



A study of stock market performance of Finnish technology-oriented companies

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Abstract

High stock returns of technology-oriented companies has been a trend throughout the decades. World is changing rapidly, and many companies and research institutions pursue new technologies and innovations. Thus, investor's interest in technology-oriented stock markets is not unexpected. However, technology-oriented stocks are considered to be risky investments as they are volatile and not all of the companies are able to capitalize their products. The main objective of this dissertation is to explore the stock market risk and return relationship of the technology-oriented Finnish companies and to explore whether the stock returns are finding their association with expected returns calculated using Capital asset pricing model (CAPM) and Jensen's alpha.

Thesis adapted deductive methodology with quantitative approach. As the Finnish technology-sector is limited in size a decision to include not purely technology companies but closely related companies was made. The sample consisted of 25 Finnish technology-oriented companies traded in Helsinki Stock Exchange and First North Helsinki and three indexes for comparative calculations. The timeframe of the study was 2020-2022 which makes the sample size 75 firm-years. The data of individual stocks and indexes was collected from OMX Nordic website and compiled in a Microsoft Excel spreadsheet by the author. In addition, data analysis was performed using Microsoft Excel.

Results point out that the portfolio overperformed the market during the period and had a positive Jensen's alpha. In 2020 and 2021 the stock returns were abnormal whereas in 2022, the stock returns were negative. However, the overall period returns of the portfolio was positive. Results also indicate that high risk associated with increased risk. Analysis was made and presented in company-specific (micro) and portfolio (macro) levels. In addition, current study limitations and recommendations for further study were presented.

Keywords/tags (subjects)

Risk and return, CAPM, Jensen's alpha, Finnish stock market, Stock performance, Technology-companies.

Miscellaneous (Confidential information)

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Peltoniemi, Santtu

Tutkimus suomalaisten teknologia-painotteisten yritysten osakekehityksestä

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Tiivistelmä

Teknologia-painotteisten yritysten korkea osaketuotto on ollut trendi läpi vuosikymmenten. Elämme nopeasti muuttuvassa dynaamisessa maailmassa ja siksi monet yritykset tavoittelevat uusia teknologisia murroksia ja innovaatioita. Siksi sijoittajien kiinnostus teknologiayrityksiä kohtaan on loogista. Teknologia-painotteisia yrityksiä kuitenkin pidetään riskialttiina sijoituksina sillä kaikki yritykset eivät pysty luomaan tuotteitaan menestyksekkäiksi. Tämä opinnäytetyö pyrkii tutkimaan teknologia-painotteisten yritysten riski ja tuottosuhdetta ja selvittää ovatko osakkeiden Capital asset pricing- mallin (CAPM) mukaiset tuotto-odotukset linjassa toteutuneiden tuottojen kanssa käyttäen Jensenin alfaa mittarina ylituotolle (alituotolle).

Opinnäytetyössä pääosissa on deduktiivinen päättelytapa ja määrällinen lähestymistapa. Koska suomalainen teknologiasektori on kooltaan varsin pieni, on portfolioissa mukana myös yrityksiä jotka eivät ole puhtaasti teknologiayrityksiä mutta teknologiasektoriin liittyviä yrityksiä. Otos koostuu 25 suomalaisesta teknologia-orientoituneesta yrityksestä joiden osakkeet on listattu Helsingin Pörssissä ja First North Helsinki-listalla sekä kolmesta pohjoismaisesta indeksistä. Tutkimuksen ajanjakso on 2020-2022, jolloin otoksen koko on 75 yritysvuotta. Data on kerätty Nasdaq OMX Nordicin verkkosivuilta ja koottu yhteen Microsoft Excel tiedostoon kirjoittajan toimesta. Lisäksi analyysi on suoritettu käyttäen Microsoft Excelliä.

Tulokset paljastavat että portfolio tuotti ylituottoa tutkimusjakson aikana ja sillä oli positiivinen Jensenin alfa. Vuosina 2020 ja 2021 portfolio tuotti selvästi ylituottoa kun vuonna 2022, tuotto romahti ja tulos oli negatiivinen. Tulokset paljastavat myös että suurentunut tuotto lisäsi riskitasoa. Analyysi on esitelty yrityskohtaisella (mikro) ja portfoliokohtaisella (makro) tasolla. Lopuksi on esitelty myös tutkimuksen rajoitteet sekä suositukset jatkotutkimuksia varten.

Avainsanat (asiasanat)

Riski ja tuotto, CAP- malli, Jensenin alfa, Helsingin pörssi, Osakemarkkinoiden kehitys, Teknologiayritykset

Muut tiedot (salassa pidettävät liitteet)

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1 Introduction

This dissertation explores the risk and return relation and stock market performance of 25 Finnish technology-oriented stocks during 2020-2022. This study aims to explore if the portfolio companies were able to overperform the market individually and as a portfolio. Analysis is performed by deriving expected returns using capital asset pricing model and comparing the expected returns to occurred returns using Jensen's alpha.

The introduction chapter of this dissertation discusses the research background, relevance of the thesis and research questions. First, in chapter 1.1 research background and author's personal motivation and interest towards the topic. In addition, chapter 1.1 discusses the relevance of the topic and the underlying macroeconomic trends that are relevant. Furthermore, section 1.2 contains the research questions that this dissertation aims to explore.

1.1 Research background and motivation

Stock market is a marketplace, where individual investors and institutions may buy stocks of a publicly traded companies. In addition, investors expect to get return on the investment. Usually, investors try to find stocks that appear to be undervalued and buy them in hope, that they can sell it with higher price in the future. However, the world is changing rapidly, and new innovations are being pursued and capitalized by numerous of companies and research institutions around the world. Hence, the investor's interest in the technology-oriented stocks is not unexpected. For example, returns on Nasdaq 100 have been abnormal in the past years due the investor's high interest in the technology companies (Statista, 2023).

The current study of this dissertation aims to explore whether relatively high stock returns are finding their association with expected returns calculated using Capital asset pricing model (CAPM). In general, technology sector is growth sector which correlates with high risk. In addition, this thesis aims to explore if the Finnish technology sector became even more riskier during the turbulent times of 2020-2022.

The stock market analysis using CAPM model is well studied topic in general, however there is a paucity of empirical evidence regarding the Finnish technology-oriented stock market. Therefore, it is an underexplored area of research which makes this dissertation not relevant only for the academics, but also for the practitioners. Gaining knowledge on fundamental analysis, CAPM and stock market dynamics may enrich researcher's ability to understand the stock market functions and improve the understanding of publicly traded companies as a whole.

Although, the stock market performance is perceived to be an indicator of prosperity of an economy, the stock prices are not always reflecting the real economy as they may be influenced by several scenarios.

For instance, during the years of Covid-19 pandemic (2020-2022) many Central banks contributed to the stock markets by applying open market operations (OMO). For instance, European Central Bank (ECB) introduced a Pandemic Emergency Purchasing Programme (PEPP) in 18. March 2020 to keep the money supply high (interest rates low) and support the companies that were struggling during the pandemic. The purchasing programme continued until end of March 2022 and 1850 billion euros worth of private and public securities were bought over two years (European Central Bank, 2023). PEPP had a impact on the stock markets during the period and returns were abnormal (Statista, 2023). However, the unemployment rate and real GDP growth per capita was not adjusted accordingly and even though the GDP was growing over the period, so was unemployment (Eurostat, 2023). Therefore, it may be speculated that the contributions that central banks made during the Covid-19 Pandemic did not fully reflect the real output of an economy. However, its impact on stock market returns was clear.

1.2 Research questions

The main purpose of this dissertation is to explore the stock market performance of chosen companies during the Covid-19 pandemic and the energy crisis of 2022 and explore the misalignment of expected returns and occurred returns by using CAPM during the chosen period.

As the stock returns in Helsinki stock exchange have been abnormal during the Covid-19 pandemic and investor's interest in stock markets have been high CEIC (2023). Therefore, investor sentiment is considered to be significant factor of excessive stock returns.

To reach the desired outcomes of this dissertation, following research questions have been developed:

- What is the relationship between risk and return in technology-oriented companies listed in Helsinki stock exchange and First North Helsinki?
- What is the extent of misalignment between expected return and occurred return of technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki?

2 Literature review

Literature review section of this dissertation highlights the key theories and aspects of accounting and stock market dynamics. First, the section 2.1 explores the characteristics and relevance of accounting information, accounting standards, accounting quality and accounting of intangible assets. Moreover, section 2.3 aims to focus on the stock market dynamics and various of theories regarding equity valuation whereas, section 2.4 inspects the investor sentiment.

Moreover, the literature review provides important information regarding accounting and stock market functions, including equity valuation and sentiment. Although, the study of this dissertation focuses on the risk and return, it is important to discuss the accounting aspect as it relates to the topic closely. Beside the theories, the literature review aims to provide practical information that is useful for practitioner's as well as academics. Moreover, it will enhance researcher's abilities to create a relevant and up to date research that is backed by previous academic literature and empirical observations.

2.1 Accounting information

Accounting is a process in which all the financial information of a company is recorded and analyzed. In a public companies accounting data is published quarterly in financial statements and once a year in annual report. This means that when a financial statement is published, it considers the past three months or a year and therefore the accounting information of a certain period is always reported afterwards. Hence, investors or other stakeholders have no access to the data before it is released. Accounting information is important to all the stakeholders of the company, but

especially to the shareholders, lenders, creditors and to the tax authorities (Basioudis, 2019). Accounting is consisted of cash accounting principle and accrual accounting principle.

Cash accounting is considered to be recording cash receipts and payments as accrual accounting emphasises accounts receivable and account payable. Hence, cash accounting may fail to provide important information about transactions that do not involve cash such as stocks or other equities and liabilities (Khan & Mayes, 2009).

Accrual accounting method is more commonly used than cash accounting because it is *credit based* instead of *cash based*. Majority of transactions are credit based because it smoothen up the business environment and makes purchasing and selling more fluent, furthermore it creates more opportunities for the seller and buyer (Bushman et al. 2016).

Accrual accounting is an accounting principle in which the transaction is recorded when the transaction happens regardless the timing of payment or financial transaction. When in cash accounting principle, transaction is recorded when cash changes the owner. Therefore, applying accrual accounting provides a better image of a corporation's financial health than cash accounting principle (Bushman et al. 2016).

2.1.1 Accounting standards

Accounting is highly regulated and there are two kinds of accounting standards that publicly listed companies use. International Financial Reporting Standards or IFRS is an accounting standard applied in over 140 countries. However, public companies listed in the United States of America apply Generally Accepted Accounting Principles or US GAAP.

Previous literature suggests that there are minor differences in IFRS and US GAAP but they are not considered to be significant. IFRS and US GAAP both have a same objective, to increase accounting transparency and therefore improve the accounting quality. (Barth et. al. 2012; EY, 2021)

US GAAP standards are tailored to be used in United States as IFRS standards are more of a "one size fits all" solution to global corporations as it is being used in more than 140 countries. IFRS is not ideal solution to any country itself as it cannot be tailored to the economy of a single country,

but on the other hand it makes the corporations accounting more comparable to another companies in a global markets (Barth et. al. 2012).

As US GAAP is seen as an rule-based accounting standard with strict restrictions whereas IFRS is seen as an principle based, therefore *it is not as strict as US GAAP*.

According to Smith, (2012), US GAAP and IFRS apply different expressions as seen below:

• IFRS	• US GAAP
• Turnover	• Sales
• Stocks	• Inventory
• Share capital	• Common stock or paid-in capital
• Share issue premium	• Additional paid-in capital
• Debtors	• Accounts receivable
• Creditors	• Accounts payable
• Revenue reserves	• Retained earnings

Table 1. IFRS vs US GAAP Expressions, Adapted from Smith, (2012)

Previous research suggests that accounting standards have impact on the financial reporting quality. In research which discussed European banking industry before and after International Financial Reporting Standards (IFRS), it was found that after adaption of IFRS the impact of earnings to the stock prices were increased. It was also found that IFRS increased accounting quality, because IFRS is more detailed than its ancestors, the corporations are having less choice to expand value of balance sheet and prevent arbitrage (Agostino et al. 2010). That is a crucially important aspect of accounting since credible accounting information is important to capital markets since it increases the incentive to invest in equity markets. Usually, managers possess more information regarding the value of business than investors and may have interest to inflate the value of business or abuse the assets that investors invest.

2.1.2 Accounting quality

Essentially accounting quality means that financial data in the financial reporting is precise, correct, reliable and transparent. In other words, a complete and transparent financial reporting that is not meant to deceive its users. (Jonas & Blanchet, 2000; Chiş & Achim, 2014).

There are several factors that affect the accounting quality. Directors have more information than investors, therefore information asymmetry may affect the quality of accounting as there is always a chance of moral hazard. For example, a director may inflate the revenue or other accounting measures for the benefit of him/herself. Therefore, the board of directors and auditors are supervising the executive officers to protect the corporation and investors (agency theory) (Eisenhardt, 1989).

Auditor is a supervisor that will supervise that accounting is made within the standards and laws and that accounting is transparent and reliable, therefore auditing enhances the quality of accounting.

Corporations have internal auditors that work for the corporation and external auditors that are independent. Independent auditors usually come from one of the companies of the “big four” (Deloitte, Ernst & Young, KPMG and PWC) and their objective is to inspect the work of inside auditors.

External auditors may also be affected by moral hazard. External auditors may offer Non-Auditory Services (NAS) for the corporations which may increase the arbitrage in accounting of a corporation if such services are being bought. A recent study by Hundal, (2019) suggests that the higher NAS fees are compared to the auditing fees might decrease the accounting quality.

Accounting informativeness studies the impact of accounting information to the stakeholders such as investors. In other words, how well can accounting information (balance sheet and income statement) of a firm inform the investor's on the firm's financial performance. Whereas income statement provides information on the firm's operational side (income, costs), balance sheet provides information on the firm's financial stability (assets, liabilities, equity). For example, Investors might use the information from the income statement as a benchmark to estimate the following year's income (Senthilnathan, 2012) and accordingly use the balance sheet to estimate firm's solvency in the following year (Chen et. al, 2019).

2.1.3 Accounting of Intangible assets

Intangible assets are assets that firm uses to create profits. The valuation of intangible assets is not as simple and precise as valuation of tangible assets. Therefore, the value of intangible assets can be substantially imprecise. Therefore, are easier subjects for arbitrage for managers and directors (Green et. al. 2022).

Intangible assets are the backbone of many firms, especially technology-oriented firms as their patents, softwares and copyrights are essential to the business. According to Elsten and Hill (2017), in “2015, Intangible assets formulated 84% of the market value in S&P 500 corporations” (p.1).

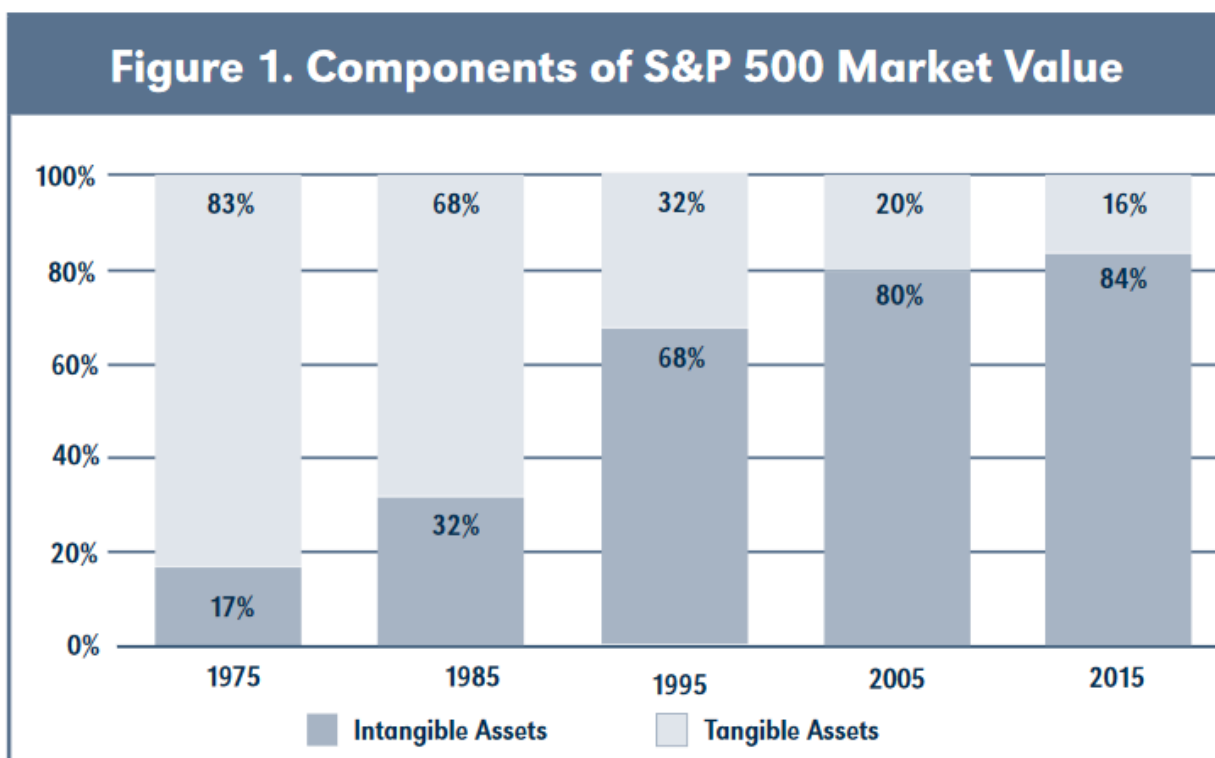


Figure 1. Components of S&P 500 Market Value. Adapted from Elsten and Hill, (2017)

Majority of Intangible assets are patents, copyrights, brands, and softwares that corporations use. Most of the intangible assets are subject to amortization and their value is diminishing year by year. For example, if a pharmaceutical firm owns a patent that is due in 15 years, a 1/15 of the value is being amortized annually as the patent is worthless after it expires, and all of the competitors are able to use the patent. Intangible assets that are not subject to amortization will be revalued yearly in a process called impairment.

Past studies suggest that stocks of the corporations that have significant proportion of intangible assets are more likely to be mispriced than corporations with low proportion of intangible assets as the valuation may be difficult and therefore decrease the accounting quality (Cornell et al. 2017; Baker & Wurgler. 2003; Glezakos et al. 2012).

Research and Development (R&D) expenditure is also seen as intangible assets as the firm is spending money on research and development to pursue new technologies and innovations. In accounting R&D expenditure can be either capitalized or marked as expense for a firm Green et al. (2022). Technology-oriented firms are known to have high proportion of R&D expenditure as the firms are pursuing more and more innovations that may be successful or not. Therefore, spending money on R&D is a complicated matter for the management as it can be seen as that the firm is sacrificing earnings in present time to generate more profits in the future. Most of the top management of firms are usually getting most of their compensation through the bonuses and other performance-based indicators, hence the management has incentive to decrease R&D expenditure and decapitalize the assets used in R&D to pursue short term profits. However, previous research suggests that in the long run R&D expenditure correlates with higher profits in the future (Green et al. 2022).

R&D expenditure can be also used for earnings manipulation. Managers can use R&D projects to smoothen earnings, as when a firm needs cash, it can decrease R&D spending to meet the capital requirements (Xiang et al. 2020).

2.2 Stock market dynamics

Stock market is a regulated and supervised public marketplace where investors can trade stocks of publicly listed corporations. Almost every country has its own stock market. In so called primary market, corporations can enter the stock market by organising Initial Public Offering (IPO) where a corporation is issuing new or already existing stocks that corporation has access to. The stocks are being sold in a fixed price and just for the investors who engaged in the IPO. By going “public”, corporation can gain significant amount of equity for the firm. Primary market is fairly low compared to secondary market, however, there has been significantly large IPOs over the decades. When the market is *bullish*, more IPOs appear. For example, in 2020 1591 IPOs were organized and 331 billion \$ of capital was raised. Compared to 2019, the increase was 42% (Canner et al. 2020).

Global IPO (2019 vs 2020)

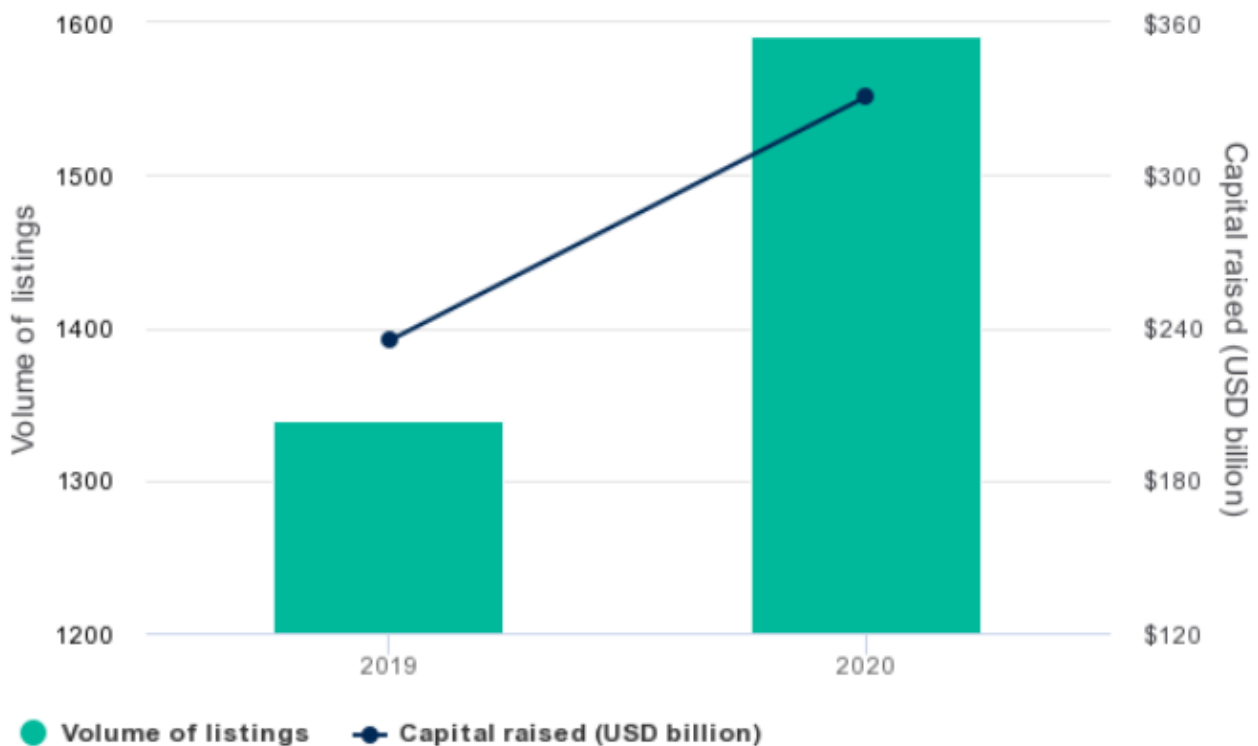


Figure 2. Global IPO (2019 vs 2020), Adapted from Canner et. al, (2020).

After the stocks has been issued to the stock market, investors may trade the stocks they own in so called secondary market. When investors want to sell or buy stocks, they may place a bid to stock market. When the seller and buyer find the equilibrium price, transaction will happen and stock changes its owner. Therefore, demand and supply of stocks will either rise or lower the price of stocks. If demand for a stock is increasing, the price will increase as the number of buyers is higher than sellers and if the supply of a stock increasing, the price will decrease as the number of sellers is higher than buyers (Heaton & Lukas, 2000).

Overall stock exchange performance is tracked by stock indexes which are composed of the stocks with various parameters. There are various different stock indexes which can represent different countries, continents or sectors in the stock markets around the world.

Country coverage indexes measure the largest stocks in a certain country. Most known country coverage indexes are FTSE 100 (United Kingdom), DAX (Germany), Nikkei 225 (Japan) and S&P 500 (USA).

All-share or composite indexes measure all of the stocks traded in a certain stock exchange such as OMXHPI (Helsinki Stock exchange) or Nasdaq composite (USA) or S&P 1500 (USA).

Global coverage indexes are composed of stocks from different countries such as MSCI world index, Dow Jones Global index and S&P Global 100.

Sector based coverage indexes measure the performance of certain industries performance such as S&P 500 energy and STOXX global 3000 banks (Yahoo finance, 2022).

In stock markets, there are investors who have different investing strategies. Most of the investors are so called value investors who only buy stocks that appear to be undervalued (Damodaran, 2012). For example, if a Stock A is traded at 80 \$ per share but the investor thinks that the fair value for the stock is 100\$, then the investor will buy it for 80\$ and hold the stock until the price is at its fair value and then sell it to gain profits. Another major group is so called growth investors who buy stocks that have higher than average growth even if they appear to be overvalued by fundamental parameters. Value and growth investors are the two majority investor groups in the modern stock markets (Damodaran, 2012).

2.3 Equity valuation

The value of the stock is changing throughout the trading day according to the investor's behaviour, therefore it is important for investors to estimate the value of the stock in the future. There are two major schools of thought in this matter, fundamental and technical analysts. In addition, the functions of key valuation tools will be discussed in this section.

2.3.1 Fundamental analysis

Fundamental analysis aims to estimate the fair value of an asset by analysing various factors that have impact on the corporation. Factors can be divided into internal and external factors. In principle, when applying fundamental analysis, investor will try to use all the information available to predict the intrinsic value of the stock in the future.

Most important internal variables to use when applying fundamental analysis is the financial reporting of the corporation. From annual reports investors want to investigate the corporations operating ratios, profitability ratios, solvency ratios and liquidity ratios to see if the corporation is able to generate value from operations, to see its capital structure, to see if it is able to pay back its debts, and if it is able to generate wealth for the shareowners (Griffioen, 2003; Lim, 2015).

External variables are divided in three sections, industry, sector, macroeconomic. Industry and sector variables try to explain the characteristics, competition and growth expectations of the industry or sector (competition, demand and supply, comparative advantage, procurement) and any other issues that affect only a certain industry or sector. Whereas economics variables try to explain the changes in the overall economy in micro and macro levels. Economic variables may be such as inflation, interest rates, exchange rate of a currency, energy prices, gross domestic product, gross national product, unemployment rate, credit rating, geographical location, political stability, and any other variables that gives the investor an idea of the economy as a whole (Griffioen, 2003; Lim, 2015).

Perhaps the most known user of fundamental analysis is Warren Buffet. Buffet was a student of Benjamin Graham who is the author of one of the most known fundamental analysis books, the *Intelligent Investor* that was published in 1949. Later on, between 1999 and 2001, Warren Buffet created so called Buffet Indicator (Swankels & Umlauf, 2022). Buffet Indicator compares the Stock market capitalization (MarkCap) to Gross Domestic Product (GDP). In a nutshell, if the stock market has more value of equity than the GDP of the country, the stock market is overvalued and vice versa. Buffet Indicator suggests that investors are more likely to find undervalued stocks when the MarkCap/GDP ratio is low than if it is high.

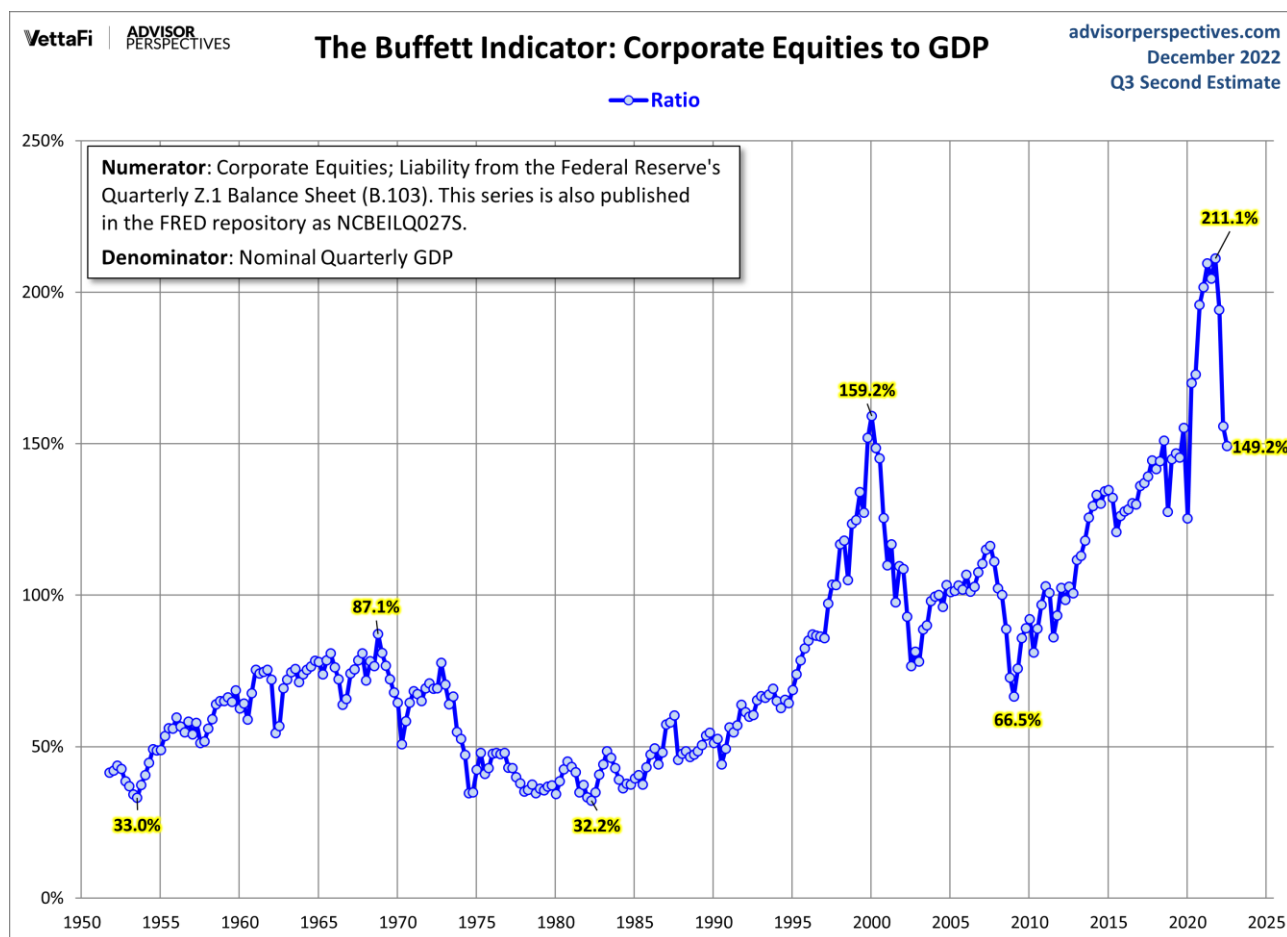


Figure 3. The Buffet Indicator, adapted from Misliniski, (2022)

2.3.2 Efficient Market Hypothesis (EMH)

Efficient Market Hypothesis by Fama (1970) is a theory that declares that stock market should reflect all the available information. For example, if a firm states that it had a poor performance in the previous quarter, the stock price of a firm should adjust immediately and precisely to its equilibrium. Therefore, according to efficient market hypothesis, it is not possible to find any undervalued stocks as the asset prices are always at the equilibrium. However, as in any econometric model, there is always a “stochastic error term” or also called as “disturbance term” which states that all of the independent variables that affect dependent variable cannot be measured completely and precisely and therefore any estimation is never 100% precise.

One of the major issues regarding efficient market hypothesis is anomalies. Anomalies are long term systematic deviations that happen for unexplanatory reasons and on a regular basis and which speculative investors might exploit to make abnormal returns. One of the most common

anomalies is the January effect. Stocks, and especially small firm's stocks tend to have abnormal returns on January (Ahokas, 2021).

Another major anomaly is the abnormal intraday versus overnight return. According to previous studies, it seems that overnight trading is having a robust pattern that investors might exploit to make abnormal returns. That anomaly has been investigated with all the major indexes throughout the decades. For example, in Nasdaq composite index from 1990 to 2021, overnight return has been 47,78% compared to intraday return of 0,29% (Knuteson, 2022; Branch & Ma. 2018; Berkman et al. 2011).

Perhaps the most contradictory anomaly with efficient market hypothesis is the earnings report anomaly. When a firm is announcing increase in earnings for a period, the stock price seems to overreact with a delay so that investors who act fast, can make abnormal returns (Yan & Zhao. 2009).

Furthermore, as stock markets are being affected by herd behaviour, overreactions and underreactions are common, when the investors are pessimistic (bearish) or optimistic (bullish) towards the markets, mispricing of stocks are more common than if a market is stable (Baker & Wurgler, 2003; Cornell et al. 2017).

In conclusion, efficient market hypothesis faces two kinds of problems. First, Anomalies cause disturbances in the theory as the efficient market hypothesis is not being able to explain such dilemmas. Second, issues caused by herd behaviour and market sentiment which causes mispricing of stocks.

A Bigger fool theory is contrary theory to efficient market hypothesis which states that even if the stocks at the market seem to be overpriced, investors are nevertheless willing to buy the stocks as there is a "greater fool" that is willing to buy the stock from the investor with a higher price that the investor paid for it. This applies until there are not "greater fools" left to buy the stocks (Oberholzer, 2010). The greater fool theory may explain the creation of speculative bubbles as if markets would work according to efficient market hypothesis, birth of speculative bubbles would be impossible.

2.3.3 Modern portfolio theory (MPT)

Modern portfolio theory (MPT) by Markowitz (1952) is one of the most important principles that investors may use to maximize the returns on minimal risk. The key idea of MPT is that investors can reduce the unsystematic risk by diversifying their portfolios according to the expected risk/return rate (Mengram, 2013). MPT assumes that all investors are risk averse and want to maximise their returns on minimal risk and achieve the best ER-VAR ratio. ER stands for expected returns and VAR stands for variance (risk). Hence, according to the MPT, investors should always pursuit the efficient frontier. Efficient frontier refers to the mixture assets that has the highest return on the lowest risk possible. Markowitz illustrates the efficient frontier followingly:

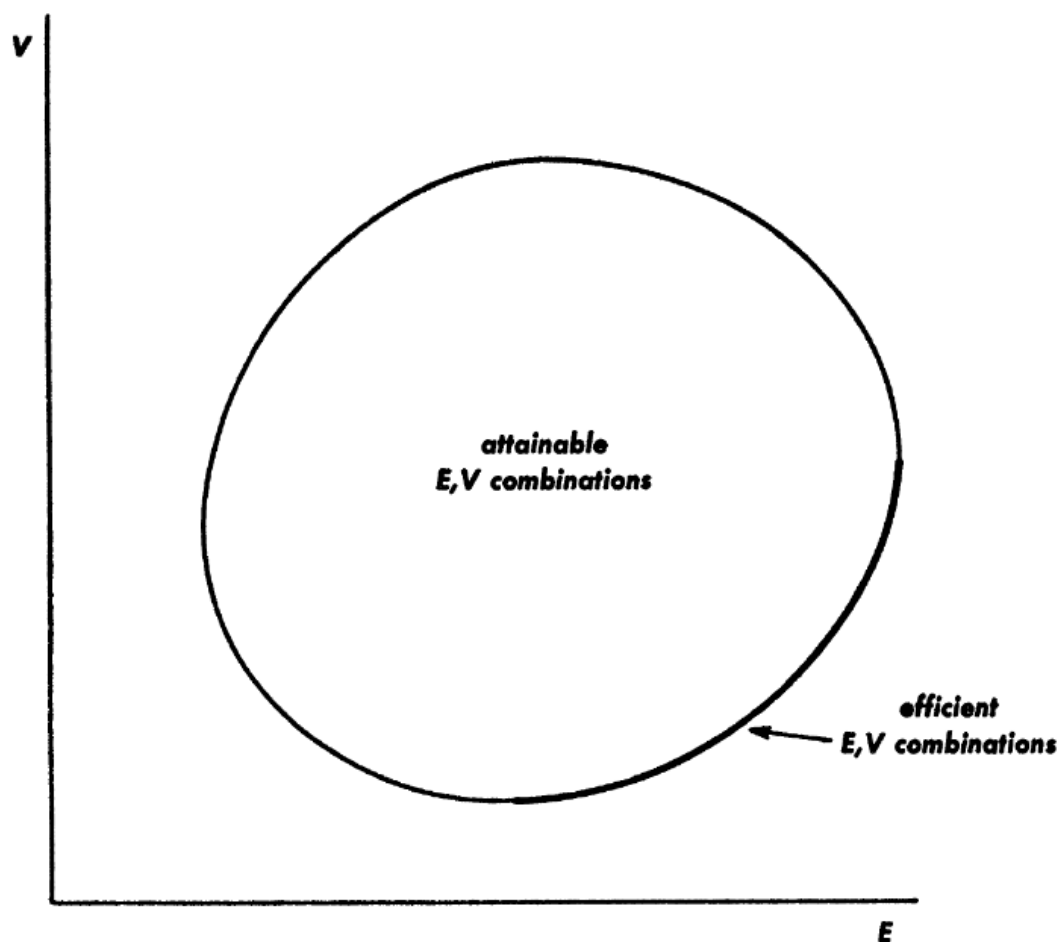


Figure 4. Efficient frontier, adapted from Markowitz, (1952).

2.3.4 Capital Asset Pricing Theory (CAPM) and Jensen's alpha

Capital Asset Pricing Model (CAPM) by Sharpe (1964) is a theory which describes the relation of risk and return. In principle, higher the risk, higher the expected return for a investment. The foundation of CAPM is in the Modern Portfolio Theory (MPT) by Markowitz (1952) which states that investors should diversify their portfolios to maximize returns and minimizing the risk. However, according to MPT, investors cannot escape the market risk or so called, systematic risk which markets possess, however by diversifying the portfolios, it is possible to affect the unsystematic risk which individual companies possess based the company specific risk factors.

Based on the idea of Markowitz, CAPM was founded by Sharpe (1964). CAPM does not only consider the ER-VAR ratio, it also considers other factors. In addition, CAPM considers risk free rate (government bond yield, Euribor interest rate or similar), market returns (chosen indexes) and slope coefficient of the chosen index (or beta, β).

CAPM is fairly easy theory to understand when calculating expected returns of equity. CAPM formula is following:

$$ER_i = R_f + \beta_i(ER_m - R_f)$$

Where:

ER_i = Expected return for equity

R_f = Risk-free rate (usually a treasury bond yield)

β_i = Market beta

ER_m = Expected market return

Even though CAPM is widely used to estimate the risk and expected return on stocks, it faces two major controversies with modern research:

1. CAPM assumes that stock markets are efficient (Fama & French, 2003).
2. CAPM assumes that investors in the stock markets are risk averse and rational (Fakhoury, 2020).

Michael C. Jensen derived Jensen's alpha in 1967 that originates in CAPM. In the original paper, Jensen compared the expected return derived by CAPM to the occurred return of 115 mutual funds (Jensen, 1967). The findings indicate that the portfolio managers can scarcely generate more profits than the markets (Jensen, 1967). If the alpha is positive, portfolio manager (or an asset) *overperformed* the market and was able to generate excess returns vice versa, if the alpha is negative, portfolio manager (or an asset) *underperformed* the market. Hence, stocks with positive (negative) alpha have been able to generate more (less) profits than expected return derived with CAPM model. According to Samarakoon & Hasan (2009), Jensen's alpha formula is following:

$$\alpha = r_p - [r_f + \beta_p(r_m - r_f)]$$

Where:

α = Jensen's alpha

r_p = Return of the portfolio

r_f =Risk-free rate

R_p =Return of the market portfolio (or an asset)

β_p = Beta of the portfolio (or an asset)

2.3.5 Arbitrage Pricing Theory (APT)

Arbitrage Pricing Model (APT) by Ross (1976) is more developed and sophisticated alternative to CAPM. Where CAPM only considers the slope coefficient (beta) as a risk coefficient, APT considers various of macroeconomic factors. Factor portfolio and factor intensity (beta) is chosen by investor by choosing variables that may affect the return of an asset and the intensity accordingly. Hence, in fundamental point of view, APT may provide more accurate information but is more complicated to calculate. According to Nickolas (2021), APT formula is following:

$$ER_i = R_f + \beta_i^1 * RP_1 + \beta_i^2 * RP_2 + \beta_i^3 \dots RP_n + \beta_i^n$$

Where:

ER_i = Expected return for equity

R_f = Risk-free rate (usually a treasury bond yield)

β_i = Factor intensity

RP = Risk premium

2.3.6 Technical analysis

Technical analysis studies the price development in the past to predict the price in the future. Whereas fundamental analyst tries to use all the available information to reveal the intrinsic value of asset, technical analyst studies the price movements and charts to find if the market is bearish or bullish. Therefore, technical analyst does not give any value to the fundamental information available (Griffioen, 2003; Lim, 2015). What comes to internal variables, fundamental analyst is always lagging in time as the financial reporting is done quarterly, however the price of the assets is changing constantly throughout the trading day and therefore the technical analyst does not experience the time lag as the fundamental analyst does. One major change between the fundamental

and technical analysts is that where fundamental analysts try to find reasoning for the price movements of an asset, technical analysts only try to understand the price movements (Mäenpää, 2019).

Technical analysts may various tools from expensive and sophisticated algorithms and even artificial intelligence to simple charts and common sense. One of the basic tools that technical analysts use is moving averages. Moving averages express the changes of the average prices of assets in any given period of time. Moving averages reveal if the market is going upwards (bullish) or downwards (bearish).

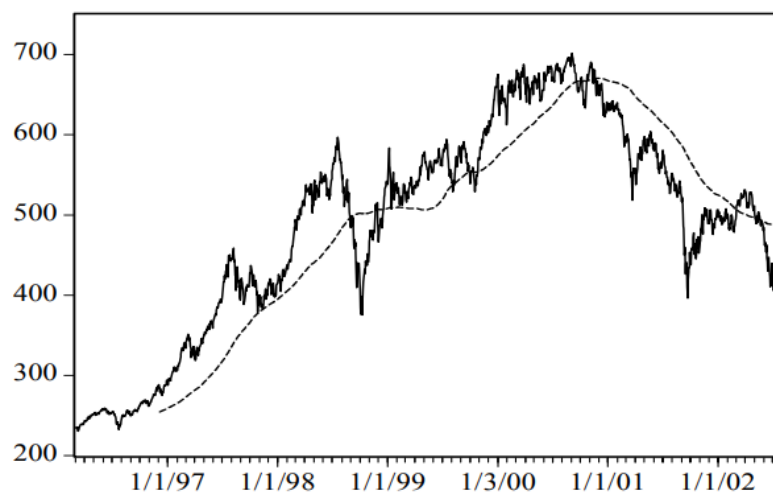


Figure 5. A 200-day moving-average trading rule applied to the AEX-index in the period March 1, 1996 through July 25, 2002, adapted from Griffoen, (2003).

Fundamental and technical analysis may sound very different, however they are often combined as they both contribute to the decision-making process (Mäenpää, 2019). By analysing fundamental information and reinforcing it with technical analysis has been proven to be effective investment strategy as fundamental analysis provides more information about the core of the business by analysing cross-sectional variables whereas technical analysis focuses on the market development (Mäenpää, 2019).

2.4 Investor sentiment

Whereas fundamental value is derived from accounting, and it measures the performance of a business, investor sentiment refers to the general atmosphere in the stock markets. Sentiment can be seen as optimism or pessimism that investors have towards the stock market. When the stock prices are going up, investors are pursuing more profits and willing to take more risk (bullish) and when stock market is going down investors are hesitating to buy stocks and rather have cash in their hand (bearish), therefore investor sentiment considers investors feelings and behaviour instead of numbers.

Investor sentiment is not being taken into account at classical finance theories as it is assumed that investors are acting rationally and diversifying their portfolios to maximise returns (portfolio theory). Evidence suggests that this is not always the true and investors are being affected by herd behaviour (Baker, Wurgler. 2003; Cornell et al. 2017). Evidence also suggests that stock market analysts are also affected by the sentiment, When the sentiment is high, analysts may face more peer pressure to give praising recommendations the stocks that appear to be overvalued or highly volatile (Baker, Wurgler. 2003; Cornell et al. 2017).

John Maynard Keynes described the effect of market sentiment as an Animal Spirit that is “a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities.” (Keynes, 1936, p.81).

Investor sentiment can be measured in many ways. Perhaps the easiest way is to look at the volume of trading. When the sentiment is high, the stocks are changing owners on a higher volume than average. However, when the sentiment is low and pessimism controls the markets, volume of trading is lower and it might be hard to find a buyer for the stocks.

Another good way to measure sentiment is to look at the analysts' recommendations. as the level of optimism is high (low), analysts tend to give more praising (condemning) recommendations to the stocks (Landsman & Stubben. 2017).

2.5 Hypotheses

Based on the previous literature, studies, and dissertations, it is indicated that the stock returns (as well as risk) of technology-oriented companies are higher than their expected returns as there is high growth potential, they are harder to evaluate due to the high proportion of intangible assets and high investor sentiment which may cause mispricing of stocks. In addition, the stock returns in Helsinki Stock Exchange and First North Helsinki have been substantially high over the study period. Therefore, the following hypotheses were formed:

Hypothesis 1: There is a misalignment between expected return and occurred return in technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki.

Hypothesis 2: Risk level positively affects the stock returns in technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki

3 Methodology

Saunders et. al (2019, 4), refer to method as a set of tools that are to be used to analyze and observe the data. On the other hand, methodology is the theory of how the research is to be done. Whereas literature review discussed the theoretical background and the key concepts and theories for the study and created hypotheses, the methodology section reveals how the data is collected, analyzed, and presented in the context of this dissertation to provide meaningful information on how the analysis was undertaken.

3.1 Research design

According to Saunders et. al (2019, 173), Research design is the prevalent scheme to answer research questions, explain the researcher's train of thought and to explain the philosophy behind the chosen approach.

Saunders et. al (2019, 174) explain the process of research design in what they call a "research onion". Research onion explains the process of choosing the philosophies and methods to answer the research questions. The first layer of the onion explains the philosophy behind the thought of

the researcher. Philosophy in this dissertation is positivism because it suits the scheme of this dissertation. Essentially, positivism is a philosophical school of thought that focuses on the facts, and the knowledge that is available (empirical and present) to provide factual and up to date information that has the minimum number of ambiguous assumptions (Saunders et. al, 144).

Second layer of the onion explains the approach to theory development. It essentially means the reasoning to explain the results of the dissertation. Furthermore, it explains, how the results are observed and what kind of conclusions are made based on the results. The approach for this study is deductive. Deductive approach essentially means that the dissertation is to test the validity of results based on the research questions and hypotheses (eg. hypothesis testing) (Saunders et. al. 2019, 153).

Third layer of the onion explains the methodological choice for the study. In this dissertation, descriptive and inferential methodology is applied as the dissertation does not only describe the results, but also comparative analysis is performed. The results are in numerical information which makes it quantitative and therefore qualitative approach is not possible to be applied (Saunders et. al. 2019, 175).

Fourth layer of the onion explains the strategy that is applied to answer the research questions. In this dissertation, there is no particular strategy from research onion to be applied. However, the study is empirical, as it considers the past events. The strategy of this dissertation is to use all the available information to explain and describe the stock returns of the 25 chosen companies on calendar years of 2020, 2021 and 2022. This explains also the fifth layer, which describes the time horizon. Time horizon for this dissertation longitudinal as the data and results are gathered and analyzed on an annual basis as well for the whole period.

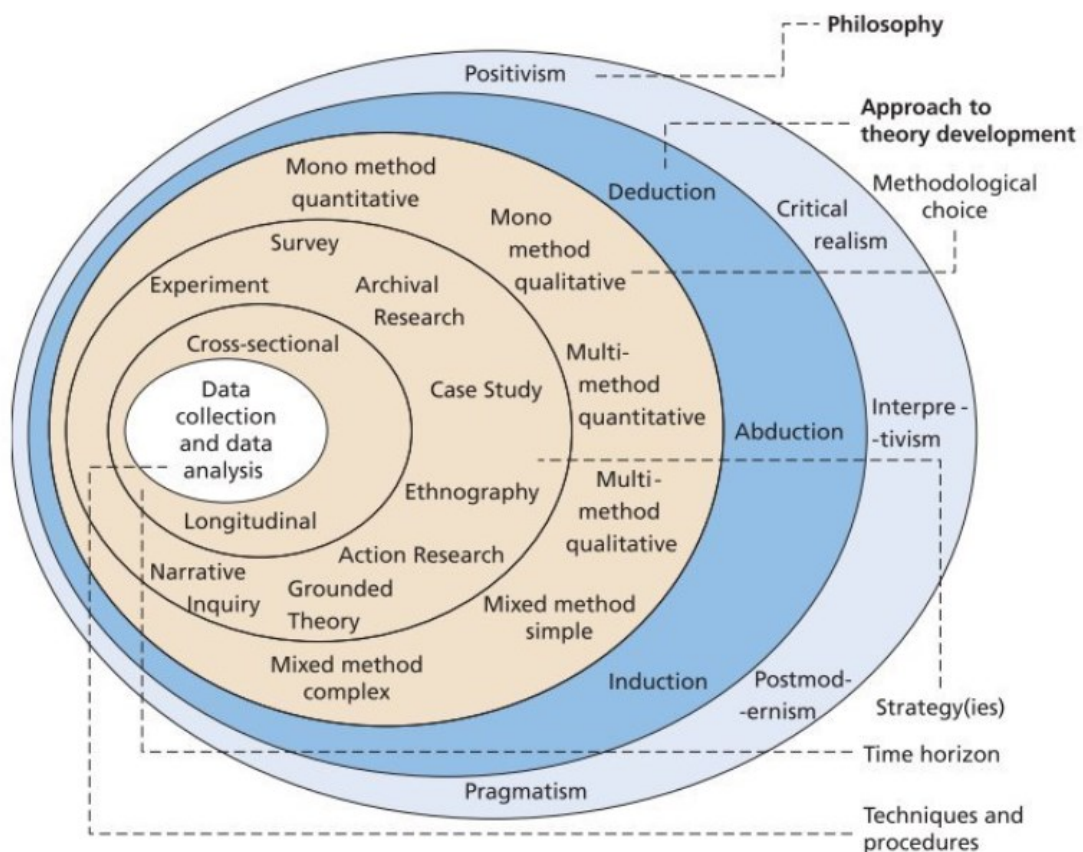


Figure 6. Research Onion. Adapted from Saunders et. al, (2019).

3.2 Data collection

This dissertation aims to explore the stock performance of the Finnish technology-oriented companies during 2020-2022. In addition, this dissertation also aims to explore the risk and return relationship as the technology-sector is perceived to be growth sector which also associates with high risk. Globally, technology stocks returns were substantially high during 2020-2021 as a cause of multiple factors, such as Covid-19 pandemic and Pandemic Emergency Purchasing Program (PEPP) (European Central Bank, 2023). In 2022, energy crisis and inflation arrived in European stock markets as a cause of Russian invasion of Ukraine.

Since the Finnish technology-oriented stock market is limited in size, the decision was made to also include technology-oriented companies that are not purely technology companies but closely related to technology sector. Chosen companies are traded in Helsinki Stock Exchange and First

North Helsinki. All the data used in this dissertation is secondary data. Secondary data refers to data that is by its nature meant to be used for other purposes (Saunders et al. 2019, 338).

Data from 25 individual stocks and three stock market indexes is collected directly from Nasdaq OMX Nordic website (Nasdaq OMX Nordic, 2024). Data is collected in in a separate Microsoft Excel spreadsheet. Data is consisting of daily observations of individual stocks closing price and chosen indexes closing price for the period of 1.1.2020-30.12.2022. Missing data for individual days is filtered out by not considering data for other stocks for a missing date. In other words, if one of the stocks, or the chosen indexes were missing datapoint (daily observation), the data for a missing day was deleted from the dataset from all of the assets for that particular day and therefore, was not considered. Total daily observations for the period is 746 and 75 firm-years. Risk free rate determined by 10 year Finland government bond rate and the data was collected directly from Bank of Finland website (Suomen Pankki, 2024).

Company name	Symbol	Stock market	Sector	Market cap
Admicom	ADMCM	First North Helsinki	Technology	Small
Aspocomp	ACG1V	Helsinki Stock Exchange	Technology	Small
Bittium	BITTI	Helsinki Stock Exchange	Technology	Mid
Detection Technology	DETEC	First North Helsinki	Industrials	Small
Digia	DIGIA	Helsinki Stock Exchange	Technology	Mid
Digistalist Group	DIGIGR	Helsinki Stock Exchange	Technology	Small
Efecte	EFECTE	First North Helsinki	Technology	Small
Gofore	GOFORE	Helsinki Stock Exchange	Technology	Mid
Innofactor	IFA1V	Helsinki Stock Exchange	Technology	Small
Leaddesk	LEADD	First North Helsinki	Technology	Small
Nokia	NOKIA	Helsinki Stock Exchange	Telecommunications	Large
QPR Software	QPR1V	Helsinki Stock Exchange	Technology	Small
QT Group	QTCOM	Helsinki Stock Exchange	Technology	Large
Remedy	REMEDY	Helsinki Stock Exchange	Consumer Services	Mid
Rovio	ROVIO	Helsinki Stock Exchange	Consumer Services	Mid
Scanfil	SCANFL	Helsinki Stock Exchange	Industrials	Mid
Siili Solutions	SIILI	Helsinki Stock Exchange	Technology	Small
Solteq	SOLTEQ	Helsinki Stock Exchange	Technology	Small
SSH Communications Security	SSH1V	Helsinki Stock Exchange	Technology	Small
Tecnotree	TEM1V	Helsinki Stock Exchange	Technology	Mid
Teleste	TLT1V	Helsinki Stock Exchange	Telecommunications	Small
TietoEvyry	TIETO	Helsinki Stock Exchange	Technology	Large
Trainer's House	TRH1V	Helsinki Stock Exchange	Technology	Small
Vincit	VINCIT	First North Helsinki	Technology	Small
With Secure	WITH	Helsinki Stock Exchange	Technology	Mid

Table 2. List of sample companies. (Source: Nasdaq, 2024. Compiled by author)

Index name	Index symbol	Currency
N Technology EUR PI	N10EURPI	EUR
OMX Nordic 40	OMXN40	EUR
OMX H25	OMXH25	EUR

Table 3. List of sample indexes. (Source: Nasdaq,2024. Compiled by author)

Period	Finland 10 year bond yield
2020	-0,40 %
2021	0,70 %
2022	0,31 %

Table 4. Finland 10 year bond yield. (Source: Suomen Pankki, 2024. Compiled by author)

3.3 Data analysis

After reviewing relevant literature, formulating the hypotheses and collection of data for the purpose of analyzing it, the analysis itself was made accordingly. Following variables were gathered to complete the analysis. The data was analyzed in Microsoft Excel spreadsheet using the formulas and data analysis tool.

Firstly, after gathering the daily stock market data required for the analysis of chosen companies and indexes mentioned in table 2 and 3, stock returns were derived. Stock return is derived by discounting the asset price in t_1 by asset price of t_0 and then dividing the result by asset price in t_0 . In other words, discounting asset price of yesterday from today's price and then dividing the deviation by asset price of yesterday.

Stock return formula is following:

$$\text{Stock return} = \frac{SP_{T1} - SP_{T0}}{SP_{T0}}$$

Where:

SP_{t1} = closing price of asset

SP_{t0} =Closing price of asset in previous day

After deriving the daily returns of assets, the returns were annualized to see the overall return per year. The periods were full calendar years, starting on the first of January and ending on the 31. December. Annual returns are calculated by deriving the average daily return for a calendar year and multiplying it by the number of trading days per year. Generally, average full year is consisted of 252 trading days. Hence, 252 is being used as a multiplier.

Annualized asset return formula is following:

$$\text{Annual stock return} = (1 + \text{Average stock return of a period})^{252} - 1$$

Where:

Average stock return of a period= Average asset daily return divided by observations of a calendar year

252= Number of trading days

After deriving the return measures, risk measures were derived. In general, riskiness of an asset is indicated by its variance. More the asset price is fluctuating, more risk is involved. In other words, an asset that has a stable price such as gold, is considered less risky investment than an asset that's value is more unstable, such as stocks or in extreme cases, crypto currencies.

Standard deviation represents the total risk of an asset. Daily standard deviation was calculated by calendar years. Standard deviation is square root of a variance. Formula is following:

$$\sigma = \sqrt{\sigma^2}$$

Where:

σ = Standard deviation

$\sqrt{}$ = Square root

σ^2 = Variance

After daily standard deviation (total risk) was derived, it was annualized to see the overall annual risk and to make it comparable for the annual returns. Annual risk is derived by multiplying the

daily observation by square root of trading days. Similarly, the number of trading days were 252. To annualize the standard deviation, following formula was being used:

$$\text{Annual total risk} = \sigma \times \sqrt{252}$$

Where:

σ = standard deviation (daily average)

x = multiplier

$\sqrt{}$ = square root

252= number of trading days

As in classical finance theories, such as CAPM, risk and return go hand in hand, it is important to compare them to see how much return the chosen assets were able to generate with how much risk. Moreover, to see how the chosen assets performed during the period. Risk to return and return to risk ratios were derived. Risk to return ratio calculated by dividing total annual risk by total annual return. Furthermore, return to risk ratio is calculated by dividing total annual return by total annual risk.

Following the risk calculation, slope coefficient (β) was derived. Slope coefficient is the lineal regression line through the observations. Beta coefficient was derived using Microsoft Excel SLOPE formula and it was derived on annual basis starting from the first day of the calendar year and ending on the last day of the calendar year.

Subsequently after deriving the Beta (β), risk decomposition was derived. Risk can be separated to unsystematic risk (asset specific risk) and systematic risk (market risk). As mentioned in the chapter 2.3.3, according to Modern portfolio theory (MPT), investors are risk averse and want to gain

as much return as possible with the least risk possible (Markowitz, 1952). However, systematic risk (market risk) is always present. Market risk is represented by index risk. Furthermore, unsystematic risk or the asset specific risk represents the level of risk attached to a individual asset and it is derived by discounting the market risk from the total risk.

Systematic risk formula is following:

Index annualized standard deviation $\times \beta$

Hence, unsystematic risk formula is:

Total risk – systematic risk

Once the risk and return as well as beta coefficient was derived, expected return (ER) calculation was derived by applying the capital asset pricing model (CAPM). CAPM derived expected return were calculated on annual basis for each of the chosen companies by pairing each of the stocks with each of the chosen indexes for comparison. As mentioned in the chapter 2.3.4, CAPM measures the risk and return relation. According to CAPM, higher the risk, higher the expected return for an asset. Expected return is derived by summing the risk-free rate (government bond yield) and multiplying it by market return (index return) discounted by risk-free rate.

CAPM formula is following:

$$ER_i = R_f + \beta_i(ER_m - R_f)$$

Where:

ER_i = Expected return for equity

R_f = Risk-free rate (usually a treasury bond yield)

β_i = Market beta (slope coefficient)

ER_m = Expected market return

Once the expected return was indicated, Jensen's alpha was derived. Jensen's alpha in principle denotes if an asset overperformed or underperformed during the period. Positive alpha states that the occurred return of an asset (or portfolio) was higher than the expected return (CAPM).

Jensen's alpha formula is following:

$$\alpha = r_p - [r_f + \beta_p(r_m - r_f)]$$

Where:

α = Jensen's alpha

r_p = Return of the portfolio (or a asset)

r_f =Risk-free rate

r_m =Return of the market portfolio (or an asset)

β_p = Beta of the portfolio (slope coefficient)

Once the variables were identified, results were summarized on descriptive statistics table for all of the variables by year to year as well as for the whole period using Microsoft Excel data analysis tool.

4 Results

Results chapter is divided in to two sections, company specific results and overall results for the reason that the data analysis may present more precise results in *Micro* and *Macro* levels.

4.1 Company specific results

This section presents the company specific results of the individual companies that altogether form the portfolio. All of the individual companies expected returns and Jensen's alphas are calculated using three chosen indexes represented in the table 2. This means that the CAPM calculations are performed three times for each individual company. This section is divided in to four sections. First, the section 4.1 represents the risk and return measures of the individual companies. Section 4.1.1 represents the CAPM calculations using the OMX Technology PI index, furthermore 4.1.2 section represents the CAPM calculations using OMX Nordic 40 index and 4.1.3 represents the CAPM calculations using the OMXH25 index. Risk and return measures are presented by tables and supplementary figures of the key variables.

Figure 7 represents the average annualized return of the individual companies. Results indicate that the highest spread on the annualized returns was in 2020 as the range was substantially high. Tecnotree had the highest average annual return for the year (519,3%), following Remedy with 293,2% and Leaddesk with 276,3%. Also, QT Group had over 200% annualized return (219,3%). In addition, four companies, (Gofore (153,1%), Admicom (133,4%), Efecte (132%) and Solteq (116%)) had over 100% average annual return for the 2020. In 2020, only four companies (Aspocomp (-20,8%), Teleste (-13%), Bittium (-7%) and Digitalist Group (-5,7%) had negative returns for the year.

In the following year of 2021, stock returns were more moderate. However, four companies were able to reach over 100% stock returns (QT group (172%), Trainer's house (157,3%), Tecnotree (143,2%) and SSH Communications Technology (100%). Furthermore, only five companies had negative returns during 2021 (Leaddesk (-35,4%), Admicom (-33,2%), QPR Software (-11,2%), Bittium (-4,3%) and Digia (-1,8%).

In 2022 stock returns plummeted as the uncertainty conquered the markets as a consequence of inflation, increased interest rates and energy crisis. Only two companies of the portfolio had positive return for the investment in 2022 (Aspocomp (33,8%) and Siili Solutions (17%). Rest of the companies in the portfolio had negative returns for the period.

In conclusion, the results indicate that during the years of 2020 and 2021 the stock returns of the technology-oriented companies was high. However, during 2022 the losses were high as vast majority of the companies were generating losses and pessimism intruded the stock markets.

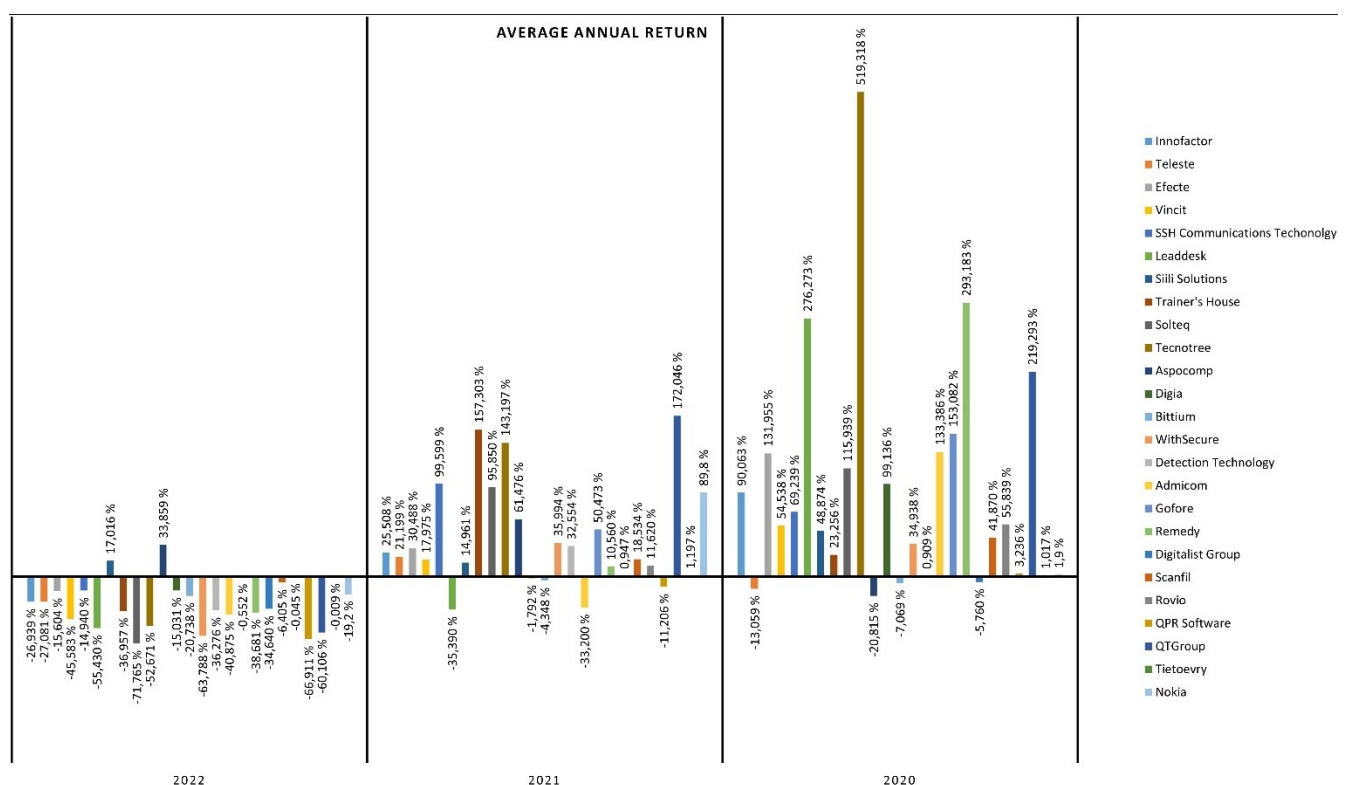


Figure 7. Average annual return 2020-2022

Figure 8 represents the annualized risk factor levels of each individual companies. Risk is derived annualizing the standard deviation of the individual companies derived from the daily observations.

Figure 8 indicates that the spread on risk levels was highest in 2020 and 2022 and more constant in 2021. However, the risk levels remained high during the period. Results may indicate that technology-oriented companies that are considered to be risky investments, became even more riskier during the period.

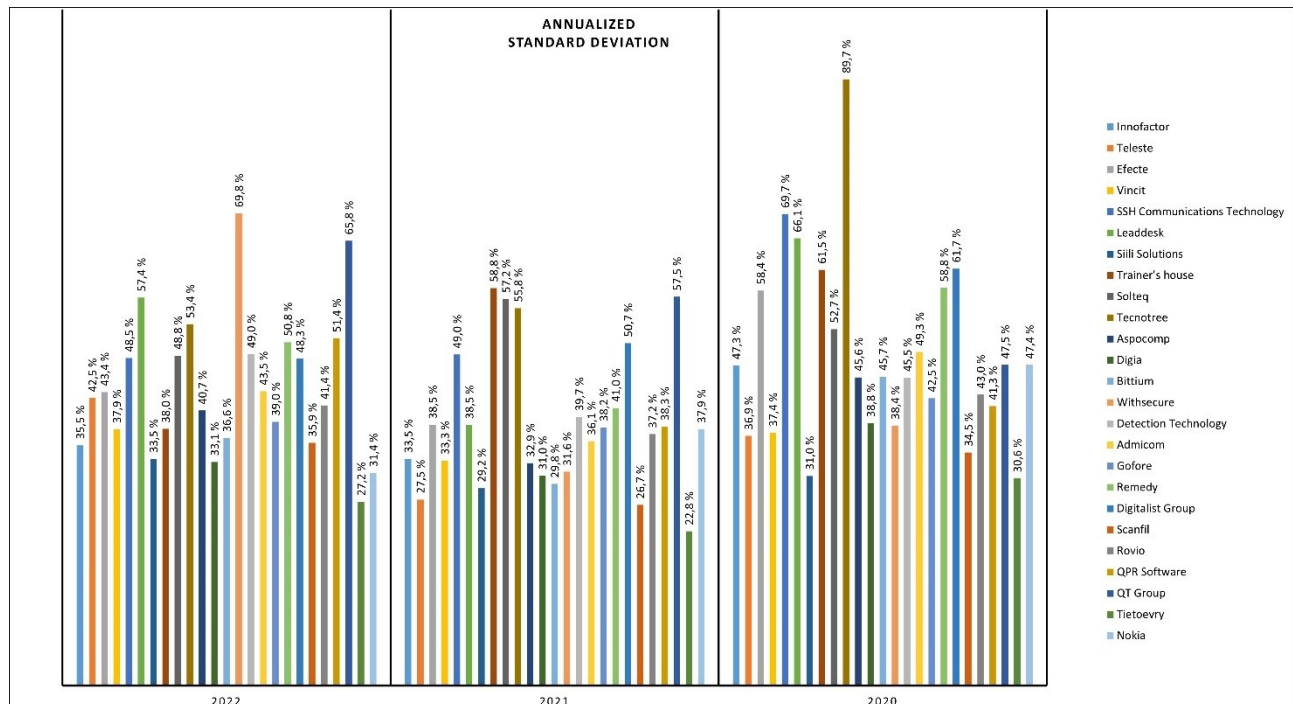


Figure 8. Annualized risk

Figure 9 represents the return to risk ratio of the chosen companies. As expected, results indicate that the chosen companies were able to generate extraordinary risk-adjusted returns during 2020 and 2021 whereas during 2022, the return to risk ratios plummeted.

In 2020, Tecnotree was able to break the 500% return to risk ratio (579,2%). Three other companies (Remedy (498,6%), QT group (462,1%) and Leaddesk (417,7%) were able to break the 400% return to risk ratio. In addition, Gofore (360,1%) had substantially high return to risk ratio.

In 2020, only four companies (Aspocomp (-45,7%), Teleste (-35,4%), Bittium (-15,5%) and Digitalist group (-9,3%) had negative return to risk ratio.

Similarly in 2021, return to risk ratios remained high. However, none of the companies were able to reach the 300% return/risk ratio. Yet, five companies exceeded the 200% level (QT Group

(299,2%), Trainer's house (267,6%), Tecnotree (256,5%), Nokia (236,8%) and SSH Communications Technology (203,4%).

However, five companies had negative return to risk ratios (Leaddesk (-91,9), Admicom (-91,8), QPR Software (-29,3%), Bittium (-14,6%) and Digia (-5,8).

As expected, in 2022, the return to risk ratios plummeted and only two companies were able to generate positive return to risk ratio (Aspocomp (83,2%) and Siili Solutions (50,7%). The rest of the companies in the portfolio had negative ratio and three companies had over -100% negative return to risk ratio (Solteq (-147,1%), QPR software (-130,3%) and Vincit (-120,2%).

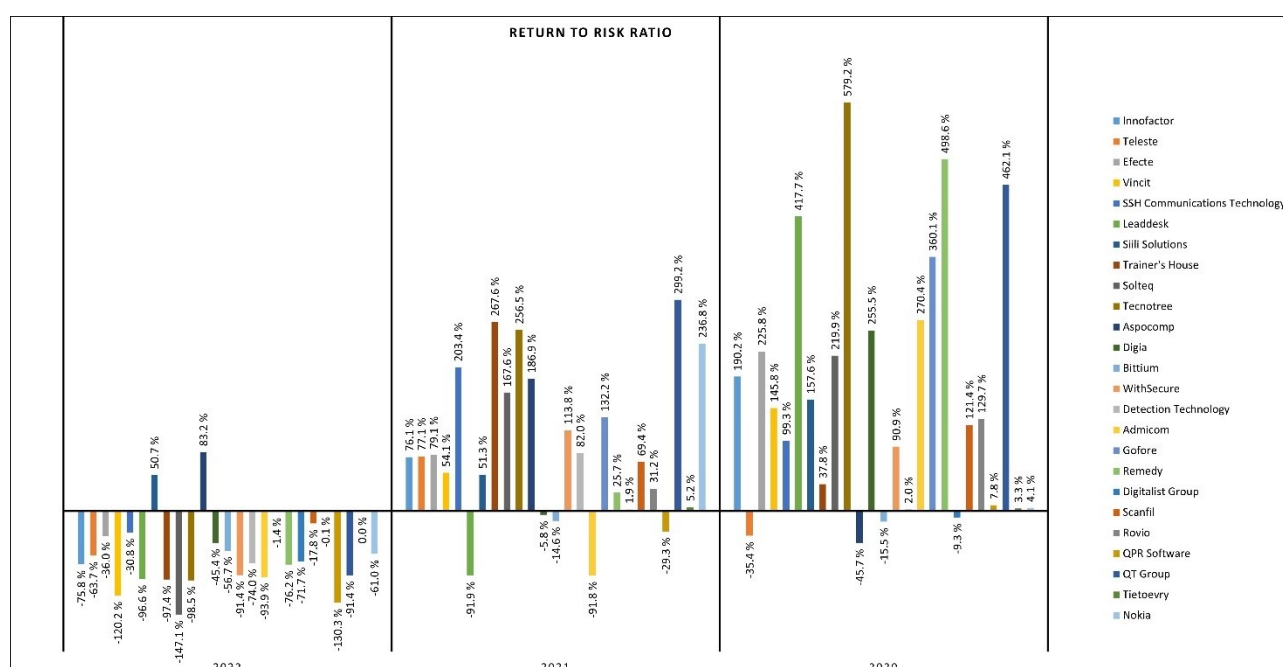


Figure 9. Return to risk ratio

4.1.1 OMX Technology PI

Figure 10 represents the CAPM derived expected returns of the individual companies on year-to-year basis. Figure 10 shows that the expected returns were extraordinary for the year 2020 as the stock markets were blooming and none of the companies had negative expected returns. Two companies (Nokia (63,7%) and Tecnotree (57,1%) exceeded the 50% expected return limit. QPR Software Technology (10,8%) had the lowest expected return in 2020. However, 10% expected return is considered to be high in normal times as the average long-term stock returns are expected

to be around 8%. In 2021, expected returns were more moderate. However, none of the companies had negative expected returns. Expected returns plummeted in 2022 as the uncertainty hit the markets and index returns were negative.

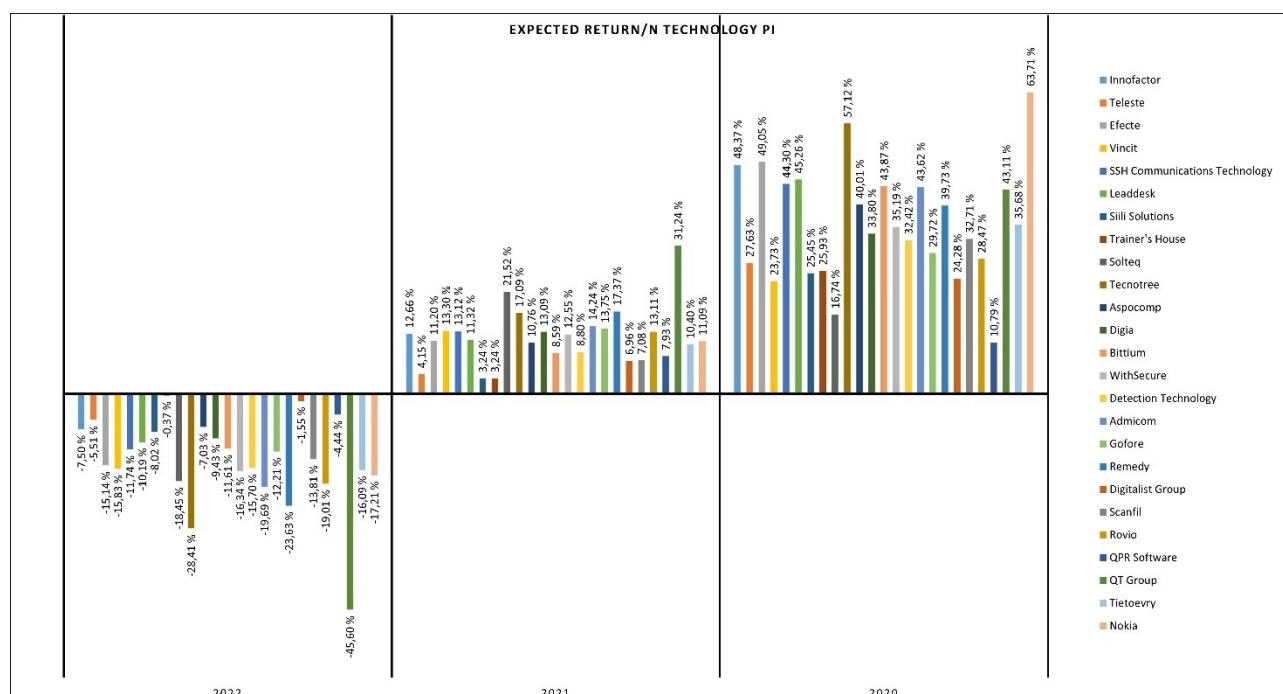


Figure 10. CAPM derived expected returns. Index: OMX N Technology PI

Figure 11 shows the Jensen's alpha of the individual companies. Jensen's alpha compares the occurred return with expected return. If the occurred return is higher than expected return, Jensen's alpha is positive and vice versa.

Majority of the companies were able to generate positive Jensen's alpha during 2020 and 2021 which is excellent result. In 2020, five companies (Tecnotree (462,2%), Remedy (253,46%), Leaddesk (231%), QT Group (176,2%) and Gofore (123,4%)) had over 100% result.

In 2021, three companies (Trainer's house (154%), QT Group (140,1%) and Tecnotree (126,1%)) had over 100% Jensen's alpha.

In 2022, only six companies had positive alpha (Aspocomp (40,9%), Siili Solutions (25%), Rovio (19%), Tietoevry (16,1%), Gofore (11,7%) and Scanfil (7,4%).

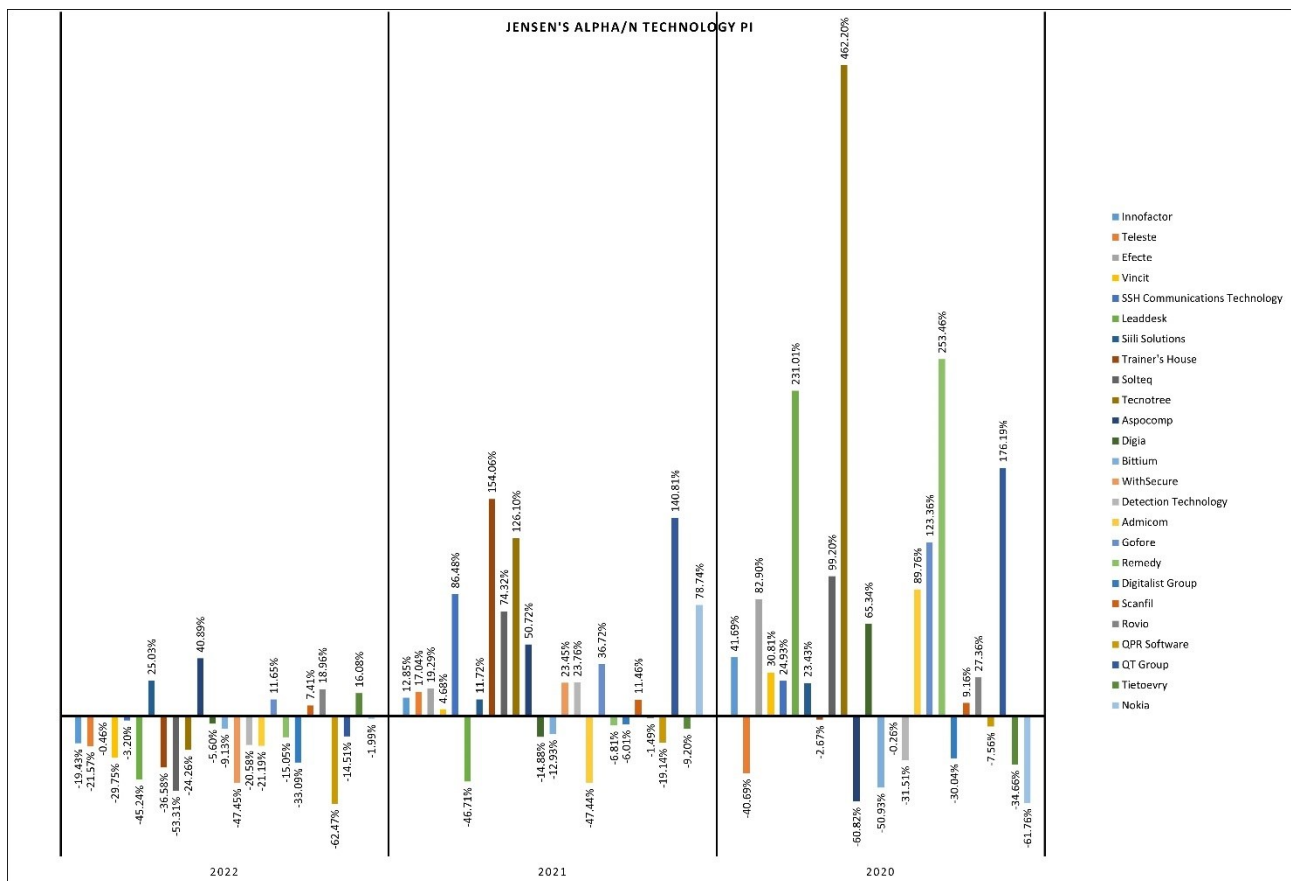


Figure 11. Jensen's alpha calculations. Index: OMX N Technology PI

Furthermore, table 5 shows annualized averages of the key figures for 2020-2022.

OMX N technology PI	Avg annual return	Avg Annual stdev(total risk)	Return to risk ratio	Beta	Systematic risk	Unsystematic risk	Expected return	Jensen's alpha
Nokia	24.2 %	38.9 %	60.0 %	0.66	21.2 %	17.7 %	19.2 %	5.0 %
Tietoevry	0.7 %	26.9 %	2.8 %	0.49	15.8 %	11.1 %	10.0 %	-9.3 %
QTGroup	110.4 %	56.9 %	223.3 %	1.04	33.0 %	23.9 %	9.6 %	100.8 %
QPR	-25.0 %	43.7 %	-50.6 %	0.23	6.8 %	36.8 %	4.8 %	-29.7 %
Rovio	22.5 %	40.6 %	53.6 %	0.51	16.3 %	24.3 %	7.5 %	14.9 %
Scanfil	18.0 %	32.4 %	57.7 %	0.41	13.5 %	18.9 %	8.7 %	9.3 %
Digitalist	-13.2 %	53.6 %	-26.4 %	0.26	8.0 %	45.6 %	9.9 %	-23.0 %
Remedy	88.4 %	50.2 %	149.4 %	0.66	21.0 %	29.2 %	11.2 %	77.2 %
Gofore	67.7 %	39.9 %	163.6 %	0.47	14.5 %	25.4 %	10.4 %	57.2 %
Admicom	19.8 %	43.0 %	28.2 %	0.61	19.5 %	23.5 %	12.7 %	7.0 %
Detection Technology	-0.9 %	44.8 %	3.3 %	0.45	14.6 %	30.2 %	8.5 %	-9.4 %
WithSecure	2.4 %	46.6 %	37.8 %	0.52	16.4 %	30.2 %	10.5 %	-8.1 %
Bittium	-10.7 %	37.4 %	-28.9 %	0.47	15.2 %	22.2 %	13.6 %	-24.3 %
Digia	27.4 %	34.3 %	68.1 %	0.46	14.1 %	20.2 %	12.5 %	15.0 %
Aspocomp	24.8 %	39.7 %	74.8 %	0.44	13.7 %	26.0 %	14.6 %	10.3 %
Tecnotree	203.3 %	66.3 %	245.7 %	0.80	25.6 %	40.8 %	15.3 %	188.0 %
Solteq	46.7 %	52.9 %	80.1 %	0.55	16.6 %	36.3 %	6.6 %	40.1 %
TrainersHouse	47.9 %	52.7 %	69.4 %	0.21	6.8 %	46.0 %	9.6 %	38.3 %
Siili	27.0 %	31.2 %	86.5 %	0.28	9.2 %	22.1 %	6.9 %	20.1 %
Leaddesk	61.8 %	54.0 %	76.4 %	0.50	15.8 %	38.2 %	15.5 %	46.4 %
SSH	51.3 %	55.7 %	90.6 %	0.54	16.7 %	39.0 %	15.2 %	36.1 %
Vincit	9.0 %	36.2 %	26.5 %	0.46	14.5 %	21.7 %	7.1 %	1.9 %
Efecte	48.9 %	46.8 %	89.7 %	0.57	18.0 %	28.8 %	15.0 %	33.9 %
Teleste	-6.3 %	35.7 %	-7.3 %	0.28	9.0 %	26.7 %	8.8 %	-15.1 %
Innofactor	29.5 %	38.8 %	63.5 %	0.52	15.9 %	22.9 %	17.8 %	11.7 %

Table 5. Company specific averages 2020-2022. Index: OMX Technology PI

4.1.2 OMX Nordic 40

Figure 12 represents the CAPM derived expected returns of the individual companies on year-to-year basis using the OMX Nordic 40 index. Similarly to OMX Technology PI calculations, none of the companies had negative expected returns in 2020 and 2021, However the expected returns were more moderate and stable between different companies in comparison to OMX Technology PI. However, expected returns remained high in 2020 and 2021 and plummeted in 2022.

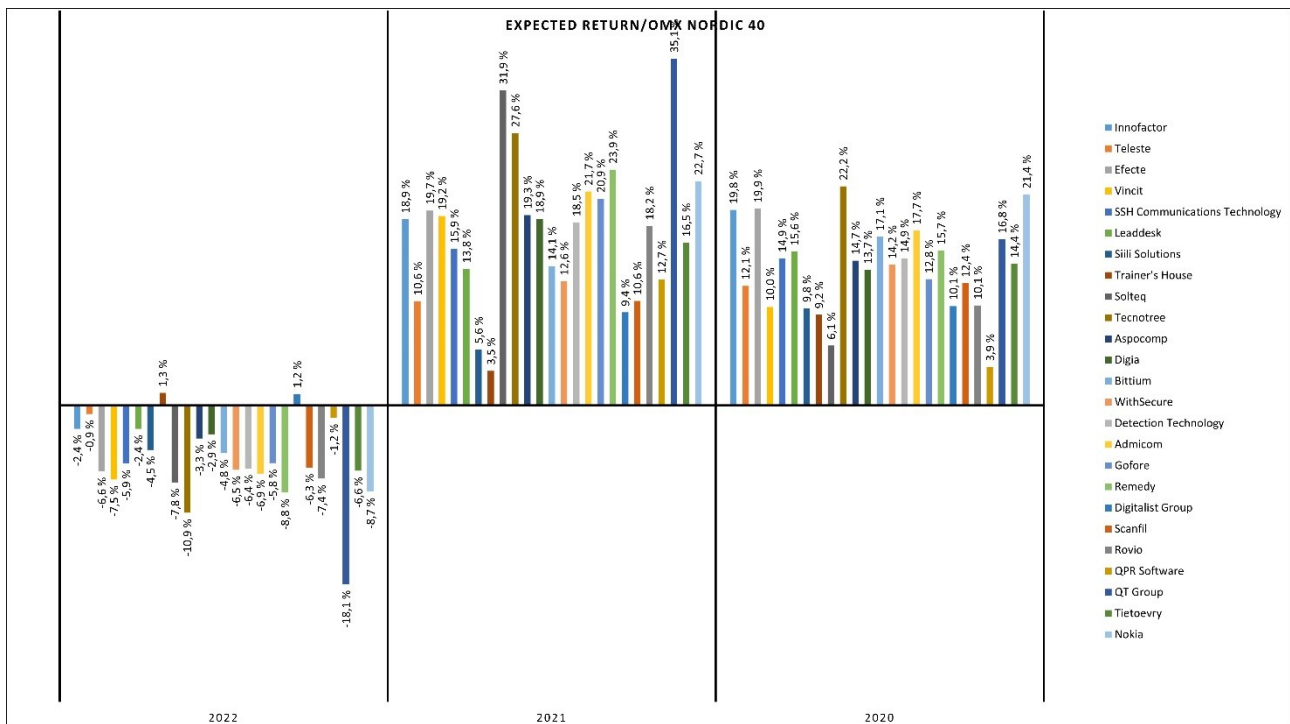


Figure 12. CAPM derived expected returns. Index: OMX Nordic 40

Figure 13 shows the Jensen's alpha calculations in a graphical form. Similarly, to expected returns, Jensen's alphas were more moderate when comparing to OMX Technology PI calculations. However, they show a similar pattern. As expected, Jensen's alpha remained high during 2020 and 2021 and plummeted in 2022.

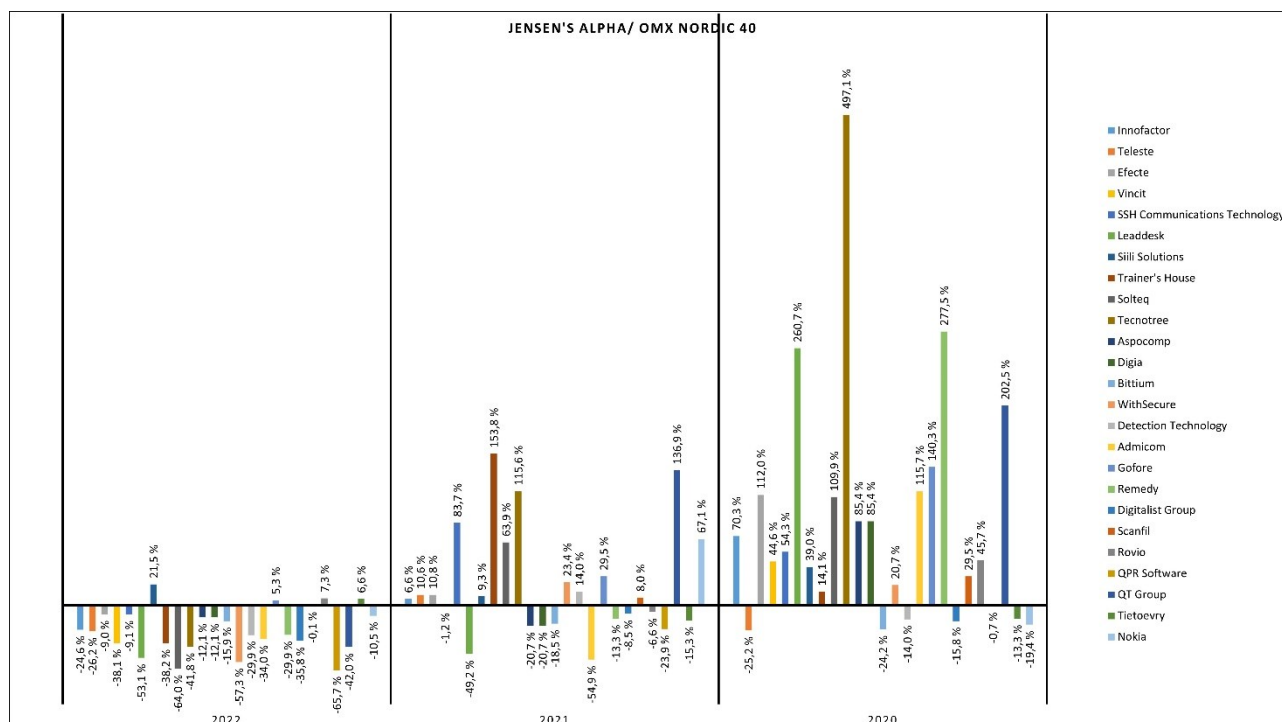


Figure 13. Jensen's alpha calculations. Index: OMX Nordic 40

Furthermore, Table 6 represents the averages of the key figures of portfolio companies for the period of 2020-2022.

OMX Nordic 40	Avg annual return	Avg Annual stdev(total risk)	Return to risk ratio	Beta	Systematic risk	Unsystematic risk	Expected return	Jensen's alpha
Nokia	24.2 %	38.9 %	60.0 %	1.00	21.8 %	17.1 %	11.8 %	12.4 %
Tietoevry	0.7 %	26.9 %	2.8 %	0.74	16.1 %	10.8 %	8.1 %	-7.4 %
QTGroup	110.4 %	56.9 %	223.3 %	1.33	28.1 %	28.8 %	11.3 %	99.1 %
QPR	-25.0 %	43.7 %	-50.6 %	0.36	7.2 %	36.5 %	5.2 %	-30.1 %
Rovio	22.5 %	40.6 %	53.6 %	0.70	16.6 %	24.0 %	7.0 %	15.5 %
Scanfil	18.0 %	32.4 %	57.7 %	0.62	14.6 %	17.8 %	5.6 %	12.4 %
Digitalist	-13.2 %	53.6 %	-26.4 %	0.36	8.5 %	45.1 %	6.9 %	-20.1 %
Remedy	88.4 %	50.2 %	149.4 %	0.91	21.5 %	28.7 %	10.3 %	78.1 %
Gofore	67.7 %	39.9 %	163.6 %	0.74	17.5 %	22.4 %	9.3 %	58.4 %
Admicom	19.8 %	43.0 %	28.2 %	0.87	20.5 %	22.5 %	10.8 %	8.9 %
Detection Technology	-0.9 %	44.8 %	3.3 %	0.77	18.0 %	26.7 %	9.0 %	-10.0 %
WithSecure	2.4 %	46.6 %	37.8 %	0.68	16.1 %	30.6 %	6.8 %	-4.4 %
Bittium	-10.7 %	37.4 %	-28.9 %	0.71	16.7 %	20.7 %	8.8 %	-19.5 %
Digia	27.4 %	34.3 %	68.1 %	0.65	15.4 %	18.9 %	9.9 %	17.5 %
Aspocomp	24.8 %	39.7 %	74.8 %	0.69	16.2 %	23.5 %	10.2 %	14.6 %
Tecnotree	203.3 %	66.3 %	245.7 %	1.13	26.7 %	39.6 %	13.0 %	190.3 %
Solteq	46.7 %	52.9 %	80.1 %	0.81	19.1 %	33.8 %	10.1 %	36.6 %
TrainersHouse	47.9 %	52.7 %	69.4 %	0.27	6.3 %	46.4 %	4.7 %	43.2 %
Siili	27.0 %	31.2 %	86.5 %	0.46	10.9 %	20.3 %	3.7 %	23.3 %
Leaddesk	61.8 %	54.0 %	76.4 %	0.61	14.4 %	39.6 %	9.0 %	52.8 %
SSH	51.3 %	55.7 %	90.6 %	0.72	16.9 %	38.8 %	8.3 %	43.0 %
Vincit	9.0 %	36.2 %	26.5 %	0.72	16.8 %	19.4 %	7.2 %	1.7 %
Efecte	48.9 %	46.8 %	89.7 %	0.88	20.7 %	26.1 %	11.0 %	37.9 %
Teleste	-6.3 %	35.7 %	-7.3 %	0.47	11.0 %	24.7 %	7.3 %	-13.6 %
Innofactor	29.5 %	38.8 %	63.5 %	0.75	17.7 %	21.1 %	12.1 %	17.4 %

Table 6. Company specific averages 2020-2022. Index: OMX Nordic 40

4.1.3 OMXH25

Figure 14 shows the CAPM derived expected returns derived from all of the portfolio companies using OMXH25 index as a market factor. In comparison to OMX N Technology PI and OMX Nordic 40, results indicate that the expected returns were more modest in OMXH25 in 2020 and 2021. However, the results show similar pattern where all the portfolio companies had positive expected returns in 2020 and 2021 whereas in 2022 expected returns for majority of the companies turned out to be negative. In fact, only Trainer's House had positive expected return for the year.

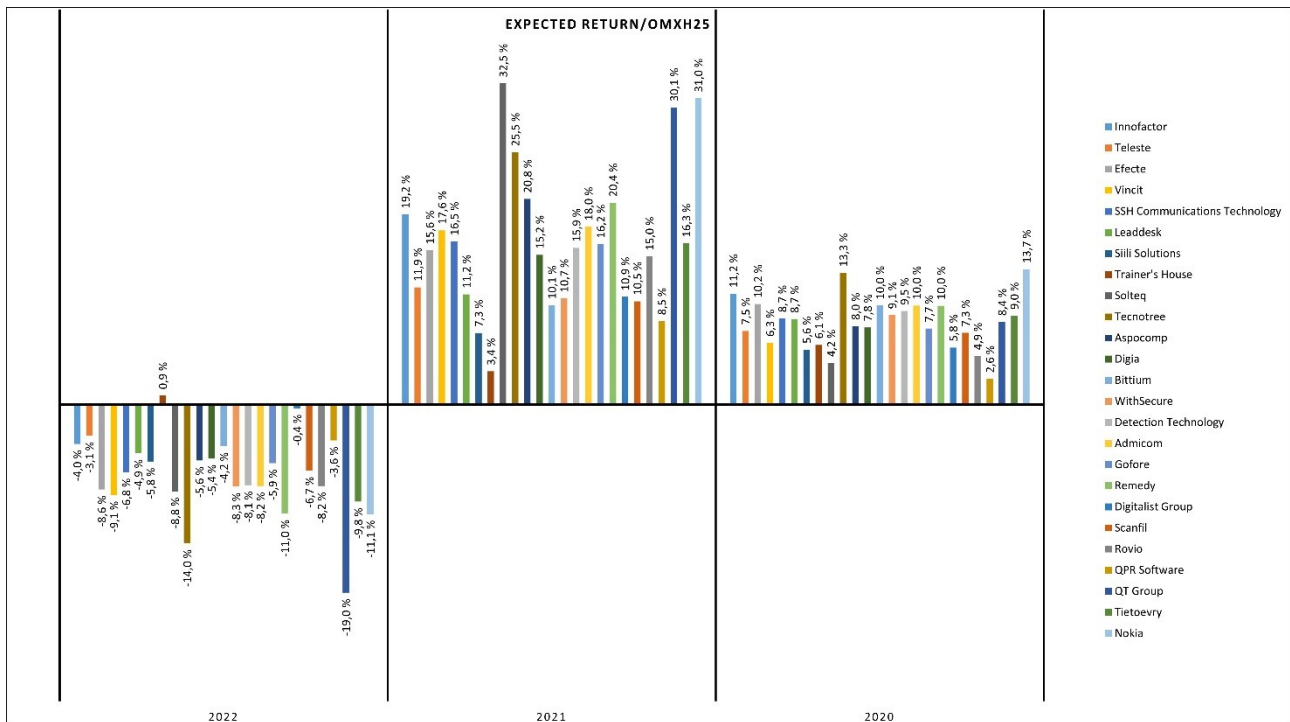


Figure 14. CAPM derived expected returns. Index: OMXH25

Similarly, Jensen's alpha remains high in majority of the companies in 2020 and 2021. In 2022 majority of companies had negative alpha. Results show similar pattern in comparison to OMX N Technology PI and OMX Nordic 40 indexes.

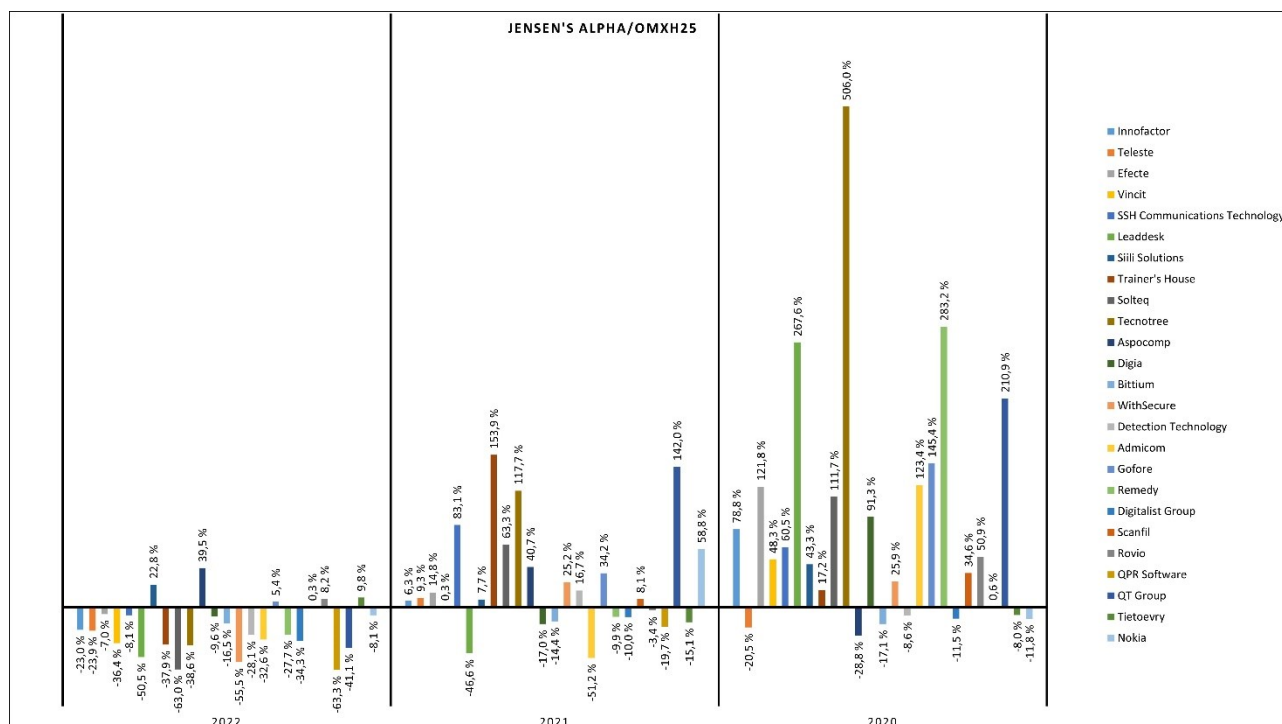


Figure 15. Jensen's alpha. Index: OMXH25

In addition, Table 7 represents the averages of the key figures of portfolio companies for the period of 2020-2022.

OMXH25	Avg annual return	Avg Annual stdev(total risk)	Return to risk ratio	Beta	Systematic risk	Unsystematic risk	Expected return	Jensen's alpha
Nokia	24.2 %	38.9 %	60.0 %	1.17	25.2 %	13.7 %	11.2 %	13.0 %
TietoEvry	0.7 %	26.9 %	2.8 %	0.80	17.7 %	9.1 %	5.2 %	-4.5 %
QTGroup	110.4 %	56.9 %	223.3 %	1.19	25.0 %	31.9 %	6.5 %	104.0 %
QPR	-25.0 %	43.7 %	-50.6 %	0.36	7.7 %	35.9 %	2.5 %	-27.5 %
Rovio	22.5 %	40.6 %	53.6 %	0.63	14.6 %	25.9 %	3.9 %	18.5 %
Scanfil	18.0 %	32.4 %	57.7 %	0.59	13.8 %	18.6 %	3.7 %	14.3 %
Digitalist	-13.2 %	53.6 %	-26.4 %	0.41	9.6 %	43.9 %	5.5 %	-18.6 %
Remedy	88.4 %	50.2 %	149.4 %	0.91	21.2 %	29.0 %	6.5 %	81.9 %
Gofore	67.7 %	39.9 %	163.6 %	0.67	15.6 %	24.3 %	6.0 %	61.6 %
Admicom	19.8 %	43.0 %	28.2 %	0.82	19.0 %	24.0 %	6.6 %	13.2 %
Detection Technology	-0.9 %	44.8 %	3.3 %	0.77	17.8 %	27.0 %	5.7 %	-6.7 %
WithSecure	2.4 %	46.6 %	37.8 %	0.68	15.9 %	30.7 %	3.9 %	-1.5 %
Bittium	-10.7 %	37.4 %	-28.9 %	0.61	14.1 %	23.2 %	5.3 %	-16.0 %
Digia	27.4 %	34.3 %	68.1 %	0.65	15.1 %	19.2 %	5.9 %	21.6 %
Aspocomp	24.8 %	39.7 %	74.8 %	0.74	17.2 %	22.5 %	7.7 %	17.1 %
Tecnotree	203.3 %	66.3 %	245.7 %	1.15	26.8 %	39.6 %	8.3 %	195.0 %
Solteq	46.7 %	52.9 %	80.1 %	0.88	20.4 %	32.5 %	9.3 %	37.4 %
TrainersHouse	47.9 %	52.7 %	69.4 %	0.28	6.5 %	46.2 %	3.5 %	44.4 %
Siili	27.0 %	31.2 %	86.5 %	0.48	11.1 %	20.2 %	2.4 %	24.6 %
Leaddesk	61.8 %	54.0 %	76.4 %	0.60	14.0 %	40.0 %	5.0 %	56.8 %
SSH	51.3 %	55.7 %	90.6 %	0.72	16.9 %	38.9 %	6.2 %	45.1 %
Vincit	9.0 %	36.2 %	26.5 %	0.73	16.9 %	19.3 %	4.9 %	4.0 %
Efecte	48.9 %	46.8 %	89.7 %	0.79	18.4 %	28.4 %	5.8 %	43.2 %
Teleste	-6.3 %	35.7 %	-7.3 %	0.54	12.5 %	23.2 %	5.4 %	-11.7 %
Innofactor	29.5 %	38.8 %	63.5 %	0.77	17.9 %	20.9 %	8.8 %	20.7 %

Table 7. Company specific averages 2020-2022. Index: OMXH25

4.2 Overall results

This section presents the overall results of the portfolio or in other words, the “big picture”. The risk and return measures are presented by descriptive statistics with supplementary figures of the main findings.

Table 8 shows the descriptive statistics of stock returns in annual basis as well as for the whole period. The mean of stock returns was substantially high during 2020 (92,8%) and 2021 (40%) whereas in 2022, mean of stock returns was negative (-27,9%). However, due the high returns in 2020 and 2021, mean of stock returns for the whole period remained positive (35%). In addition, high standard deviation exists in the returns on 2020 (1,24) and 2021 (0,56) whereas in 2022, standard deviation reduced to 0,26. Standard deviation represents that there are misalignments between the stock returns. Hence, the range of returns between companies was substantially high during 2020 (5,4) and 2021 (2) whereas in 2022, range deflated to 1,05. Range represents the deviation between the lowest return and the highest return of individual companies. High range indicate that the returns between companies was misaligned.

Annualised return							
2020		2021		2022		2020-2022	
Mean	0,928233535	Mean	0,40214792	Mean	-0,279740285	Mean	0,350213723
Standard Error	0,249055102	Standard Error	0,112507715	Standard Error	0,053457138	Standard Error	0,108110396
Median	0,545376501	Median	0,211988593	Median	-0,270813556	Median	0,032363738
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A
Standard Deviation	1,245275512	Standard Deviation	0,562538573	Standard Deviation	0,26728569	Standard Deviation	0,936263492
Sample Variance	1,550711101	Sample Variance	0,316449646	Sample Variance	0,07144164	Sample Variance	0,876589327
Kurtosis	4,801847258	Kurtosis	0,399813779	Kurtosis	-0,207839962	Kurtosis	9,47625292
Skewness	2,009464437	Skewness	1,057936187	Skewness	0,333958557	Skewness	2,555072774
Range	5,40133253	Range	2,07435956	Range	1,056234125	Range	5,910827148
Minimum	-0,208153623	Minimum	-0,353902143	Minimum	-0,717648241	Minimum	-0,717648241
Maximum	5,193178907	Maximum	1,720457418	Maximum	0,338585884	Maximum	5,193178907
Sum	23,20583838	Sum	10,05369799	Sum	-6,993507125	Sum	26,26602924
Count	25	Count	25	Count	25	Count	75

Table 8. Annualized return descriptive statistics

Table 9 shows descriptive statistics of the risk factor. As expected, standard deviation mean remained fairly stable throughout the period. In 2020, standard deviation mean was 48,9%, in 2021

38,9% and in 2022 44,1%. For the whole period, mean was 43,9%. This indicates that the risk level did not fluctuate as much as the level of the returns during the period. However, range remained high. Range in 2020 was 0,59, 2021 0,35 and 2022 0,42. This means that there were major deviations in the risk levels between the assets.

Annual total risk (Standard deviation)							
2020		2021		2022		2020-2022	
Mean	0,488657571	Mean	0,389158632	Mean	0,4411573	Mean	0,439657834
Standard Error	0,027197734	Standard Error	0,020597989	Standard Error	0,020724699	Standard Error	0,013949323
Median	0,456903599	Median	0,379336203	Median	0,425242949	Median	0,413428532
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A
Standard Deviation	0,135988672	Standard Deviation	0,102989946	Standard Deviation	0,103623497	Standard Deviation	0,120804681
Sample Variance	0,018492919	Sample Variance	0,010606929	Sample Variance	0,010737829	Sample Variance	0,014593771
Kurtosis	1,972094788	Kurtosis	-0,418869751	Kurtosis	0,554246893	Kurtosis	1,667670983
Skewness	1,208733626	Skewness	0,714621082	Skewness	0,800238131	Skewness	1,036146094
Range	0,590379346	Range	0,359596275	Range	0,426583991	Range	0,668505268
Minimum	0,306298289	Minimum	0,228172367	Minimum	0,271689011	Minimum	0,228172367
Maximum	0,896677635	Maximum	0,587768642	Maximum	0,698273002	Maximum	0,896677635
Sum	12,21643928	Sum	9,7289658	Sum	11,0289325	Sum	32,97433758
Count	25	Count	25	Count	25	Count	75

Table 9. Annualized total risk descriptive statistics

Table 10 shows the return to risk ratio which shows that how much return the companies were able to create in comparison with the risk level. If return to risk ratio is positive, return was higher than risk and vice versa, if return to risk ratio is negative, it means that the companies were generating higher levels of risk than return.

Mean of return to risk ratio was abnormal in 2020 (1,66) and 2021 (0,87) whereas in 2022, it ended up being negative (-0,65) as expected based on table 8 and 9. Standard deviation remained also high in 2020 (1,8) and 2021 (1,08) and was halved in 2022 (0,54). Also, range remained high throughout the period as on it was 2020 (6,2) and 2021 (3,9) and in 2022, (2,3).

Return/risk ratio							
2020		2021		2022		2020-2022	
Mean	1.669362539	Mean	0.87344157	Mean	-0.577364221	Mean	0.655146629
Standard Error	0.36052539	Standard Error	0.216706496	Standard Error	0.108806309	Standard Error	0.179163062
Median	1.297404939	Median	0.760745516	Median	-0.71652084	Median	0.078281337
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A
Standard Deviation	1.802626949	Standard Deviation	1.083532481	Standard Deviation	0.544031547	Standard Deviation	1.551597628
Sample Variance	3.249463917	Sample Variance	1.174042637	Sample Variance	0.295970324	Sample Variance	2.4074552
Kurtosis	-0.219899732	Kurtosis	-0.59251193	Kurtosis	0.785094157	Kurtosis	1.37193593
Skewness	0.832483474	Skewness	0.358675346	Skewness	0.86166259	Skewness	1.225864907
Range	6.248151169	Range	3.910142537	Range	2.302902045	Range	7.262360743
Minimum	-0.456572677	Minimum	-0.918533378	Minimum	-1.470782251	Minimum	-1.470782251
Maximum	5.791578492	Maximum	2.991609158	Maximum	0.832119793	Maximum	5.791578492
Sum	41.73406348	Sum	21.83603925	Sum	-14.43410553	Sum	49.1359972
Count	25	Count	25	Count	25	Count	75

Table 10. Risk and return descriptive statistics

Table 11 represents the risk composition of the portfolio. As mentioned before, year 2021 was the least risky for the portfolio companies, following the year 2020 and 2022. The average annual total risk remained at 44%. Proportion of systematic risk/total risk (the percentage of market risk of total risk) for the period in OMX N Technology PI was the lowest (35,6%) following the OMXH25 (37,4%) and OMX Nordic 40 (37,8%).

Composition of risk	OMX N Technology PI				
	OMX N Technology PI		OMX N Technology PI		OMX Technology PI
	Total risk	Systematic risk	Unsystematic risk	Proportion of systematic risk/total risk	Proportion of unsystematic risk/total risk
2020	48.9 %	19.18 %	29.69 %	39.25 %	60.75 %
2021	38.9 %	10.94 %	27.97 %	28.12 %	71.88 %
2022	44.1 %	16.83 %	27.28 %	38.16 %	61.84 %
2020-2022	44.0 %	15.65 %	28.31 %	35.60 %	64.40 %
	OMX Nordic 40		OMX Nordic 40	OMX Nordic 40	OMX Nordic 40
	Systematic risk		Unsystematic risk	Proportion of systematic risk/total risk	Proportion of unsystematic risk/total risk
	48.9 %	18.6 %	30.3 %	38.1 %	61.9 %
2020	48.9 %	18.6 %	30.3 %	38.1 %	61.9 %
2021	38.9 %	14.6 %	24.3 %	37.5 %	62.5 %
2022	44.1 %	16.6 %	27.5 %	37.7 %	62.3 %
2020-2022	44.0 %	16.6 %	27.4 %	37.8 %	62.2 %
	OMXH25		OMXH25	OMXH25	OMXH25
	Systematic risk		Unsystematic risk	Proportion of systematic risk/total risk	Proportion of unsystematic risk/total risk
	48.9 %	17.4 %	31.4 %	35.7 %	64.3 %
2020	48.9 %	17.4 %	31.4 %	35.7 %	64.3 %
2021	38.9 %	15.5 %	23.5 %	39.7 %	60.3 %
2022	44.1 %	16.4 %	27.7 %	37.2 %	62.8 %
2020-2022	44.0 %	16.4 %	27.5 %	37.4 %	62.6 %

Table 11. Composition of risk

Table 12 represents the risk and return calculations of the chosen indexes. As mentioned in the table 3, following indexes were chosen as market variables to complete the CAPM calculations and to compare the stock market performance to market (index) performance.

Index returns remained high in 2020, (61,6, 18 and 11,5) and on average 30,2%, and in 2021, (25,9, 26,6 and 22,7) and on average 25,1% whereas in 2022 the stock returns plummeted (-36,8, -9,2 and -11,5) and on average -19,2. However, risk factor remained in a more stable level. In 2020, average was (28,7), 2021 (17,7) and 2022 (28,6). Total period average was 25,0. Average return to risk ratio for the chosen indexes remained high in 2020 (100,2%) and in 2021 (147,6%), However, as the returns plummeted in 2022, return to risk ratio was negative of (61,1%). Average for the overall period remained positive (62,2%).

In comparison, N Technology PI index was able to create the highest average annual return for the period (16,7), following the OMX Nordic 40 index (11,8%) and last, OMXH25 (7,6%). However, the N Technology PI index carried the highest risk as well. The average annual risk for the period of N Technology PI was (31,6%), followed by OMXH25 (22,0%) and last, OMX Nordic 40 (21,4%). Return to risk ratio winner was OMX Nordic 40 with average return to risk ratio of (68,8%), followed by N Technology PI with average return to risk ratio of (67,7%) and last, OMXH25 with (50,1%). Results may be seen in the light that OMX Nordic 40 had the best performance over the period as it was able to create the highest risk adjusted return, following the N Technology PI index and OMXH25.

N Technology EUR PI					OMX Nordic 40					OMXH25				
Year	2020	2021	2022	2020-2022	Year	2020	2021	2022	2020-2022	Year	2020	2021	2022	2020-2022
Avg daily return	0.2 %	0.1 %	-0.2 %	0.0 %	Avg daily return	0.1 %	0.1 %	0.0 %	0.0 %	Avg daily return	0.0 %	0.1 %	0.0 %	0.0 %
Avg annual return	61.1 %	25.9 %	-36.8 %	16.7 %	Avg annual return	18.0 %	26.6 %	-9.2 %	11.8 %	Avg annual return	11.5 %	22.7 %	-11.5 %	7.6 %
Avg daily Stdev(total risk)	2.0 %	1.5 %	2.4 %	2.0 %	Avg daily Stdev(total risk)	1.6 %	1.0 %	1.5 %	1.3 %	Avg daily Stdev(total risk)	1.8 %	0.9 %	1.5 %	1.4 %
Avg Annual stdev(total risk)	32.4 %	23.7 %	38.9 %	31.6 %	Avg Annual stdev(total risk)	25.3 %	15.3 %	23.5 %	21.4 %	Avg Annual stdev(total risk)	28.3 %	14.3 %	23.3 %	22.0 %
Return to risk ratio	189%	109%	-95%	67.7 %	Return to risk ratio	71%	174%	-39%	68.8 %	Return to risk ratio	41%	159%	-49%	50.1 %
Risk to return ratio	53%	92%	-106%	13.0 %	Risk to return ratio	140%	57%	-256%	-19.4 %	Risk to return ratio	246%	63%	-202%	35.6 %
Summary:	2020	2021	2022	2020-2022										
Average annual return	30.2 %	25.1 %	-19.2 %	12.0 %										
Average annual risk	28.7 %	17.7 %	28.6 %	25.0 %										
Average return to risk ratio	100.2 %	147.6 %	-61.1 %	62.2 %										
Average risk to return ratio	146.5 %	70.6 %	-187.9 %	9.8 %										

Table 12. risk and return indicators of chosen indexes

Table 13 represents the summary of findings. The CAPM expected return for the portfolio was derived and compared to three chosen indexes on annual basis. In comparison, highest expected return for the period was in N Technology PI index (11,25%), followed by OMX Nordic 40 (8,7%) and OMXH25 (5,8%). However, the highest Jensen's alpha of the portfolio during the period was detected in OMXH25 (29,2%), followed by OMX Nordic 40 (26,3%) and OMX N technology PI (23,77%). Results indicate that portfolio *overperformed* all the chosen indexes during the period.

	2020	2021	2022	2020-2022
Average annual return	92.8 %	40.2 %	-28.0 %	35.0 %
Average total risk	48.9 %	38.9 %	44.1 %	44.0 %
Return to risk ratio	190.0 %	103.3 %	-63.4 %	79.7 %
Average beta coefficient (OMX N Technology PI)	0.59	0.46	0.43	0.50
Average expected return(OMX N Technology PI)	36.03%	11.91%	-14.18%	11.25%
Average jensen's alpha(N Technology PI)	56.80%	28.30%	-13.79%	23.77%
Average Systematic risk(OMX N Technology PI)	19.18%	10.94%	16.83%	15.65%
Average Unsystematic risk(OMX N Technology PI)	29.69%	27.97%	27.28%	28.31%
Average beta coefficient (OMX Nordic 40)	0.780	0.666	0.706	0.718
Average expected return (OMX Nordic 40)	14.0 %	17.7 %	-5.6 %	8.7 %
Average Jensen's alpha (OMX Nordic 40)	78.8 %	22.5 %	-22.4 %	26.3 %
Average Systematic Risk(OMX Nordic 40)	18.6 %	14.6 %	16.6 %	16.6 %
Average Unsystematic Risk (OMX Nordic 40)	30.3 %	24.3 %	27.5 %	27.4 %
Average beta coefficient (OMXH25)	0.724	0.723	0.705	0.717
Average expected return (OMXH25)	8.2 %	16.5 %	-7.2 %	5.8 %
Average Jensen's alpha (OMXH25)	84.6 %	23.8 %	-20.8 %	29.2 %
Average Systematic risk (OMXH25)	17.4 %	15.5 %	16.4 %	16.4 %
Average Unsystematic risk (OMXH25)	31.4 %	23.5 %	27.7 %	27.5 %

Table 13. Summary of findings

In addition, figure 16 represents the information in graphical form.

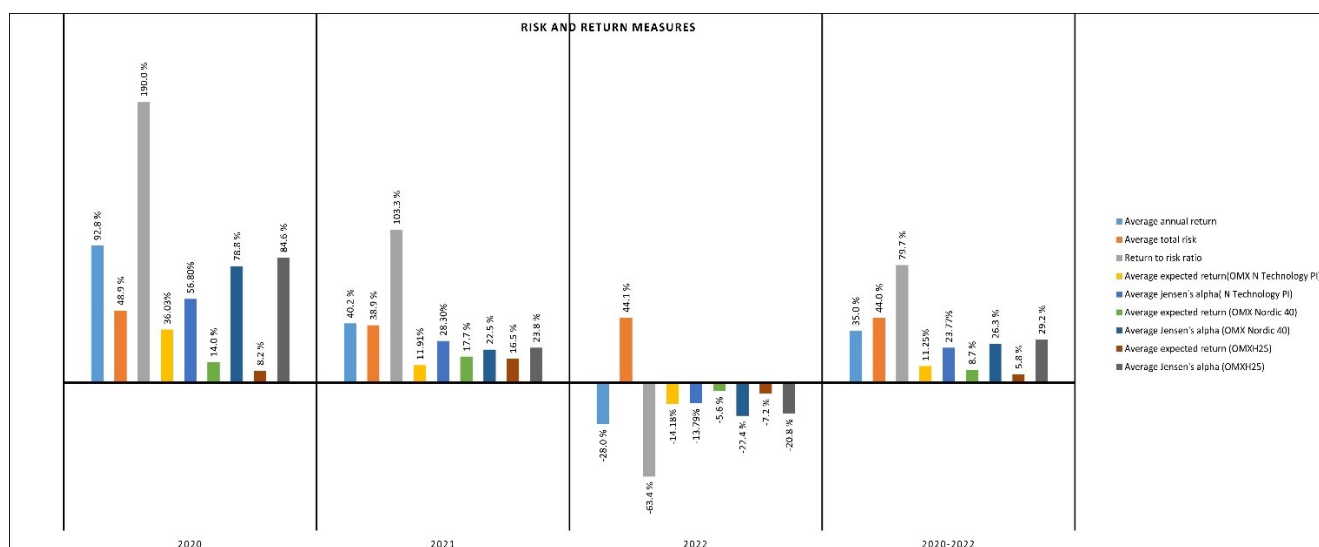


Figure 16. Risk and return measures

5 Conclusion

This section of this dissertation is divided in to two parts. First, section 5.1 provides a recap of the study and emphasizes the key findings. Section 5.2 discusses the limitations and authors recommendations for further research.

5.1 Discussion

The main objective of this dissertation is to explore the risk and return relationship and to study the misalignment between the expected return and occurred return in context of Finnish technology-oriented stocks. The author's motivation for the study was clear, to study if the risk and return are finding their association with expected returns and to see if the portfolio overperformed or underperformed the market in the period of 2020-2022.

Research questions in chapter 1.2 provide a core of the study. Research questions are following:

- What is the relationship between risk and return in technology-oriented companies listed in Helsinki stock exchange and First North Helsinki?
- What is the extent of misalignment between expected return and occurred return of technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki?

Moreover, section 2 provides a discussion about the key theories that are relevant to the study. First, section 2.1 discusses the accounting as it is important aspect of stock returns formation. Even though, the current study of this dissertation does not directly study the impact of accounting information on stock prices, it is still related and important aspect to discuss. Following the section 2.2 discusses the stock market dynamics. Section 2.3 discusses the equity valuation. It is important to understand methods and philosophies that investors may apply in stock markets around the world. Furthermore section 2.4 discusses the market sentiment and its characteristics and aspects. This is important aspect to discuss as investors want to believe in rationality. However, we are often affected by our surroundings. Based on the literature review, hypotheses were formed. Hypotheses are following:

Hypothesis 1: There is a misalignment between expected return and occurred return in technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki.

Hypothesis 1 is accepted as according to table 13, there was a major misalignment between the CAPM derived expected returns and occurred return. However, Jensen's alpha remained positive in all of the indexes for the period.

Hypothesis 2: Risk level positively affects the stock returns in technology-oriented companies listed in Helsinki Stock Exchange and First North Helsinki

According to table 10, portfolio return to risk ratio was substantially high during 2020 (166,9%) and 2021 (87,3%) whereas in 2022, it was negative (-57,7%). For the full period, it remained positive (65,5%). The results suggest that the risk and return have a positive connection. Thus, hypothesis 2 is accepted.

The portfolio returns were abnormal during 2020 (92,8%) and 2021 (40,2%). However, the portfolio returns turned out to be negative in 2022 (-28%). The risk factor however shows that the year 2020 had the highest standard deviation (48,9%), following the year 2022 (44,1%) and 2021 (38,9%). This indicates that high returns (losses) correlated with high risk. Table 11 also indicates that the proportion of systematic risk of the chosen indexes remained more or less stable throughout the period (35,6%, 37,8% and 37,4%). Thus, majority of the risk was unsystematic risk (company specific risk). This indicates that the relationship between systematic and unsystematic risk remained stable between the indexes.

Table 13 shows that Jensen's alphas varied between the indexes. In 2020 and 2021, portfolio Jensen's alpha was positive in all three indexes. However, similarly in 2022, it ended being negative. However, the portfolio's Jensen's alpha during the study period was positive in comparison to all indexes.

In conclusion, the portfolio overperformed all the chosen indexes during the full period.

5.2 Limitations and recommendations for further research

Author states that there are three major limitations in the current study of this dissertation. First limitation is the sample size. The sample of this study is consisted of 25 companies, and the timeframe is three years which equals 75 firm-years. However, the technology-sector in Finland is limited in size. Author concludes that increasing sample size may provide more robust results.

Second limitation is the timeframe of the study. The current study of this dissertation considers only 2020, 2021 and 2022. The years were unusual for the stock markets by reason of macroeconomic events (Covid-19 and energy crisis). Previous factors make the study relevant, but on the other hand, by expanding the timeframe to consider longer period of time may be more informative and provide more comprehensive results.

Third limitation is geographic. As mentioned, the current study of this dissertation considers only Finnish technology-oriented stock market. By expanding the study to consider cross-country sample, for example Nordic countries, may provide more robust and comparable results.

Author has recognized the limitations of this study and has formed following recommendations for further research.

First, whereas this dissertation only applies CAPM model which means that only the slope coefficient (Beta) is considered as a risk factor, applying different tools such as Arbitrage Pricing Theory (APT) or regression analysis may also provide informative results.

Secondly, even though the study of this dissertation does not directly consider the accounting information, Efficient Market Hypothesis states that all the available information reflects to the stock prices. Therefore, it can be assumed to have impact on the stock prices of the sample companies. Investigating the influence of accounting information on the technology-oriented stocks could provide interesting results as it is an fairly underexplored area of research. Moreover, as technology-oriented stocks are considered to be riskier when compared to many other sectors. Therefore, exploring if the bigger fool theory applies in the technology-oriented sector could provide captivating results. In general, majority of the technology-oriented companies assets are intangible assets and therefore the accounting informativeness plays key role in accounting quality.

By applying a multi variable OLS (ordinary least squares) regression analysis could be effective. In addition, the study regarding the asset formulation (tangible assets/intangible assets ratio) could provide meaningful information about the capital structure of technology-oriented companies.

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