is always some risk involved in every kind of investment. So, risk is all about the uncertainity available in the expected return. Taking risk may lead to an opportunity as well as loss because no one knows what will happen next. Accordingly, every investment involves risk (Bodie et al. 2004).

Risk free- Risk free is a type of return in which investors get some return by the end of their holding period. Here, government bond is also taken as risk free assets due to the fact that government always print money and this is helpful for the investors as they get assured about their investment. Investors need to give some amount in advance so that they will get that amount back at the end of period (Sibilkov 2007).

Risk premium- Risk premium is all about the compensation involved in the investment. This can be measured by the rate of return earned by having the investment from the excess of risk free ROR (Drobny 2010).

Therefore, risk refers to the variability or volatility of returns associated with an investment (Markowitz 2016). Due to changes in the firm's operating conditions, sector and market factors, an investment may not generate the expected return (Markowitz 2016). Therefore, investment decisions must consider both expected returns and risk.

The total risk associated with an investment is measured using the standard deviation. Standard deviation is measure of the variability of returns from the mean return (Watson & Head 2016). It is determined by getting the square of variance as follows:

Var(r) $=\sum_1^n (r_i - \mu)^2$, where r_i is the return and μ is the mean or average return.

Standard deviation = $\sqrt{Var(r)}$

2.3.2 Systematic and Unsystematic return

According to Markowitz (2016), total risk is divided into systematic and unsystematic risk, depending on the contributing factors.

Total Risk = Systematic Risk + Unsystematic Risk

Unsystematic risk: It the risk inherent in a specific firm or industry(Moyer, McGuigan & Kretlow 2005). It is due to factors such as employee strikes, government policy specific to a sector, firm's financial challenges, and unavailability of raw materials, among other firm-specific factors. It is also called diversifiable risk since it can be eliminated through diversification.

Systematic Risk: It is the proportion of total risk that is inherent in the entire market. It is due to market-wide factors and affects all firms or investments irrespective of the sector (Moyer et al. 2005). Causes of systematic risk include changes in interest, inflation, exchange rates, among other market-wide factors (Moyer, et al. 2005). Such factors are beyond the control of a firm or investor. Thus, unsystematic risk cannot be eliminated through diversification (Watson & Head 2016). According to Markowitz (2016), unsystematic risk can be eliminated through diversification, hence investors base their decisions on systematic risk. Systematic risk is measured using beta.

2.3.3 Standard deviation- A Measure of Risk

Bodie at al. (2004) discussed that while making a decision to invest or not, an investor has to take the possible outcomes of investing in current scenario and also HRP stocks in the current scenario. After that, he also needs to caculate the estimated probability of every scenario.

Table 1- Probability of each scenario with certain rate of return [Accessed from Bodie at al. (2004)]

Scenario	Probability, denoted p(s)	HPR, denoted r
1	p1	r1
2	p2	r2
3	p2	r3
....	....	....
s	p(s)	r(s)

Here, an example is taken in the above table where s denotes the number of scenario. The statistical measurement of expected risk and return is presented in the above table of probability distribution. According to the table, HRP is equal to the return on the investment which is expected.

E(Rt)=RtPs where,

Rt denotes realized return of every single stock.

$$Var(r) = \sum_{s=1}^{s} p(s)(R(s) - \mu)^2$$

Variance is used to measure the volatility of the realized return. This is helpful in calculating or estimating the uncertainty of the risk. In addition to that, we take square root of variance for calculating the standard deviation so that the risk taken from expected return must have the same dimensions.

$$\sigma = \sqrt{Var(r)}$$

However, for calculating the stock performances, standard deviation and the expected return are the major parameters (ibid).

2.4 Beta

Beta is a measure of an investment's volatility relative to that of the entire market (Lumby & Jones 2003). For instance, if a stock's beta is 1.2, it implies that the volatility of the stick's returns is 20% greater than that of the market. On the other hand, a beta of 0.8 implies that the stock's risk is 20% lower than that of the market. This also implies that if the market volatility increases by 1 unit, the stock's risk will increase by 0.8 (Lumby & Jones 2003).

Beta is calculated by determining the covariance between the stock's return and the index or benchmark's return divided by the variance of the benchmark's return (Lumby & Jones 2003). Alternatively, it be estimated by getting the regression of a stock's returns on the benchmark's return (Lumby & Jones 2003). It is the coefficient of the benchmark's return in the regression model.

Beta, $\beta = \frac{Cov(r_i, r_b)}{Var(r_b)}$, where r_i represents the stock's returns and r_b returns on the benchmark.

2.5 Capital Asset Pricing Model (CAPM)

CAPM explains the relationship between return and risk. The model was introduced by Jack Treynor in 1961 to help in pricing assets (Brealey, Myers & Allen 2011). The model states that securities are priced commensurate with a trade-off between un-diversifiable/systematic risk and expectations of return (Dempsey 2013). This implies that investors consider the systematic risk associate with a security to determine the expected return and price of the security. The model further provides that the required return on a portfolio or asset is based on the asset's systematic risk (beta) and the market risk premium (Brigham & Houston 2016). The difference in between the market return and the risk-free rate is known as market risk premium.

Required return, Ri = Risk-free rate + Beta × (Market return – Risk-free rate)

The risk-free rate is the return on assets considered risk-less such as government bonds and securities. Beta is the measure of a security's systematic risk, that is, the volatility of its returns relative to that of the market (Brigham & Houston 2016). The market return is the return on the entire market. Returns on various market indices such as the OMX Nordic 40 are often used as the proxies for market return.

CAPM is based on the following assumptions:

1. The model assumes that all investors are risk-averse and rational. Risk-averse investors are those that only accepts additional risk on an investment if the investment provides an additional return to compensate the risk (Fabozzi& Ake 2013). Therefore, investors require an additional return over and above the risk-free rate. It implies that the greater the asset's volatility, the higher the return the investors will require on the asset (Brigham & Houston 2016). Thus, there is a linear positive association between risk and return.

2. CAPM also assumes that all investors aim to maximise utility (Fabozzi & Ake 2013). This implies that one given two or more options, an investor would select the security that maximise return at every level of risk.

3. The model further assumes that the markets are efficient and investors have all the information about securities (Brigham & Houston 2016). In efficient markets, asset prices reflect all information about the securities. Assets in efficient markets are correctly priced hence an investor cannot outperform the market by applying fundamental and technical analysis to predict future price movements and identify underpriced securities (Brigham & Houston 2016). Besides, market efficiency implies that there are no transaction costs, taxes, as well as restrictions on short selling (Fabozzi & Ake 2013).

4. A fundamental assumption of the CAPM is that investors base their investment decisions on risk and return. The model further postulates that beta is the only important measure of risk (Clayman, Fridson& Troughton, 2012). This assumption is premised on the modern portfolio theory which states that unsystematic risk can be eliminated through diversification, and that the markets are efficient (Clayman, et al. 2012). Market efficiency enables investors to create well-diversified portfolios, thereby eliminating unsystematic risk.

5. Investors can lend and borrow unlimited amounts at the risk-free rate of interest (Clayman, et al. 2012). This implies that there are securities designated as risk-free. Thus, investors have an option of investing in risk-free assets or in risky assets. For investments in risky assets, investors require an additional return over and above the risk-free rate. Government bonds and other securities are considered risk-free (Guerard & Schwartz 2010).

6. The model also assumes that investors have similar expectations of risk and return (Guerard & Schwartz 2010). This implies that the estimates of risk and return are similar across all investors. This is

attributed to the fact that information is available to all investors in the market (Clayman, et al. 2012). Therefore, all investors give a similar estimate of the price of a security.

7. CAPM also assumes that investors have identical horizons (Markowitz 2016). This implies that investors buy all securities and sell them at one common point in time. Thus, the model assumes a single investment horizon. This means that investors are only concerned about the terminal wealth, that is, the value of the investment at the end of the investment period.

8. Finally, the model assumes that all securities are marketable and highly divisible (Markowitz 2016). This indicates that it is possible for an investor to buy or sell any security at any time they wish.

The CAPM has been criticized for its theoretical limitations. According to Brigham and Houston (2016), CAPM is based on unrealistic assumptions. For instance, the assumption of a single period investment horizon is unrealistic. Investors are not only concerned about the terminal value of their investments. In reality, most investors have continuous investment horizons. Besides, the assumption that all investors have similar expectations of risk and return is unreasonable. Investors have different expectations of the market (Kürschner 2008). This is due to the fact that markets are not perfectly efficient. Information is not available to all investors. This explains why some investors outperform the market by incurring efforts and resources to obtain information that is not readily available, through measures such as technical and fundamental analysis (Peterson 2012). The assumption that investors can borrow and lend unlimited amounts of money at the risk-free rate of interest is also unrealistic (ibid.)

2.5 Jensen Alpha

Jensen alpha, is also known as Jensen measure, was introduced in 1968 by Michael Jensen (Peterson 2012). It is used to assess the performance of a stock or portfolio against the market or the CAPM required return (Guerard & Schwartz 2010). It is the difference between the actual return and the CAPM required return.

$$\text{Jensen alpha} = R_i - [Rf + \beta \times (Rm - Rf)]$$

Where Ri is the actual return on the portfolio or stock, Rf is the risk-free rate, β si beta, and Rm is the market or index return.

The sign of the Jensen alpha indicates whether an investment has underperformed or outperformed the market. If it is positive, it indicates that the investment's actual return is greater than the risk-weighted expected return (CAPM return). This implies that the investment has outperformed the theoretical expected return. It means that the investment has delivered a higher return than what it beta suggests. However, if the Jensen alpha is negative, it indicates that the actual return on the investment is less than the theoretical expected return. This shows that the investment has underperformed the market. Since the required return is based on beta, a negative alpha suggests that an investment has not delivered sufficient returns to commensurate its systematic risk.

According to Brigham and Houston (2016), Jensen alpha is used to evaluate the performance of portfolio or investment managers, as well as the allocation of funds to portfolios. This is because it reflects the future performance of the portfolio or investment. When comparing two or more investments, the one of the highest Jensen alpha is considered to have outperformed the other investments. Therefore, a portfolio with the highest Jensen alpha is allocated more resources than those with negative or low Jensen alpha. An investor would divest a portfolio or security if its Jensen alpha is negative since it indicates that the return on the investment is not commensurate with its systematic risk.

2.7 Summary

The chapter reviewed theoretical and empirical literature on CAPM and the relationship between risk and return (Fabozzi& Ake 2013). Risk and return are fundamental measures investors rely on during investment decisions. Risk refers to the variability of returns on an investment (Brigham & Houston 2016). Risk is classified into systematic and unsystematic risk depending on the contributing factors. Systematic risk is due to market-wide factors such as changes in interest rates, inflation, and exchange rates, among other variables. Unsystematic risk is due to firm and sector-specific factors (ibid.) Unsystematic risk can be eliminated by creating a well-diversified portfolio of assets. Systematic risk is measured using beta, while total risk is measured using standard deviation. Because unsystematic risk can be eliminated, CAPM assumes that beta is the only determinant of stock and portfolio returns (Fabozzi& Ake 2013). Modern portfolio theory provides a guideline for reducing portfolio risk. It recommends that investors should create a portfolio consisting of unrelated stocks, since the covariance between such stocks is low. The theory suggests that investors can create an efficient portfolio, or the minimum variance portfolio. This is the portfolio that maximizes the risk-adjusted performance (Brigham & Houston 2016). Risk-adjusted measures include Sharpe and Treynor ratios. Sharpe ratio shows the excess return above risk-free rate per unit of standard deviation (Fabozzi& Ake 2013). The chapter also discussed CAPM including its assumptions such as existence of risk-free rate, similar expectations of risk and return, markets are efficient, among other assumptions.

3. EMPIRICAL LITERATURE REVIEW

3.1 Introduction

This section reviews the empirical literature on CAPM and the relationship between risk and return. Empirical literature review is important since it enhances understanding of the topic and enables the identification of research gaps. It assists in developing hypothesis and determining the appropriate methodology for future studies on CAPM.

After the introduction of CAPM, various empirical studies have been conducted to determine its validity in stock markets. Most of the studies have focused on one fundamental assumption of the CAPM, that is, beta is the only determined of return, and that the relationship between beta and return is linear. Based on this assumption, the regression model of return and beta should be statistically significant. Besides, the intercept of the model should not be significantly different from the risk-free rate.

3.2 Empirical Literature Against CAPM

Among the early empirical studies on the CAPM was conducted by Lintner. Lintner used ten-year data on 301 stocks from 1954 to 1963. Lintner's analysis involved a two-stage regression analysis. The first stage was the time series regression analysis conducted to estimate the beta of each asset. The slope of the regression of the stock's returns and the market returns gave an estimate of beta. The second stage of the analysis involved a cross-section regression of the 301 pairs of returns and beta. Lintner's cross-sectional regression model is shown by the following equation:

$$R_i = \alpha_0 + \alpha_1\beta + \epsilon$$

Lintner found that the intercept of the cross-sectional regression was significantly different (greater) than the risk-free rate. Besides, the coefficient of beta in the model was not statistically significant. Lintner concluded that the analysis did not support the validity of CAPM.

Miller, Jensen, and Scholes (1972) analysed monthly data of all securities listed on the NYSE from January 1926 to December 1930. They used time-series regression to estimate beta for each of the stocks. They then divided the sample into ten different portfolios based on beta values. Miller, et al. (1972) then conducted two cross-sectional regressions. The first cross-section regression was between portfolio returns and beta. In the second regression, Miller, et al. (1972) added residual variance to the model. The results showed that the R-square of the model increased when residual variance was added. This indicates that beta is not the only determined of return, thereby invalidating CAPM.

Levy (1978) used the same methodology as Miller, et al. (1972) analyzing twenty-year data of 101 stocks. The r square of the model cross-sectional regression with beta was 0.21, but when variance was added, the r-square increased to 0.38. Levy (1978) concluded that the CAPM was not valid since beta was not the only determined of return on stocks and portfolios. Fama and French (2003) also tested the empirical validity of the CAPM and found no empirical proof of CAPM assumptions.

Novak, and Petr (2004) studied the impact of CAPM beta, market value of equity and momentum on stock return on the Stockholm Stock Exchange. The study found that none of the factors, including CAPM beta is significant for explaining stock returns on the Stockholm Stock Exchange. This suggests that CAPM is not valid since it posits that CAPM beta is a significant and the only factor explaining variability of stock returns.

Östermark (1991) used regression model to assess the relationship between beta and stock returns in two Scandinavian Stock Markets; Sweden and Finland. The study relied on the r-square (coefficient of determination) to assess the explanatory power of squared beta. The study found that in the Finnish Stock Market, the explanatory power of squared beta was low. The model for the Swedish Stock market indicates that squared beta explained a greater percentage of the variations in stock returns than in the Finnish market. Östermark (1991) concluded that the Finnish model was consistent with international evidence on the invalidity of CAPM.

Boďa and Kanderová (2014) used monthly data of 10 S&P 500 index stocks from 2003 to 2012 to test the linearity of the relationship between CAPM beta and stock returns. They divided the data into two subsequent non-overlapping 5-year sub periods. They used regression model to determine the relationship between beta and stock returns. The study found that there is no linear relationship between beta and stock returns. Besides, there was a significant change in beta between the two sub periods. The results invalidate the linearity assumption of CAPM (Boďa, and Kanderová 2014).

Anwar and Kumar (2018) tested whether the CAPM holds in the Indian stock market, using data of NIFTY 50 companies from April 1, 2009 to March 31, 2016. The performed time-series regression to determine stocks' betas and cross-sectional regression to assess the relationship between beta and stock returns. The data was subcategorized into portfolios based on size and value. The regression models indicated that CAPM beta was not robust in explaining stock returns of the NIFTY 50 companies. However, when portfolios were used, the explanatory power of the CAPM beta improved although it was still very low. Anwar and Kumar (2018) concluded that the CAPM did not hold in the Indian stock market.

Karp and Van Vuuren (2017) studied the validity of CAPM and the Fama French Three-Factor model in the Johannesburg Stock Exchange. Using data of 46 companies listed on the JSE from 2010 to 2015, they constructed portfolios using an annual sorting procedurebased on Size and Book-to-Market. The study found that the models are poor in explaining stock returns. However, Karp and Van Vuuren (2017) identified inadequate market proxy measures as the primary reason for the poor performance of the models.

These findings suggest that CAPM is inadequate in being used as a proxy to help improve returns to investors. Particularly, the studies looked at how the model influences beta, stock's returns and the market returnin various marketsacross selected stock exchanges. They find that CAPM is not robust enough to explain the returns earned, irrespective of the company or market in question.

3.3 Empirical Literature Supporting CAPM

Although most studies have rejected the validity of CAPM, other studies have supported the validity of CAPM and its application in estimating stocks' returns. Fama and MacBeth (1973) studied monthly percentage returns of all stocks listed on the New York Stock Exchange between January 1926 and June 1968. They performed time-series regression on each stock to estimate betas. They divided the data into 20 portfolios on the basis of ranked betas of individual stocks, with each portfolio having equally weighted stocks. They estimated the beta for each portfolio (equally weighted), residual variance and squared beta. Fama and MacBeth (1973) then conducted cross-sectional regression analysis with actual returns on each portfolio as the dependent variable, while beta, residual variance and squared beta were the independent variables. Analysis showed the intercept of the model was not statistically significant. The coefficients of squared beta and residual variance were not statistically significant, while the coefficient of beta was statistically significant. They concluded that the regression showed that beta was the only significant determinant of stock returns, thereby supporting the CAPM.

Sreenu (2018) tested the capital asset-pricing model (CAPM) and three-factor model of Fama in Indian Stock Exchange. Using daily and annual average data of 54 companies listed on the National Stock Exchange from 2010 to 2016, they developed regression models for both the CAPM and Fama models. The results showed that the intercepts of both models were statistically insignificant (Sreenu 2018). This supports CAPM since an insignificant coefficient implies that beta is the only factor explaining variability of returns.

Satrio (2015) tested the validity of CAPM and the Three-Factor model in explaining returns of Indonesian stocks. Using data of 284 firms listed on the Indonesian Stock Exchange from December 2002 to December 2012, he found that CAPM is valid.

Roll (1977) provided a critique of the empirical tests that concluded that CAPM is not valid and should not be applied in estimating returns. He argued that the so called ‘empirical tests’ are invalid since they are based on inefficient benchmarks. When estimating beta of a portfolio or stock, the returns are regressed against the returns on a benchmark or market index. CAPM requires such benchmark to be efficient. Roll (1977) also argued that empirical arguments against CAPM are not valid from the theoretical and practitioner’s view point. The fundamental principle of the CAPM is that investors only consider systematic risk when determining returns since they can eliminate unsystematic risk through diversification (Roll 1977). The critique of CAPM that beta is not the only risk determining returns implies that investors expected to be paid or compensated for unavoidable risk, an idea which Roll (1977) finds inconsistent with the beliefs of theorists and practitioners.

3.4 Chapter Summary

This chapter reviewed empirical studies that have been conducted to test CAPM in stock markets. Most of these studies focused on the CAPM assumption that beta is the only determinant of return. Empirical studies have reached conflicting conclusions about the validity of CAPM in stock markets. Miller, Jensen, and Scholes (1972), Levy (1978), and Boďa and Kanderová (2014), among other studies found that CAPM does not hold in stock markets. However, Fama, and MacBeth (1973), Sreenu (2018), and Satrio (2015) found that CAPM is valid. The literature review shows that very few studies have been conducted to test the validity of the CAPM in the Nordic Stock market. This study uses the most recent 10-years data to test CAPM in the Nordic stock market.

4. RESEARCH METHODOLOGY

4.1 Introduction

This chapter explains the research approach and strategy, data collection method and variables used in the study. It also explains the statistical methods employed to determine the relationship between risk and return, and test CAPM.

4.2 Research Approach

Various research approaches can be used to conduct a study, and according to one if the researcher, the choice of a particular approach over the other is often pegged on how the researcher indents to treat truth and objectivity, collect data, ananlyse the data and make inferences from the study. The question of truth and how it is treated in a research is determined by the research philosophy, of which there are positivism and interpretivism. On research philosophy, this thesis is a positivism study. According to Wilson (2019), a positivist research approach is a study in which the researcher is independent and the findings can be considered objective. In this case, the role of the researcher is restricted to collecting data and interpreting the results of data analysis. The data used in the analysis is secondary data (stock prices), which the researcher has no control over. The main strength of a positivist approach over interpretivism is that it maintains objectivity where interpretivists treat data with a subjective view, thereby leading to research biases.

Trochim (2005) outlines two types of logical reasoning in research: inductive and deductive. The key differences between them is that inductive techniques focus on generating new theory and thought, whereas deductive reasoning focus on testing the existing thought or theory to see its applicability within a given context.A deductive approach implies that the aim of the study is to test hypothesis about existing theories and not to develop new theories (Trochim 2005). The study adopts a deductive approach for two reasons. First, as outlined in chapter one, this study aims at finding out whether CAPM beta (systematic) and total risk explain the cross-section variation in returns on stocks listed on the Nordic Stock Market. CAPM is an existing theory, which means the use of a deductive approach to examine it is appropriate. Secondly, this study focuses on a specific context, rather than just examining the theory in a broad spectrum. Particularly, in this case, the hypothesis tested is whether CAPM is valid in the Nordic Stock Exchange.

Another important methodological consideration was the research strategy. According to Mc Burney and White (2013), research strategies can be categorized into many brackets, the main ones being case studies, surveys, experiments and field excursions. In the present case, case study is the preferred strategy. Case studies refer to a research in which the goal is to look at a specific organisation, country or segment of the market with the goal of understanding how a phenomenon influences that selected entity based on its unique characteristics. The strengths of conducting a case study is that the findings are often specific to the context, making it relevant for recommendations to be drawn and implemented from them. He also points out that using a case study approach limits the ability to generalize findings. Nevertheless, by using the case study approach, this study can focus particularly on the Nordic stock market, which is where the research interest is situated (ibid.)

Finally, this thesis uses a correlational research design. According to Mc Burney and White (2013), a correlational research design involves determining the relationship between two variables using quantitative data. The variables in this study are numerical, making it possible to conduct a correlational (quantitative) research.

4.3 Context of the study

As mentioned, the study is based on the Nordic stock markets. Before describing the sampling and data collection procedures, it is imperative to situate the study within the context. Nordic countries refer to countries situated within a specific geographical region of North Atlantic and Northern Europe, and typically comprise Sweden, Norway, Iceland, Denmark, Finland, Greenland and Faroe Islands (Gotz 2003).The financial services and marketplaces for this region is controlled by the Nasdaq subsidiary, Nasdaq Nordic, which also controls the Baltic and the Caucasian regions.

Nasdaq Nordic was formed in 2003 as OMX AB, when HEX plc merged with OM AB. It was renamed to Nasdaq AB, although it is also known as OMX AB since February 2008 (Bakie 2014). Nasdaq Nordicoperates two divisions, which control eight exchanges. These include Copenhagen, Stockholm, Helsinki, Iceland, Tallinn, Riga, Vilnius, and Armenian stock exchanges. It is one of the larger Nasdaq subsidiaries in Europe based on key statistics. Specifically, as of end of year 2018, the daily average traded in Nasdaq Nordic was 3.10 billion EUR.

The stock market has seen growth across most of its indicators. According to its annual trading statistics report, average trades per day grew by 13.4% in 2018, while derivatives grew by 4%. However, the number of new companies listed in Nasdaq Nordic declined significantly, from 118 to 84 between 2017 and 2018, although this is due to switches of where some 23 companies were listed during the period (Nasdaq Nordic 2019).Nevertheless, the total number of listed companies in the Nasdaq Nordic continued to grow, jumping from 792 to 10002 between 2014 and 2019. Table 2.1 is a summary of the growth in number of listed companies in the Nasdaq Nordic and Baltic as reported by Nasdaq, while Table 2.2 is a summary of the main sectors within the market, together with the number of companies represented for each market.

Table 2. 1: Nasdaq Nordic & Baltic growth between 2014 and 2018

Year end	**Total Number of Listed Companies**
2014	792
2015	852
2016	900
2017	984
2018	1,002

Table 2.2. number of companies in Nasdaq Nordic & Balticby sector

Industry/ sector	**Companies per ICB Sector**
Oil & Gas	27
Basic Materials	47
Industrials	238
Consumer Goods	113
Health Care	149
Consumer Services	102
Telecommunications	15
Utilities	13
Financials	178
Technology	120
Total	1002

Notably as well, one of the main indices for the Nasdaq Nordic is the OMX Nordic 40 (OMXN40), which was formed in 2006. The index consists of 40 most traded stock classes under the OMX Nordic umbrella in four markets, which are Stockholm, Reykjavik, Helsinki and Copenhagen.

This context is significant for the study because Nasdaq Nordic is one of only two pan-European stock exchanges active today. Further, it is larger than the fellow Euronext by number of European markets represented in the listings. By using Nasdaq Nordic, the study is able to find the most reliable data for the selected study objective.

4.4 Sampling and Data Collection

According to Silverman (2010), it is advisable to work with a representative sample where the population being studied is too large to be used in its entirety. The context discussed above comprised more than a thousand companies, which is too large for the scope of this study. This calls for sampling techniques that are both useful and suitable for the particular study based on factors such affordability, timeliness, efficiency as well as relevance. In this case, random sampling is found to be the most suitable. Yin (2003) defines random sampling as the procedure for selecting participants in a study whereby any sample is selected purely based on chance, and the probability for selecting a sample is equal for all the samples.

A random sample of 35 companies was selected from the list of companies traded on the Nordic stock markets; Finland, Denmark and Sweden. A random sample is beneficial in research since it eliminates sampling bias that affects the objectivity of the findings. Close market prices of each of the 35 selected companies and the OMX Nordic 40 Index were collected for the ten years between 1 April 2009 and 31 March 2019. The daily stock prices were collected since the variable is critical in the determination of stocks' returns, a key variable in this analysis. All the data was obtained from the OMX Nordic website.

Table 2.3 shows the selected companies and the countries from which they are selected. In summary, six companies were from Finland, eight were from Denmark, and 21 were from Sweden.

Table 2.3: List of companies selected for the study as follows-

Company name	**Country**	**Total per country**
ABB LTD Alfa ASSA Abloy Atlas copco A Astra zeneca Boliden Electrolux B Ericsson B	Sweden	21

Hexagon B H&M Investor B Nordea bank Sandvik SEB A SV.Handelsbanken A SKF Swedbank A Swedish Match Tele 2 B Telia company Volvo B		
Carlsberg B Danske bank DSV Genman Novo nordisk B Novozymes B Vestas wind system Coloplast B	Denmark	8
Fortum oyj Kone oyj Neste oyj Sampo oyj Storaensooyj UPM	Finland	6

4.5 Variables

The key variables used in the analysis include risk-free rate, average annual return, standard deviation of returns (Total risk), beta, unsystematic risk, CAPM return, and Jensen alpha.

4.5.1 Risk-Free Rate

This is the return on riskless assets. The risk-free rate is important in this study since it is used in the determination of CAPM required rate of return. The yield of government bonds represent the risk-free rate. In this study, the yield on 10-year Finland government bond is taken as the proxy for risk-free rate. As on 27 October, the yield on 10-year bond was 0.138% (World Government Bonds 2019). The annualized risk-free rate is determined as follows:

Annualized Rf = $(1 + 0.138\%)^{250} - 1 = 3.51\%$

4.5.2 Return

Return is the percentage change in the daily close price of a stock. Daily returns are calculated for each stock and the index as follows:

Daily return = $\frac{(Current\ day's close\ price - Previous\ day's\ close\ price)}{Previous\ day's\ Price} \times 100\%$

Annualized return = $(1 + \text{average daily return})^{250} - 1$

4.5.3 Standard deviation (Total Risk)

Daily standard deviation of each stock and index is determined by the following formula:

Daily Variance of stock returns, Var(r) = $\sum_1^n (r_i - \mu)^2$

Daily Standard deviation = $\sqrt{Var(r)}$

Annualized total risk (standard deviation) = Daily standard deviation × $\sqrt{250}$

4.5.4 Beta

Beta is the measure of systematic risk of stock relative to that of the market. In this analysis, beta is determined through regression of each stock's returns and the index return. Beta is estimated for each of the 35 stocks.

Stock returns, Ri = α + βRm + ϵ, Rm is the daily return on the market index (OMX Nordic 40 Index). The slope of the market return in the model is the estimate of the asset's beta.

Given the values of beta and standard deviations, systematic and unsystematic risk of each of the 35 securities are calculated as follows:

Total risk = standard deviation

Total systematic risk = Beta of the stock × standard deviation of index (market)

Total unsystematic risk (residual variance) = Total risk – systematic risk

4.5.5 CAPM Return

CAPM return measures the required return based on a stock's beta and the market risk premium. It is calculated as follows:

Required return, R = Risk-free rate + Beta × (market return – risk-free rate)

4.5.6 Jensen Alpha

This is the difference between the actual and required return. Jensen alpha is calculated using the formula below:

Jensen Alpha = Actual annualized Return – [Rf + Beta×(Rm – Rf)]

Table 2.4: Definition of Key variables

Name of variables	Sources/Formula
Risk free rate	www.worldgovernmentbonds.com/country/finland/
Return on stock	Calculated from daily prices: $(P_1 - P_0)/P_0$
Return on OMX Nordic 40 Index	Calculated from daily prices: $(P_1 - P_0)/P_0$
Equity beta (systematic risk)	Slope of regression equation: Ri = α + βRm +ϵ
Standard deviation of returns	Calculated from daily prices $\sqrt{\sum_1^n (r_i - \mu)^2}$
Total Systematic risk	Beta × Standard deviation of index
Unsystematic risk (residual variance)	Total risk – systematic risk

4.6 Data Analysis

Data analysis starts with the calculation of daily stock returns, and standard deviation of returns. The average daily return is calculated for each of the 35 stocks for the whole period (2009 to 2019). The average returns and standard deviation of the 35 companies are subjected to two stages of analysis. The first stage is the time-series regression, while the second stage is the cross-sectional regression. This is the same methodology applied by Miller, Jensen, and Scholes (1972), Levy (1978), and Fama & MacBeth (1973), among other empirical studies on CAPM.

4.6.1 Time-Series Regression

Regression analysis shows the relationship between two variables, a dependent variable and independent variable (Lind, Marchal &Wathen 2019). Linear regression assumes that there is a linear relationship between the dependent variable and the independent variable. Linear regression model is expressed as shown by the equation below:

$Y = a + bX + \epsilon$, where Y is the dependent variable while X is the independent variable, and ϵ is the error term. B is the coefficient of X and indicates the change in Y (dependent variable) associated with a unit change in the independent variable (Lind et al. 2019).

Time series regression is applied to estimate the beta of each stock. Time series regression uses the daily returns of all the 35 stocks and index from 2009 to 2019. It is determined by regressing the returns on a stock against the index return (Fabozzi, Rachev, Focardi & Hoechstoetter, 2013). In this case, stock return is the dependent variable and the index return is the independent or predictor variable (Lind, et al. 2019). The slope of the regression model between the stock's returns and the market return represents beta. The slope of the model essentially shows the change in the stock's return resulting from a unit change in the index, or market return, which is synonymous with systematic risk.

The calculated beta is then used to estimate the required return, total systematic risk and unsystematic risk of each stock as follows:

Required return = Risk-free rate + Beta (Index return – Risk-free rate)

Jensen Alpha = Actual Annualized Return – CAPM required return

Total systematic risk = Beta × Standard deviation of index return

Total unsystematic risk = Standard deviation of stock – total systematic risk

The calculated values will be interpreted using descriptive statistics such as mean, standard, minimum, and maximum. For instance, if the average Jensen alpha of the 35 companies is positive, it would imply that the companies outperformed the market.

4.6.2 Cross-Sectional Regression

According to Pardoe (2012), cross-section data is data gathered at one point in time, unlike time-series data that is collected over a given period. In this study, cross-sectional data was obtained by determining average return (10-year average), standard deviation of the stocks' returns, and beta for the entire period (2009 to 2019). This gives a sample with 35 observations of average return, standard deviation, and beta. Beta for each of the stocks was used to calculate unsystematic risk or residual variance.

Two cross-sectional regression models are developed using Excel to test CAPM. The first model is shows the relationship between beta and expected return as shown by the equation below.

$Y = \alpha + \beta 1 Beta$

Where: Y is the expected return (Average annualized return – Annualized risk-free rate) and Beta is the systematic risk.

The objective of conducting cross-sectional regression is to determine the relationship between stocks' expected returns and risk. This helps in testing the validity of CAPM by evaluating one fundamental assumption of CAPM, that is, beta is the only significant variable influencing stocks' returns (Fabozzi & Ake 2013). For the regression model to meet the above assumption, it must meet the following conditions:

1. The intercept of the model must be zero, that is, statistically insignificant. Since CAPM assumes that beta is the only determinant of return, the intercept of the regression model must be equal to zero (Markowitz 2016). If the risk free rate is not deducted

from the stock's actual returns, then the intercept of the model must be equal to the risk-free rate for CAPM to hold. Thus, if the intercept is statistically significant, it implies that beta is not the only determinant of return (Lind, et al. 2019)

2. The coefficient of beta in the model must be statistically significant. If the coefficient of beta is not statistically significant, it implies that beta has no relationship with beta (Lind, et al., 2019). This would suggest that beta is not a significant predictor of stock returns, thereby invaliding the CAPM.

The model is interpreted using and t-tests of significance to determine if it meets the above two conditions. They test the null hypotheses that the intercept ($\alpha = 0$) is zero, and that the coefficient of beta ($\beta = 0$) is zero (Pardoe 2012). Excel regression output indicates the p-values of intercept's and coefficient's t-statistics. In this case, all tests are conducted at 5% significance level. This implies that if the p-value is greater than 0.05, the null hypothesis is not rejected (Pardoe 2012).

The R-square of the model shows the percentage of the variations in the dependent variable (stock returns) explained by the predictor variable (Pardoe 2012). If the R square of the model is low, it indicates that beta is not the only variable explaining stock returns. This would provide evidence against CAPM.

The second cross-sectional model is developed by adding residual variance or unsystematic risk to the first model. The objective of developing the second regression is to determine if the addition of residual variance improves the model's r square. If the r-square of the second model is greater than that of the first model, it would indicate that beta is not the only determinant of return (Markowitz 2016). Besides, this would imply that investors are compensated for avoidable or diversifiable risk. The second model is shown by the following equation:

$Y = \alpha + \beta 1Beta + \gamma RVar$ and RVar is the residual variance or unsystematic risk.

4.6.3 t-Test for Difference in Means

The last statistical test is to determine if there have been significant changes in systematic and unsystematic risk of the Nordic stocks in the last 10 years. In this study, the average systematic and unsystematic risks of the 35 companies in the first year 2009 (April 2009 to March 2010) is compared with the average systematic and unsystematic risks in the last year (from April 2018 to March 2019).

To determine whether there has been a significant change, sample paired t-test, also called dependent sample t-test, is conducted. Paired sample t-test is used to assess whether there is a difference between the two samples(Lind et al. 2019). It tests the null hypothesis the means of the two samples are equal, that is, the difference between the means is zero. According to Graham (2011), paired sample test is used when the two samples are paired. This implies that the samples come from the same population, and the only difference between them is time. The two samples are paired since it is the same 35 stocks measured in different periods; 2009/2010 and 2018/2019.

The test is conducted at 5% significance level. If the p-value of the t-statistic is less than 5%, then there is a significant difference in the average systematic and unsystematic risks between 2009/2010, and 2018/2019. If the p-value is greater than 5%, then there is no significant change in risk.

Null hypothecs, H_0: $\mu_{2009} = \mu_{2019}$

Alternative hypothesis, H_A: $\mu_{2009} \neq \mu_{2019}$

5. FINDINGS

5.1 Introduction

This chapter presents the results of data analysis and discusses the findings of the study. It explains the results of time-series and cross-sectional regression analyses and the implications of findings on the application of the CAPM to the Nordic Stock Market. The time series regression is used to estimate the stocks' betas and determine Jensen Alpha, while the cross-sectional regression analysis establishes the relationship between beta and stock average returns. The results help determine whether it is appropriate for investors in the Nordic Stock Market to apply CAPM in estimating expected returns. The chapter also discusses the implications of the findings and compares them with previous empirical studies on CAPM.

5.2 Descriptive Statistics

Time series regression was conducted using daily returns of 35 stocks selected for the period between 2009 and 2019, to determine their betas. Average returns and standard deviation of returns were calculated. The results are presented as descriptive statistics in Table 3.1 below.

Table 3.1: Descriptive statistics

	Beta	Annualized Return	Annualized Standard Deviation	Total Systematic Risk	Total Unsytematic Risk	CAPM Return	Jensen Alpha
Average	0.0191	0.1986	0.3164	0.0036	0.3128	0.0364	0.1622
Maximum	0.0759	0.9380	1.5866	0.0145	1.5721	0.0403	0.8978
Minimum	-0.0246	0.0246	0.2059	-0.0047	0.2039	0.0334	-0.0127

As shown in the above table, the average beta was 0.0191. This implies that that systematic risk or volatility of the 35 stocks was about 99% lower than that of the index. The maximum beta is 0.759, indicating that the systematic risk of the most volatile of the 35 stocks, was 93% lower than the market volatility. The minimum beta was -0.0246 suggesting that some stock returns move in opposite directions to the movement of index returns.

The average CAPM return is 0.0364, implying that investors in the Nordic stocks require a minimum annual return of 3.64% on their stocks.

5.3 Nature and Extent or Risk

Question 1- What is the nature and extent of risk in the last 10 years?

The total risk and the separation into systematic and unsystematic risk help explain the nature and extent of risk in the Nordic Stock Market. As shown by in Table 2 above, the average tot risk (standard deviation) is 0.3164 or 31.64%, while the maximum total risk is 1.5866. Of this the average systematic risk is 0.0036 while the average total unsystematic risk is 0.3128. As shown in Figure 4 below, unsystematic risk constitutes 98.84% of the total risk of the 35 Nordic stocks, while systematic risk accounts for only 1.16% of the total risk.

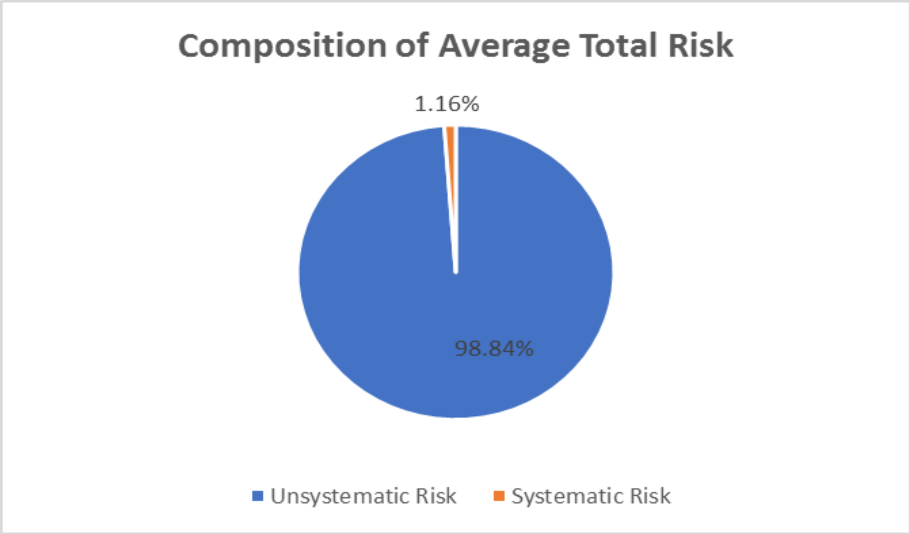

Figure 1: Composition of Total Risk

The composition of risk shows that most of the volatility of Nordic stock returns is due to sector and firm-specific factors and not market-wide factors. The high unsystematic risk can also be explained by the fact that the analysis focused on individual stocks and not portfolios. Therefore, none of the unsystematic risks has been diversified.

The study finds that more than 98% of the volatility of Nordic stock return is due to unsystematic risk.

5.4 Jensen Alpha

Question 2- Has the Nordic stock market underperformed or outperformed the expected return (CAPM) in the last 10 years?

This section answers the second research question. The actual return on the stocks is compared with the CAPM required returns to assess whether they have outperformed the market or not. The analysis shows that out of the 35 stocks, only two had negative Jensen alpha. 33 other stocks had positive Jensen Alpha, implying that their actual returns exceeded the CAPM required returns. The average Jensen Alpha is 16.22%, showing that on average, the Nordic stocks outperformed the market by 16.22%. The maximum Jensen alpha is 89%, indicating that the best performing stock delivered almost twice the CAPM required return.

The analysis shows that the Nordic Stock market has outperformed the market (expected return) in the last ten years between 2009 and 2019.

5.5 Findings of t-tests

Question 3- Is there any change in systematic, unsystematic and total risks in Nordic stock market in the last 10 years between 2009 and 2019?

This section compares the stocks' systematic and unsystematic risk between 2009 and 2019.

Table 3.2: t-test outputs

Systematic Risk			UnSystematic Risk		
	2008/2009	*2018/2019*		*2008/2009*	*2018/2019*
Mean	-0.000446419	0.00291486	Mean	0.023007689	0.01337127
Variance	1.66864E-06	1.80786E-06	Variance	4.55289E-05	1.13271E-05
Observations	35	35	Observations	35	35
Pearson Correlation	-0.109547317		Pearson Correlation	0.280533334	
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	34		df	34	
t Stat	-10.12539806		t Stat	8.583388882	
P(T<=t) one-tail	4.23504E-12		P(T<=t) one-tail	2.50141E-10	
t Critical one-tail	1.690924255		t Critical one-tail	1.690924255	
P(T<=t) two-tail	8.47008E-12		P(T<=t) two-tail	5.00282E-10	
t Critical two-tail	2.032244509		t Critical two-tail	2.032244509	

As shown in Table 3.2 above, the t-stat for the difference in systematic risk between 2009 and 2019 is -10.125. The corresponding p-value is 0.000. The value is less than 5% implying that there is adequate proof to refute the null hypothesis (Lind, et al., 2019). Therefore, it can be concluded that there has been a significant change in systematic risk of Nordic stocks between 2009 and 2019 (Lind, et al., 2019). A comparison of the two means suggests that systematic risk of the Nordic stocks has increased in the last ten years.

The p-value of the test of difference of unsystematic risk is 0.000. This indicates that there is a significant difference between the mean of unsystematic risk in 2009 and 2019. It implies that there has been a significant change in unsystematic risk of Nordic stocks in the last years (Lind, et al., 2019). The two means suggest that unsystematic risk has decreased in the Nordic stock market.

5.6 Cross-Sectional Regression: Relationship between Risk and Return

Question 4- What is the relationship between risk and return of stocks listed on the Nordic Stock market?

5.6.1 Expected Return and Beta

The first cross-sectional regression model shows the association between expected returns and beta. The model's output is shown in Table 5.3 below.

Table 3.3: Regression model of returns and beta

Regression Statistics					
Multiple R	0.316088818				
R Square	0.099912141				
Adjusted R Square	0.072636751				
Standard Error	0.149161505				
Observations	35				
ANOVA					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	1	0.081500601	0.081500601	3.663087573	0.064336528
Residual	33	0.734222099	0.022249155		
Total	34	0.815722701			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.150765856	0.031819942	4.738093299	3.98282E-05	0.086027696
Beta	1.943977768	1.015705124	1.913919427	0.064336528	-0.122489844

The R Square (Coefficient of determination) of the model is 0.09991. It implies that variations in beta of the 35 stocks explain only 9.991% of the variations in actual returns on the stocks between 2009 and 2019 (Pardoe 2012). It suggests that beta explain a small percentage of the variations in stock returns. More than 90% of the variations in stock returns is explained by variables other than systematic risk. The model's coefficient of determination is small implying that its predictive power is low (Pardoe 2012). This indicates that the model is not a good predictor of actual daily returns on stocks trading on the Nordic Stock Market.

To determine if beta was the only determinant of the actual daily stock returns of the 35 companies listed on the Nordic Stock Exchange, the intercept of the model was tested for significance. The intercept of the model is 0.1508 suggesting that the average return on a stock would be 15.08% if beta is zero, that is if systematic risk is zero (Pardoe 2012). The significance of the intercept is determined by testing the null hypothesis that it is zero or significantly close to zero. The t-statistic of the intercept is 4.738 with a p-value of 0.0000398. The p-value is less than 5%, indicating that there is sufficient proof to reject the null hypothesis. This implies that the claim that the intercept of the model is zero or significantly close to zero is false. Therefore, it can be concluded that the intercept of this model is not equal to zero. The implication of the results is that the intercept is statistically significant, meaning that beta is not the only determinant of actual returns on stocks listed on the Nordic Stock Market (ibid.)

The coefficient of beta in the above model is 1.944 suggesting a positive association between beta and actual daily returns on stocks listed on the Nordic Stock Market (Graham 2011). It implies that a unit increase in beta (systematic risk) is associated with an increase in the actual return by 1.944. This appears consistent with the CAPM, which argues that higher systematic risk attracts a higher return since investors require a high return to compensate for the high risk. The t-statistic of the coefficient of beta is 1.914, and the corresponding p-value is 0.0643. The p-value is higher than 0.05 implying that there is inadequate evidence to reject the null hypothesis that the coefficient is zero (Graham 2011). This means that the slope of beta is not statistically significant. That is, beta has no significant association with actual stock returns.

5.6.2 Expected Return, Beta, and Residual Variance

A second model was developed by adding residual variance. Residual variance represents unsystematic risk. The model shows the relationship between expected returns on the stocks and the two types of risks.

As shown in Table 5, the R square of the model is 0.7338, indicating that systematic and unsystematic risk explained 73% of the variations in stock returns of the 35 Nordic stocks. The value also implies that about 27% of the variations in stock returns are due to factors other than systematic and unsystematic risk (Pardoe, 2012). This suggests that risk is not the only determinant of actual returns of Nordic stocks.

The square of this mode is higher than that of the model with beta as the only predictor variable. It indicates that when residual risk is added to the equation, its predictive power increases. This implies that CAPM does not hold.

Table 3.4: Regression model of returns, beta and residual variance

Regression Statistics					
Multiple R	0.856650311				
R Square	0.733849755				
Adjusted R Square	0.717215365				
Standard Error	0.082368227				
Observations	35				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.598617904	0.299308952	44.11642033	6.33913E-10
Residual	32	0.217104797	0.006784525		
Total	34	0.815722701			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.004831289	0.02425204	0.199211641	0.843357616	-0.044568501
Beta	-0.12327414	0.608814909	-0.20248213	0.840821714	-1.363389527
Unsystematic risk	0.592878692	0.067909577	8.730413515	5.62791E-10	0.454551409

The intercept of the model is 0.0004, and the probability of its t-statistic is 0.8433. This is greater than 5%, meaning that it is not statistically significant (Graham 2011). However, the coefficient of this Beta in the model is -0.12 suggesting a negative association between expected returns and beta. It suggests that stocks that have high systematic risks are associated with lower returns than those with low systematic. This is a violation of CAPM and finance theories. The p-value of the t-statistic of the coefficient of beta is

0.8408. This is greater than 0.05, indicating that beta has no significant impact on actual returns (Graham 2011). On the other hand, the p-value of the t-statistic of the slope of unsystematic risk is 0.000, implying that it is statistically significant. Therefore, only unsystematic risk (residual risk) has a significant impact on actual returns.

Therefore, from the above analysis, two conclusions can be seen. First, the intercept is statistically significant implying that there are other significant influencers of actual stock returns other than the stocks' systematic risk (beta). Secondly, the coefficient of beta is not statistically significant suggesting that beta did not have a significant association with actual returns of the 35 stocks listed on the Nordic Stock Market between 2009 and 2019. The results are a violation of the CAPM which asserts that the return on an asset is dependent on its systematic risk (beta). Thus, the CAPM was not valid for stocks listed on the Nordic Stock Market between 2009 and 2014. The findings of this study imply that CAPM is not accurate and should not be used in estimating the required returns of Nordic stocks. The results are consistent with the findings of Miller, et al. (1972), Levy (1978) and Östermark (1991), who found that beta is not a good predictor of stock returns. Miller, et al. (1972) found that beta explained only 21% of the variations in stock returns, and that is not statistically significant. When residual variance was added to the model, the R squared increased (Miller, et al. 1972). In this analysis, the addition of residual variance increased the model's R square from 9% to 73%.

5.7 Chapter Summary

This chapter presents the results of data analysis to assess the relationship between returns and risk, and to test the validity of CAPM in the Nordic stock market. The first objective was to determine the nature and extent of risk. Returns and standard deviations were calculated, and time-series regression used to estimate beta for each stock was estimated. Analysis of risks indicates that 98% of the total volatility of stock returns was accounted for by unsystematic risk, with systematic risk accounting for less than 1.5% of the volatility of stock returns. Jensen Alpha indicated that the 35 stocks outperformed the market (required returns). Only two of the 35 stocks had negative Jensen Alpha. T-tests for the differences in systematic and unsystematic risk between 2009 and 2019 rejected the respective null hypotheses, implying that there was a significant change in both systematic and unsystematic risk in the last ten years.

The validity of the CAPM was tested using two cross-sectional regression models as applied by Miller et al. (1972) and Levy (1978). The first model showed that there is no significant association between beta and actual returns. The model's R square indicated that beta explained only 9% of the variations in actual returns of Nordic stocks. Significance tests of the model further suggested that the intercept was statistically significant, implying that beta is not the only determinant of returns. Besides, beta is not statistically significant suggesting that systematic risk has no significant impact on Nordic stock returns. When residual variance was added, the model's R square increased to 73%, thereby rejecting the claim that only beta determines stock returns. Beta was not statistically significant in the second model, while residual variance (unsystematic risk) was statistically significant. These findings provide evidence against the validity of CAPM in the Nordic stock market. The results were consistent with previous empirical studies by Miller et al. (1972) and Levy (1978) who used the same methodology and concluded that CAPM is not valid.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusions

The study has focused on CAPM and its significance in estimating the returns of investments. The study aim was to determine the performance of the Nordic stock market over a ten-year period between 2009 and 2019. The study had two main questions, which were set as follows: Is there any change in systematic risk in between 10 years in Nordic stock market?And does the Nordic stock market underperformed or over performed in 10 years? The concept of CAPM has been seen to have originated in the mid-20th century, after which interest continued to grow over the decades. As the concept grew more popular, it attracted the interest of scholars and other researchers, and in time, several studies were made which tested the underpinning theory of the model as well as evaluated its effectiveness in predicting performance. Theoretical concepts associated with CAPM include return and rate of return, risk (both systematic and unsystematic), diversification of investment portfolios and beta, which affects the market as a whole.The study combined these concepts in the formula

Ra= Rrf + [β * (Re – Rrf)] where,

”Ra” denotes expected return on the security,

”Rrf” denotes risk free rate,

”β” denotes beta,

”Re” denotes expected return of market,

(Re – Rrf) denotes risk premium

Using this formula, the study relied on secondary data gathered from the Nasdaq Nordic andsampled 35 companies. From the study, it was found that CAPM is not useful in predicting the performance of Nasdaq Nordic. The study also found that the findings are consistent with the previous findings which also reached the conclusion that CAPM is not useful in predicting performance of stocks in a market.

6.2 Summary and Discussion

From the descriptive statistics, it was found that the average beta was 0.0191, while the maximum beta was 0.759. What this implies is that the selected Nordic stocks had a systematic risk of 99% lowerthan the index.Further, the Jensen Alpha analysis showed that the Nordic stock has outperformed the market’s expected return based on CAPM productions. Looking at the t-test values, there has been a significant change in the systematic risk in Nordic stocks, and at the same time, there has been a significant change in the unsystematic risk of this market. These findings are in line with the findings of various previous studies, including those of Pardoe (2012) and Lind et al. (2019) both of whom also reached similar conclusions.

CAPM is one of the most commonly used models in estimating returns on investment. The model is applied in calculating the cost of capital, which is critical in evaluating and appraising long-term investment decisions such as the acquisition of fixed assets, expansion, among other capital budgeting decisions. CAPM assumes that investors base their investment decisions on risk and return. It shows the relationship between risk and return. The model assumes that investors can establish efficient portfolios and diversify all unsystematic risk. Therefore, only systematic risk should be considered in estimating returns. Since the fundamental premises of CAPM is the risk-return relationship, it is essential to understand the relationship between risk and return to make sound investment decisions. This study analyzed data of 35 stocks listed on the Nordic stock markets to determine the nature and extent of risk, and to tests whether both systematic and unsystematic risks have changed over the last ten years. It also tested the validity of CAPM using cross-sectional regression. Analysis of data suggests that unsystematic risk constitutes about 98% of the total volatility of returns on Nordic stock markets. Jensen alpha was used to compare actual performance to the required returns, and found that the Nordic stocks outperformed the market or their required returns. Tests of difference in samples indicated that there was a significant change in both systematic and unsystematic risk of Nordic stocks between 2009 and 2019.

Cross-sectional regression was used to determine the association between risk and return. In the model between returns and beta, it was found that beta is not statistically significant and explained only 9% of the variations of actual returns on the stocks. When residual variance was added to the model, the R square increased to 73%. Only residual variance was found to be statistically, with beta not having a significant effect on returns. The data seem to reject the validity of CAPM in the Nordic stock market. The findings were similar to those of Miller et al. (1972) and Levy (1978) who concluded that CAPM is not valid.

The implication of the findings is that investors in the Nordic stock markets should not rely on CAPM for estimating returns, especially when dealing with individual stocks. CAPM is not valid and not reliable for estimating returns as the study provides evidence against the validity of its assumptions.

6.3 Limitations of the Study

The study analyzed betas and returns of stocks and not portfolios. The CAPM assumes that investors can eliminate all unsystematic risk by diversifying their portfolios. The study used individual stocks, implying that no unsystematic risk was diversified. With only 35 stocks, it was not possible to create adequate sample of portfolios to test CAPM. This may have affected the relationship between risk and return. According to Roll (1977), CAPM presupposes that the index used in determining beta is efficient. In this study, it was assumed that the OMX Nordic 40 Index is efficient. This is not realistic since there can never be perfectly efficient markets in real life. Roll (1977) further argue that CAPM is forward-looking since it determines expected returns. Therefore, the use of historical data in testing CAPM can be misleading.

6.4 Recommendations for Future Research

Based on the study, three recommendations are given. First, it is recommended that investors in the Nordic stock markets should not rely on CAPM for estimating returns, especially when dealing with individual stocks. The reason is that CAPM is not valid and not reliable for estimating returns. The findings of this study have shown that CAPM is not a valid measure for investors because the beta did not have a significant association with actual returns of the 35 stocks listed on the Nordic Stock Market between 2009 and 2019. Further, any links between CAPM and returns were found to be insignificant, and this is consistent with the previous findings in some of the studies cited in the literature.

Secondly, it is also recommended that the managers should consider other alternative models that predict the performance of organisations other than the systematic and beta proposed in CAPM. One suggestion is using Multi Beta Models. Unlike CAPM, which uses a single beta, multi-beta models use various market risks, thus having more than one beta to predict risk. The proposed models are the Arbitrage Pricing Model and The Multifactor model.

Thirdly, this study had a number of limitations, the main one being that it focused primarily on the Nordic stock market but used a small sample size.

Thus, it is recommended that future studies look at a larger dataset within this market to offer a supporting study that can confirm or contrast these findings. Further, future studies on CAPM should develop efficient portfolios to test the validity of CAPM. This will, ensure that all unsystematic risk is diversified thus giving accurate estimates of beta. Besides, studies should focus on identifying efficient portfolios for proxies as the market return. As outlined by Roll (1977), if the benchmark is not efficient then the estimates of beta would not be accurate.

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Appendix

Appendix 1. Information of Swedish companies

Serial Number.	Name of companies	Industry	Website
1	ABB LTD	Industrial	http://www.abb.com
2	Alfa Laval	Industrial	http://www.alfalaval.com
3	Assa Abloy B	Industrial	https://www.assaabloy.com
4	Atlas Copco A	Industrial	http://www.atlascopcogroup.com
5	Astrazeneca	Healthcare	http://www.astrazeneca.com
6	Boliden	Basic materials	http://www.boliden.com
7	Electrolux B	Technology	https://www.electroluxgroup.com
8	Ericsson B	Technology	http://www.ericsson.com
9	Hexagon B	Technology	http://www.hexagon.com

10	Hennes & Mauritz B	Consumer Cyclical	http://www.hm.com
11	Investor B	Financial services	http://www.investorab.com
12	Nordea Bank ABP	Financial services	http://www.nordea.com
13	Sandvik	Industrial	http://www.sandvik.com
14	SEB A	Financial services	http://www.seb.se
15	SV. Handelsbanken A	Financial services	http://www.handelsbanken.se
16	SKF B	Industrial	http://www.skf.com
17	Swedbank A	Fiancial services	

18	Swedish Match	Consumer Defensive	http://www.swedishmatch.com
19	Tele2 B	Communication services	http://www.tele2.com
20	Telia Company	Communication services	http://www.teliacompany.com
21	Volvo B	Industrials	http://www.volvogroup.com

Appendix 2- Information on Denmark companies

Serial Number	**Name of companies**	**Industry**	**Website**
1	Carlsberg B	Consumer Defensive	http://www.carlsberggroup.com
2	Danske Bank	Financial services	http://www.danskebank.com
3	DSV Panalpina	Industrial	http://www.dsv.com
4	Genmab	Healthcare	http://www.genmab.com
5	Novo Nordisk B	Healthcare	http://www.novonordisk.com
6	Novozymes B	Basic materials	http://www.novozymes.com
7	Vestas Wind System	Industrial	http://www.vestas.com
8	Coloplast B	Healthcare	http://www.coloplast.com

Appendix 3- Information on Finnish Companies

Serial Number	**Name of companies**	**Industry**	**Website**
1	Fortum Oyj	Utilities	https://www.fortum.com
2	Kone Oyj	Industrial	http://www.kone.com
3	Neste Oyj	Energy	https://www.neste.com
4	Sampo Oyj A	Financial services	http://www.sampo.com
5	Stora Enso Oyj R	Basic Material	http://www.storaenso.com
6	UPM-Kymmene Oyj	Basic material	http://www.upm.com