UNEXPECTED INFLATION AND STOCK RETURNS

Evidence from the U.S.

Lappeenranta–Lahti University of Technology LUT

Bachelor’s Programme in Strategic Finance, Bachelor's thesis

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Examiner: University Lecturer, Henri Huovinen

ABSTRACT

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Unexpected Inflation and Stock Returns, Evidence from the U.S.

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39 pages, 10 figures and 6 tables

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Keywords: Unexpected inflation, inflation, stock returns, S&P 500 index

The objective of this thesis is to investigate how unexpected inflation affects stock market returns in different inflation environments. The study examines whether unexpected inflation has different implications in a high-inflation environment and in a low-inflation environment. This study is limited to the United States stock market.

The study examines the returns of the whole S&P 500 index as well as its 11 different sectors over the period of 1.1.2010-31.12.2022. The data used in the study is monthly time series data collected from investing.com website and Yahoo Finance database. Stock market returns are examined using a multiple linear regression, where the dependent variables used are first the entire index, and then each sector individually. The independent variables used are unexpected inflation, a dummy variable dependent on the inflation environment, and an interaction variable formed from these two.

A key finding was that unexpected inflation affects stock market returns differently depending on the inflation environment. When no unexpected inflation occurred during a time of low inflation, the stock market produced a small average return. When unexpected inflation was recorded during a time of low inflation, the average returns of the stock market increased. When there was no unexpected inflation during a time of high inflation, the stock market produced a small average loss. If unexpected inflation occurred simultaneously, the losses increased significantly.

TIIVISTELMÄ

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Kauppatieteet

Rosa Saario

Odottamaton inflaatio ja osaketuotot, näyttöä Yhdysvalloista

Kauppatieteiden kandidaatintyö

2023

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Tämän tutkielman tavoitteena on selvittää, miten odottamaton inflaatio vaikuttaa osakemarkkinoiden tuottoihin erilaisissa inflaatioympäristöissä. Tutkielmassa tarkastellaan vaikuttaako odottamaton inflaatio eri tavalla korkean inflaation ympäristössä ja matalan inflaation ympäristössä. Tutkielma on rajattu koskemaan vain Yhdysvaltojen osakemarkkinoita.

Työssä tarkastellaan S&P 500 indeksin sekä siihen sisältyvien 11 eri sektorin tuottoja aikavälillä 1.1.2010-31.12.2022. Tutkimuksessa käytettävä data on kuukausittaista aikasarjadataa, joka kerätään investing.com -sivustolta sekä Yahoo Finance -tietokannasta. Osakemarkkinoiden tuottoa tarkastellaan usean muuttujan lineaarisen regression avulla, jossa selitettävinä muuttujina käytetään ensin koko indeksiä ja sitten jokaista sektoria yksitellen. Selittävinä muuttujina käytetään odottamatonta inflaatiota, inflaatioympäristöstä riippuvaa dummy-muuttujaa sekä näistä muodostettua interaktiomuuttujaa.

Keskeisenä tuloksena havaittiin, että odottamaton inflaatio vaikuttaa eri tavalla inflaatioympäristöstä riippuen. Kun odottamatonta inflaatiota ei esiintynyt matalan inflaation aikana, osakemarkkinat tuottivat keskimäärin pientä tuottoa. Odottamattoman inflaation esiintyessä matalan inflaation aikana, osakemarkkinoiden tuotot keskimäärin kasvoivat. Kun odottamatonta inflaatiota ei esiintynyt ollenkaan korkean inflaation aikana, osakemarkkinat tuottivat keskimäärin pientä tappiota. Mikäli odottamatonta inflaatiota esiintyi samanaikaisesti, tappiot kasvoivat huomattavasti.

Table of contents

1 Introduction 1
1.1 Background 1
1.2 Limitations 2
1.3 Objectives and research questions 3
1.4 Structure of the thesis 4
2 Theoretical framework 5
2.1 The Efficient Market Hypothesis 5
2.2 Literature review 7
2.2.1 Inflation and asset returns 8
2.2.2 Inflation's impact on stock valuations 9
2.2.3 Sector-specific returns and unexpected inflation 11
2.2.4 Conclusion of the literature review 15
3 Data and research methods 16
3.1 Data 16
3.1.1 Inflation data 16
3.1.2 Stock market data 18
3.2 Methods 21
3.2.1 Linear regression model 21
3.2.2 Return and risk 24
3.2.3 Sharpe's Ratio 25
4 Results 27
4.1 Key statistics 27
4.1.1 Risk adjusted performance 28
4.2. Inflationary environment 29
4.3 Linear regression analyses 31
5 Conclusions 35
5.1 Answers to research questions 36
5.2 Comparison with previous studies 37
5.3 Use of results 38
5.4 Reliability and suggestions for further research 39
References 40

Appendices

Appendix 1. Linear relationships between sector returns and unexpected inflation during times of high inflation.

Appendix 2. Linear relationships between sector returns and unexpected inflation during times of low inflation

1 Introduction

Inflation, stock market and other macroeconomic terms have flashed through the news quite often within the last couple of years. After approximately four decades of low inflation in the United States, the emergence of high inflation became a significant economic concern during the coronavirus (COVID-19) pandemic. (Ball, Leigh & Mishra 2020) During the first quarter of 2021, inflation level rose from 1.4 percent to 4.2 percent. The second and third quarters kept inflation level close to 5.5 percent, yet by the end of the year, it had already increased to be approximately 7 percent. (U.S. Bureau of Labor Statistics 2023a) Inflation levels kept rising in 2022 and by September, the Consumer Price Index (CPI), which measures inflation, displayed an inflation rate of 8.2 percent (Ball et al. 2020). At the same time, in September 2022, U.S. stocks endured their most challenging month since the beginning of the pandemic, which resulted in the S&P 500 and Nasdaq Composite indexes both registering their third consecutive quarterly losses, a scenario not seen since the global financial crisis in 2008. Furthermore, the S&P 500 index reached a new low for the year 2022. (Cashdollar & Associates 2022) Clearly, there exists a correlation between inflation rates and stock return, which forms the central focus of investigation in this thesis.

1.1 Background

Inflation, a term long used to describe issues with currencies and money, now mainly refers to rising prices. Traditional economic thinking linked increasing money supply directly to rising prices. However, new economic theories have questioned this link, leading to inflation primarily being associated with price levels, not money supply. (Bryan 1997) Inflation is an important macroeconomic phenomenon that can reshape economies, influence consumer behavior and impact investment strategies. Therefore, understanding the importance of inflation is crucial as it can impact real value of investments, especially of those that offer fixed returns. (Lintner 1975)

The stock market, which can be a good measure of economic health, is not immune to the effects of inflation. Historically, periods of high inflation have caused disrupt in the stock market. Why is this? Because inflation can force companies to raise prices, which interferes

with consumers' purchasing power, which then again causes economic uncertainty. In short, corporate decisions can significantly influence stock prices too, depending on how companies adapt to inflationary pressure. If they pass the increased costs forward to product prices and therefore, to consumers, this affects purchasing prices negatively. Yet if they absorb the costs, it affects their own profitability. (Fischer & Modigliani 1978)

Existing research has often highlighted the stock market's sensitivity to inflation (Fama 1981; Fama & Gibbons 1982). Studies have also shown that certain sectors might be more resilient to inflationary pressure than others. For example, the energy sector has proven to perform well, even under times of higher inflation (Chiang & Chen 2023). This thesis also aims to dive deeper into analyzing several different industries to determine which have a chance of survival against inflation.

The COVID-19 pandemic reignited discussions about the connection between stock markets and inflation as both macroeconomic variables endured multiple sudden changes. As unexpected inflation increased, so did financial uncertainty. Unexpected inflation, or unanticipated inflation, is the difference between occurred inflation and expected inflation. (Zhang 2021) Unexpected inflation tends to be what causes economic harm and therefore, it is also the main focus of this paper.

1.2 Limitations

This study is limited to the United States stock market due to extensive amount of research and available data in the region. Within the United States, the Standard & Poor's (S&P) 500 index was selected to help examine the stock market because it offers a comprehensive view by including 500 leading companies from different sectors and industries, which altogether make up to 80% of the total capitalization of the U.S. equity markets. The S&P 500 index also offers extensive historical data, making it a valuable tool for analyzing market trends and evaluating investment strategies. Moreover, the index represents approximately 50% of the global equity market, highlighting its relevance on a broader scale. In other words, the market index reflects the contents of most of the world's largest indexes, even though all the firms in the S&P 500 index are from the United States, making it one of the best possible indexes to examine for this thesis. (S&P Dow Jones Indices LLC 2023)

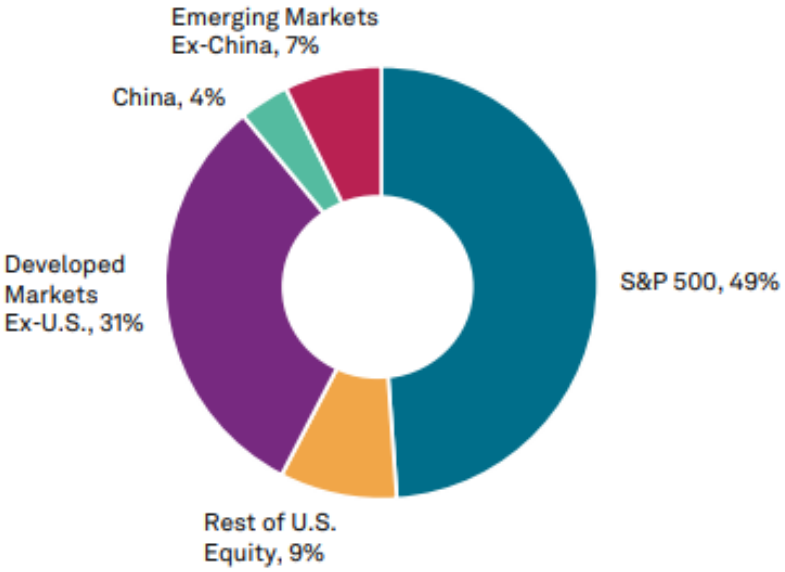

Figure 1. Global equity market capitalization. (S&P Dow Jones Indices LLC 2023)

Companies that are included in the S&P 500 index must meet specific criteria as the objective of the index is to mimic the entirety of the U.S. stock market by featuring the most noteworthy companies from the most substantial industry sectors (S&P Dow Jones Indices LLC 2023).

This thesis is limited to focusing to examine the inflation rates and stock returns in the U.S. markets between the years 2010 and 2022.

1.3 Objectives and research questions

As most previous studies have focused on examining the relationship between inflation and stock returns, the objective of this thesis is to investigate the U.S. stock market's response to unexpected inflation. Furthermore, there is limited amount of research of how unexpected inflation affects stock returns in different inflationary environments, which also creates an opportunity for further research. Both inflation and stock returns are two fundamental components of the economic landscape and understanding their interaction is an important matter for various groups such as investors, policymakers, and economists. The primary aim of this research is to figure out how unexpected inflation effects the stock market returns during different inflationary times. Following this, the thesis dives deeper and investigates the relationship between inflation and various industries to determine how different sectors

and companies are influenced by unanticipated inflation. A linear regression analysis will be conducted to investigate these correlations.

The main research question of the thesis is:

Q1: How does unexpected inflation affect the S&P 500 index during times of high and low inflation?

Sub-question that aids in answering the main research question is:

Q2: Which sectors within the S&P 500 index are most and least sensitive to unexpected inflation in both high and low inflationary environments?

1.4 Structure of the thesis

The research is structured into five main chapters, each holding a significant relevance within the overall study. The first chapter contains background information and the research's objectives, introduces the research questions, establishes the limitations to the research, and provides an overview of the thesis. The second chapter consists of the theoretical framework. The framework includes an extensive literature review as well as introduces the Efficient Market Hypothesis (EMH).

Based on this theoretical framework, the third chapter presents the used research data and describes chosen quantitative research methods. The fourth chapter presents the findings of the actual research. Finally, the fifth and last chapter includes the research conclusion, reflects on the results, assesses the reliability of the findings, and introduces potential topics for future research.

2 Theoretical framework

The aim of this chapter is to establish a theoretical foundation for the thesis, providing a comprehensive understanding of essential key concepts and theories related to the stock market and inflation. This chapter introduces the Efficient Market Hypothesis (EMH) as well as contains an extensive literature review.

2.1 The Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) is a theoretical framework introduced by Eugene Fama. The hypothesis states that within efficient markets, all available information is already incorporated in stock prices. Furthermore, the hypothesis contains the idea that as new information becomes public, investors react immediately to the new information and examine its significance for individual companies. (Fama 1965)

A market is considered to be effective when a large number of actively competing, profit-maximizing yet rational agents are striving to predict the future prices of individual stocks and where all market agents can almost freely access crucial, up-to-date data or information. (Fama 1965) In reality, this translates to the fact that within efficient markets, the prices of stocks immediately rise to the level dictated by new, relevant, and public information. As can be seen in figure 2, if the market is not efficient, investors do not immediately process and act on the new public information, which results in stock prices slowly adjusting to the appropriate level over time. (Knüpfer & Puttonen 2018, 168)

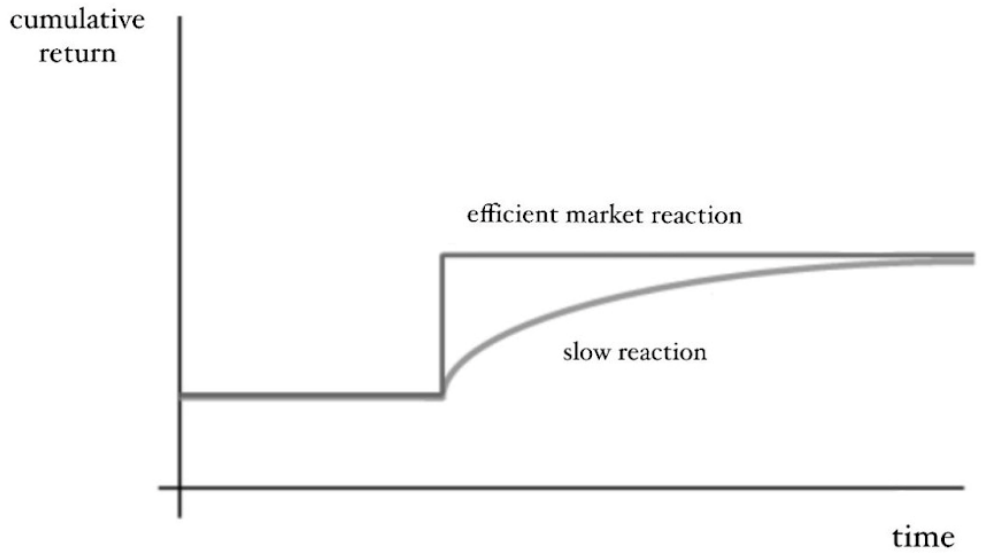

Figure 2. Reaction of efficient and inefficient markets to new positive information. (Adapted from Knüpfer & Puttonen 2018, 168)

According to Fama (1970), the efficient markets can be divided into three categories based on efficiency. These categories can be described as follows:

1. Weak markets, where stock prices already incorporate all historical price data. In these kinds of markets, the examination of past returns is unproductive as it cannot predict future returns.

2. Semi-strong markets, where prices reflect all publicly available information on top of all the historical price data. For instance, company-specific profit warnings and the effect they will have is already included in stocks prices.

3. Strong markets, where the prices of stocks not only incorporate past price movements and public data but also all possible insider information. The main idea of this market type is that when important news emerges, it quickly affects stock prices even before becoming public, making it difficult to profit from insider information.

In 1991, Fama updated his original research and pointed out that the swift reaction of prices in response to information is not the only characteristic of efficient markets. In the revised

definition, he emphasized that all available market information is already included in the price. Additionally, Fama (1991) also introduced new ways to assess market efficiency, including studying return forecasting (weakly efficient markets), event studies (semi-strong markets) and testing for insider information (strong markets).

Fast forward to the 21st century, the modern framework of EMH suggests that market efficiency does not require market prices to constantly align with the investment's true value. Rather, it means that deviations of market prices from their true value are random, implying that the market value can be above or below the true worth, but these deviations should be random and thus unpredictable. Therefore, in efficient markets, no individual investor or a group of investors should be able to constantly identify and take advantage of undervalued or overvalued stocks through any specific investment strategies. Furthermore, a common misconception of efficient markets is that no investment should have higher returns than another investment — this is incorrect as in efficient markets, investments higher in risk are also expected to yield higher returns. Thus, excessive returns refer to returns that exceed what the investment's risk-level is. (Knüpfer & Puttonen 2018, 172)

In short, the extent of market efficiency depends on the type of information embedded in stock prices (Knüpfer & Puttonen 2018, 173). In regard to this thesis, it is also important to note that according to EMH, it should not be possible to predict stock market return by using any macroeconomic variables, such as inflation rate (Kallunki, Martikainen & Niemelä 2019, 183).

2.2 Literature review

This section introduces past research related to the topics of this thesis. The primary focus in these studies is on the United States and the purpose of this section is also to provide the research results of other researchers for later comparison with the results of this study.

2.2.1 Inflation and asset returns

The complex relationship between unexpected inflation and stock returns has been a central point of financial research over several decades. Lintner's (1975) study laid the groundwork by examining the relationship between inflation rates and returns on securities, including both stocks and bonds. Using historical data and regression models, while also accounting for significant economic variables such as gross domestic product (GDP) and interest rates, Lintner discovered a negative correlation between asset returns and inflation. When looking at bonds, this is a very expected situation given their fixed interest payments. The purchasing power of fixed payments diminishes as inflation rises, leading to reduced returns for bondholders. However, stocks displayed a greater resilience, likely because they represent company ownership, and companies have the flexibility to adjust prices and strategies in inflationary environments. Lintner's findings also emphasize the importance of portfolio diversification, especially during times of economic uncertainty. Furthermore, beyond just affecting investors, the results of the study highlight broader macroeconomic concerns. Specifically, if inflation consistently diminishes investment profitability, it could suppress economic growth and development due to reduced capital investments.

Building on this foundation, Fischer & Modigliani (1978) studied the real economic implications of inflation. The primary aim of the study was to figure genuine economic problems that inflation caused. Through the development of theoretical economic models, they tried to understand how inflation influences key variables such as investment, savings, and consumer consumption. Moreover, one of the main objectives of the research was to compare the effects of expected inflation and unexpected inflation. Unexpected inflation is inflation one has not been able to prepare for. Their findings highlighted that unexpected inflation primarily results in wealth redistribution, which impacts both money borrowers and lenders as well as both government and business finances. Beyond money redistribution, Fischer & Modigliani identified real, problematic economic costs associated with unexpected inflation. For instance, during volatile inflation periods, businesses often face the challenge of having to frequently adjust prices, which causes more economic uncertainty. Additionally, they noted the potential for inflation to distort the tax system, leading to misrepresentations of real incomes. Their findings, like Lintner's (1975), emphasize the critical importance of economic stability.

In 1979, Michael Firth further expanded on this topic by examining the relationship between stock market returns and inflation rates. Through regression analysis on historical stock market and inflation data, Firth identified a negative correlation between stock returns and inflation rates. This indicated that as inflation rises, stock profits tend to diminish. This revelation was significant, suggesting that during periods of high inflation, stocks might not offer expected shield against the loss of purchasing power, which almost evidently is always the consequence of inflation. Firth's findings are significant as they highlight possible broader economic implications and put an emphasis on the same important message as both Lintner's (1975) and Fischer and Modigliani's (1978) research.

2.2.2 Inflation's impact on stock valuations

Modigliani and Cohn (1979) also studied the relationship between inflation and stock market valuations. Their work introduced the financial world to the term "Inflation Illusion," a situation where investors mistakenly view a company's higher earnings as real increases, when in reality, the increase can potentially be only due to inflation. Such misunderstandings can lead to significant mispricing in the stock market. For instance, during periods of heightened inflation, if investors fail to differentiate real earnings from inflationary additions, stocks can easily be undervalued. This misinterpretation can have devastating effects on investment decisions and market dynamics. The study also investigated the impact of inflation on corporate debt. As inflation rises, the real value, or burden, of debt decreases since its nominal value remains fixed. This reduction in the real value of debt can however benefit equity holders, as the equity value can increase in such scenarios.

Building upon the insights of Modigliani and Cohn (1979), Geske and Roll (1983) studied how fiscal and monetary policies influence the stock market's reaction to inflation. Their research methodology incorporated data from stock market returns, inflation rates, and key indicators of fiscal and monetary policies. They then used various econometric models to dissect these relationships. The main objective of their research was to investigate how government spending and differences in money supply influenced stock market reactions to inflation.

A key finding from their research was the influence of government fiscal policies, particularly deficit spending, on stock returns in the context of inflation. As governments deficit spend, meaning that governments spend more than they make, the risk of stock market reacting intensely to inflation grows. This is precisely why governments need to be mindful of their spendings, even in times of economic uncertainty. (Geske & Roll 1983)

Another interesting finding of the research was how central banks can influence how the stock market responds to inflation. By controlling the money supply and thus, practicing monetary policy, central banks can unintentionally trigger unexpected inflation, which then can have direct repercussions on the stock market and stock returns. The findings of the study highlight the importance for investors to consider broader economic indicators, including government and central bank actions, when making investment decisions. (Geske & Roll 1983)

Campbell and Vuolteenaho (2004) conducted a study that further deepened the conversation by investigating the link between stock prices and unanticipated inflation. Their findings revealed a negative correlation between stock returns and unexpected inflation. To better understand the dynamics of unanticipated inflation and stock returns, they categorized stock returns into two primary components: news about future cash flows and news about discount rates. Their research indicated that unexpected inflation primarily influences the latter, affecting the rate at which future earnings are discounted back to their present value. Higher inflation rates lead to higher discount rates, which in turn reduce the present value of future earnings and, consequently, stock prices. This finding highlights the importance of discount rates in stock valuation and the sensitivity of these discounts rates to unexpected inflation.

Furthermore, Campbell and Vuolteenaho (2004) revisited the topic of the inflation illusion. Their findings emphasized the importance of understanding and recognizing the inflation illusion and the effects unexpected inflation has as they can be significant when making investment decisions. Furthermore, the study suggests that investment portfolios may need adjusting during periods of unexpected inflation to better deal with potential wrong price estimates in the market.

Cohen, Polk, and Vuolteenaho's (2005) study revisited the Modigliani-Cohn (1979) hypothesis, the concept of inflation illusion, and its impact on stock valuations, especially during times of unexpected inflation. Their analysis revealed that during such times, stocks with high earnings growth were consistently overvalued, suggesting that investors, when caught off guard by inflationary changes, might prioritize nominal growth over real earnings. This misjudgment then often resulted in these overvalued stocks underperforming in the following periods.

Their study also emphasized that the inflation illusion isn't limited to individual stocks but often covers the entire market. To validate their findings, Cohen et al. (2005) incorporated various risk factors, both systematic and unsystematic, ensuring that observed results were genuinely rooted in unanticipated inflation and not influenced by other market dynamics.

Bekaert and Engstrom (2010) explored the relationship between inflation and stock returns, with a particular emphasis on the so-called “Fed-model”. This model indicates that there is a strong correlation between equity yields and bond yields, suggesting that the dividend or earnings yield on stocks should either mirror or be closely associated with the yield of nominal treasury bonds. In the past, many experts in finance believed that the link between equity yields and bond yields was due to certain irrational behaviors, particularly the concept of the inflation illusion. If this theory were true, then policies aimed at keeping inflation stable could help prevent these market irregularities.

2.2.3 Sector-specific returns and unexpected inflation

Pearce and Roley (1988) studied the relationship between unexpected inflation and stock returns. They built their research on prior studies and the known fact that research had consistently documented a negative correlation between stock returns and unanticipated inflation. However, they wanted to investigate this relationship even further by introducing the variable of company characteristics.

One of the key findings of the research was how unexpected inflation impacted companies of varying sizes differently. Specifically, they found that smaller companies were more vulnerable to inflationary shocks than larger companies. This observation aligns with the

expectations that larger companies, due to their more diversified operations and greater resources, might be better in facing inflation. Therefore, the study supports the findings of past literature that suggests that firm size can often act as a buffer against various macroeconomic changes. (Pearce & Roley 1988)

Furthermore, Pearce and Roley (1988) highlighted the role of leverage, or the proportion of debt, in a company's capital structure. Firms with higher leverage ratios were found to experience more negative stock returns during periods of high inflation. This is because, during unexpected inflation, these companies might find their real debt burdens increased, which can then directly affect their stock performance negatively as investors can lose confidence in the company’s financial stability.

Moreover, the study also suggests that companies that consistently pay higher dividends to shareholders tend to appear somewhat more protected from the negative impacts of unexpected inflation. This observation also connects with broader literature that often associates high-dividend-paying companies with stability, maturity, and more resilience against macroeconomic shocks. (Pearce & Roley 1988)

Additionally, according to Pearce and Roley (1988), companies with volatile earnings are more sensitive to macroeconomic shocks, such as unexpected inflation. Such companies, which usually operate in sectors with high economic variability, find their stock returns more negatively affected during times of inflationary surprises.

Boudoukh, Richardson, and Whitelaw (1994) discovered a significant relationship between industry returns and inflation. This was not entirely surprising, given that inflation can impact various industries differently. They found that industries heavily reliant on fixed assets or with high capital intensity might find it more challenging to replace or upgrade these assets during inflationary periods. Conversely, industries that can swiftly adjust prices might have a better chance of surviving in an inflationary environment. Their findings highlight the importance of understanding industry-specific sensitivities to both expected and unexpected inflation, emphasizing the need for a subtle approach rather than a one-size-fits-all strategy.

Market-anticipated inflation can be factored into investment decisions and pricing strategies, whereas unexpected inflation can disrupt market balance and lead to short-term dislocations. Findings of the study imply that industry returns are sensitive to deviations from inflation expectations. Unexpected inflation can also be particularly difficult for industries that have long-term fixed contracts or those that are not able to adjust price-levels quickly. On the other hand, industries that have assets whose values rise with inflation, such as real estate, might benefit from unexpected inflationary shocks. (Boudoukh et al. 1994)

The findings from Boudoukh et al.'s (1994) research have significant implications for portfolio management as one of the key findings of the study was how different industries and their returns reacted in their own ways to unexpected inflation. Therefore, a comprehensive analysis and understanding of individual industries and their inflation sensitivities is necessary. As inflation-level rises, strategic asset reallocation might be necessary to reduce risks and ensure best profits.

The research conducted by Boons, Duarte, de Roon and Szymanowska (2020) examines the relationship between unexpected inflation and stock returns, emphasizing the time-varying nature of inflation risk. The research focused on the concept of the nominal-real covariance, which represents the changing relation between inflation and future real consumption growth. The covariance is crucial as it serves as a primary driver of the time-variation in the inflation risk premium. According to Boons et al. (2020) a standard deviation increase in the covariance leads to an increase in the inflation risk premium.

To further understand the changes in the inflation risk premium, Boons et al. (2020) broke down the components of it. They discovered that the difference in the inflation risk premium between stocks with varying inflation betas was primarily driven by changes in the cost of inflation risk. However, the amount of risk also plays a significant role, especially when considering the average inflation risk premium across a variety of stocks. This is because the amount of inflation risk changed consistently over time for different stocks. Consequently, the broader market risk premium incorporates a time-varying inflation component, influenced by both the price and amount of risk. The findings of the research emphasize the importance of understanding the time-varying nature of inflation risk, especially in the

context of future consumption growth predictions. Furthermore, Boons et al. (2020) also highlight the unpredictable relationship between unanticipated inflation and stock returns.

A recent study conducted in the U.S. market by Chiang and Chen (2023) studied that inflation, which reached over 9 percent in June 2022, was not entirely expected and was influences by a combination of COVID-19 aftermath as well as geopolitical tensions. Such unforeseen shocks can lead to significant market volatility as investors readjust investment expectations and strategies. The research contained both an aggregate and sectoral analysis, meaning, that it examined both the overall performance of the entire economy as well as the specific performance of individual industries. This kind of a comprehensive approach allowed the researchers to gain a deeper understanding of how different parts of the economy are connected. The results of the aggregate market show that stock returns correlate negatively with unexpected inflation. Most sectoral stocks were also negatively related to inflation apart from the energy sector, which correlated positively.

Building on Bekaert and Egstrom's (2010) research, Masturzo and Mazzoleni (2021) incorporated the Phillips Curve into their analysis. The Phillips Curve posits a relationship between inflation and unemployment, suggesting that a booming economy, characterized by low unemployment, often leads to rising inflation due to increased demand. Masturzo and Mazzoleni (2021) proposed an innovative application of the Phillips Curve to investment strategies. They introduced two metrics to measure inflation: the Inflation Cycle, which captures long-term trends, and the Inflation Surprise, which focuses on short-term shifts.

Findings of the study highlight the significance of both the Inflation Cycle and Inflation Surprise metrics in predicting stock market performance. Furthermore, Masturzo and Mazzoleni (2021) emphasize that while all sectors might face challenges with inflationary pressures, some sectors might face more pronounced effects than others. The sector-specific findings also open the door for deeper studies into how individual sectors respond to the pressures of inflation.

In 2022, Masturzo and Shakernia added more to the discussion about how unexpected inflation affects investment strategies. To begin with, they presented three primary investment strategies for investors:

1. Investors can continue with their existing strategies, especially if they are oriented towards long-term gains

2. Investors can reallocate investments towards assets like commodities, which historically perform well during inflationary periods

3. Investors can adopt the Inflation Cycle metric, which focuses on adjusting investments based on unexpected inflation changes.

Their main contribution was the introduction of the Inflation Cycle Signal. Masturzo and Shakernia (2022) observed that most of the S&P 500's positive returns since the late 1940s occurred during periods of unexpectedly low inflation. They developed a method to measure these unexpected inflation changes, emphasizing a long-term approach. The Inflation Cycle Signal, with its emphasis on recalibrating investments in response to unforeseen inflationary changes, offers a more diversified approach compared to the traditional investment splits. The main conclusion of Masturzo and Shakernia (2022) work is that inflation's unpredictability requires adaptive investment strategies.

2.2.4 Conclusion of the literature review

In conclusion, the relationship between unexpected inflation and stock returns is complicated, influenced by several factors ranging from sector-specific characteristics to broader macroeconomic events and investor psychology. The findings underscore the importance of economic stability and the need for investors and policymakers to be mindful in their strategies and decisions. The consistent findings across different studies highlight the importance of understanding inflation, fiscal and monetary policies, as well as their combined impact on stock valuations and market dynamics.

3 Data and research methods

This chapter will provide a detailed presentation of the research data and the selected research method. The data was collected from Yahoo Finance and Investing.com at the end of September 2023 and beginning of October 2023. The criteria for the chosen data as well as how it was analyzed is comprehensively explained in this section. The chosen quantitative method, linear regression analysis, and how it was used is also discussed thoroughly. Moreover, Sharpe's Ratio will be introduced and used in assessing the risk-adjusted performance of the S&P 500 index and its sectors. Regarding the Sharpe's Ratio, the U.S. 3-month T-Bill will be used as the risk-free rate of return.

3.1 Data

The data used in the study is collected as monthly time series data. A times series is data that allows one to examine factors that affect certain variables over time and can be particularly useful in investigating changes in assets (Hayes 2022). The inflation data was collected from Investing.com and the stock index data was collected from Yahoo Finance. 3-month T-Bill data was collected from the Federal Reserve Bank of St. Louis. The selected time period was from January 1st, 2010, to December 31st, 2022. The length of the time period was chosen so, that it still included the aftermath of the financial crisis in 2008 but also so, that it incorporates inflation and stock price movements during the COVID-19 pandemic. The data will be analyzed in Excel using a linear regression.

3.1.1 Inflation data

The inflation data consists of numbers for both occurred and forecasted inflation for the same months. The difference between these two numbers is calculated to determine the unexpected inflation as can be seen below. It is important to note that tiny deviations from forecasted inflation could still be classified as expected inflation. However, in this thesis, all inflation numbers deviating from the forecasted inflation by at least 0,1% have been classified as unexpected inflation.

$$\textit{Actual Inflation - Forecasted Inflation} = \textit{Unexpected Inflation} \quad (1)$$

The calculated unexpected inflation is used as a variable to determine how the stock market reacts to it. As a month's inflation data becomes public only the following month (U.S. Bureau of Labor Statistics 2023b), this thesis examines the stock market's reaction in a similar way. For instance, as January's inflation data becomes public only in February, this thesis examines February's stock market reaction to January's inflation rates.

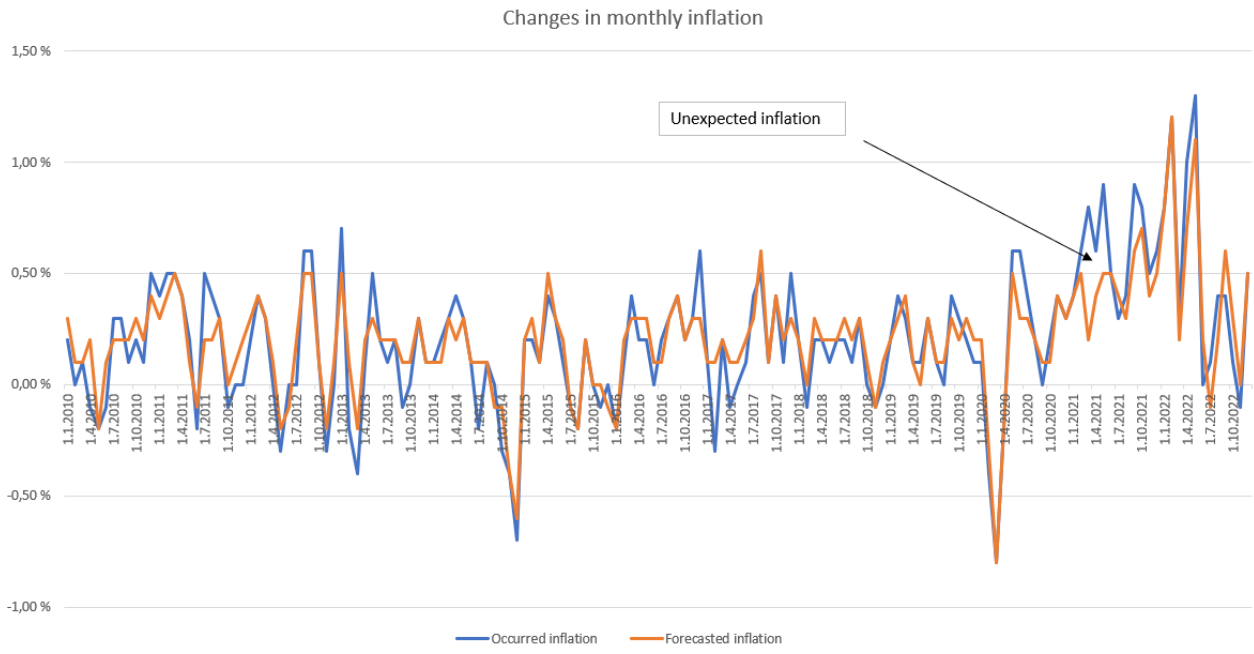

Figure 3. Occurred and forecasted inflation.

Table 1. Times inflation was more or less than the expectations.

	MORE THAN EXPECTATIONS	LESS THAN EXPECTATIONS	SAME AS EXPECTATIONS
2010	2	8	2
2011	6	3	3
2012	3	5	4
2013	2	7	3
2014	3	2	7
2015	0	4	8
2016	3	4	5
2017	2	5	5
2018	1	7	4
2019	4	3	5
2020	4	5	3
2021	7	1	4
2022	7	3	2
=	**44**	**57**	**55**

3.1.2 Stock market data

Stock index data includes monthly price history for the whole S&P 500 index as well as all its 11 sectors separately. All the index point values have been documented on the first day of each month as an average of the highest and lowest values on each day. As mentioned before, the S&P 500 was chosen as the main index for this study due to its ability to give a comprehensive and broader view of the U.S. stock market as it includes 500 leading companies. However, it is important to note that currently, the index holds not 500 but 503 stock in it. This is because some companies have multiple classes of shares. The index is rebalanced quarterly by changing the composition and weightings of the companies listed (S&P Dow Jones Indices LLC 2023). Because of the rebalancing, it is also important to note that several old companies might have been removed from the index and new companies added to the index between the years 2010-2022.

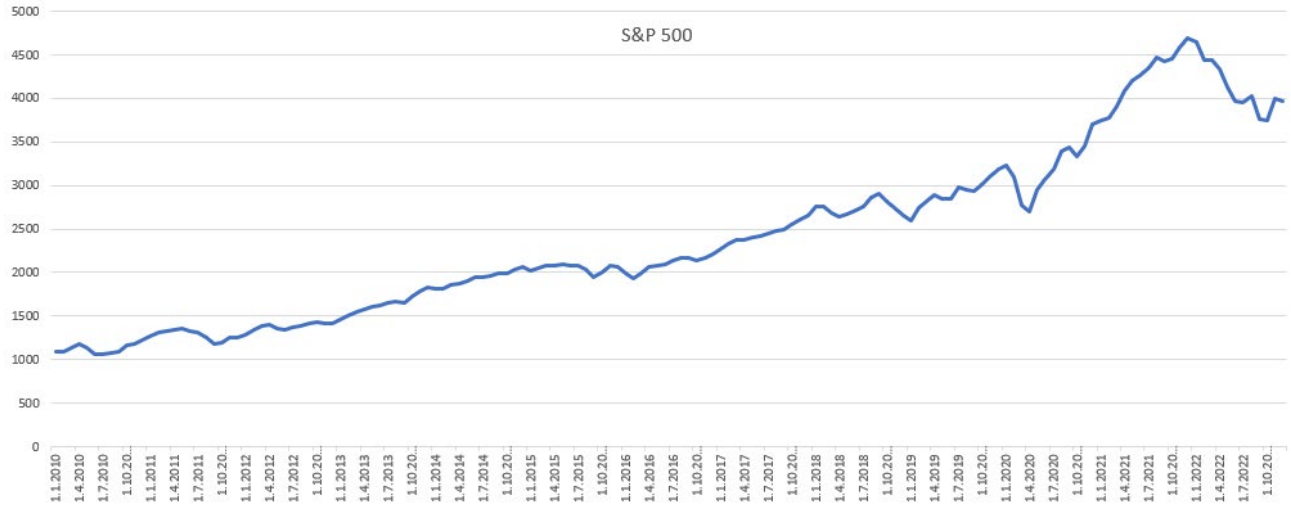

Figure 4. S&P 500 index.

All the eleven sectors of the S&P 500 index will be examined individually to gain a broader understanding of how and to what extent unexpected inflation affects different sectors. The 11 sectors are as follows (Corporate Finance Institute 2023):

1. ***Information Technology*** - companies that create or distribute technology products or services.

2. ***Health Care*** - companies that provide medical supplies, pharmaceuticals and scientific services dedicated to enhancing physical and mental well-being.

3. ***Financials*** - companies engaged in finance, investments, and handling money.

4. ***Consumer Staples*** - companies that supply essential everyday items such as food and household supplies.

5. ***Consumer Discretionary*** - companies that supply luxury goods or services that are not essential for survival.

6. ***Communication Services*** - companies that facilitate connectivity, including internet, social media, and other phone services.

7. ***Industrials*** - companies such as airlines and railroads. The industry itself is divided into 14 industries, but regarding this thesis, we will handle it as one industry.

8. ***Energy*** - companies involved in the oil, gas, or fuels industry.

9. ***Materials*** - companies that supply raw materials essential for other industries, such as metals and wood.

10. ***Real Estate*** - Real estate including Real Estate Investment Trusts (REITs).

11. ***Utilities*** - companies responsible for generating and delivering necessities such as electricity, water, and gas.

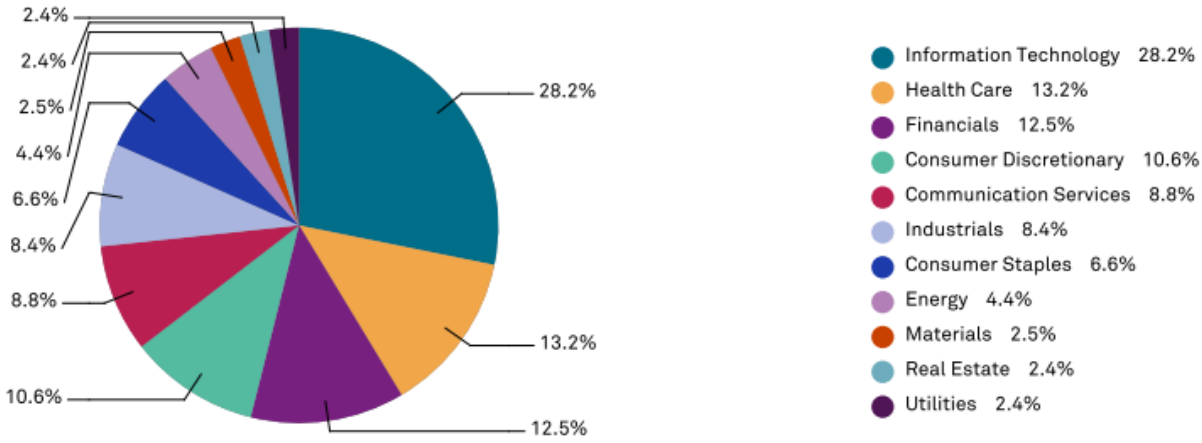

Figure 5. The weightings of the 11 sectors in the S&P 500 index on September 29th, 2023. (S&P Dow Jones Indices LLC 2023)

Table 2. Number of companies within each sector on September 29th, 2023.

Sector	Weighting within the S&P 500 index	Amount of companies
Information Technology	28,20 %	142
Health Care	13,20 %	66
Financials	12,50 %	63
Consumer Discretionary	10,60 %	53
Communication Services	8,80 %	44
Industrials	8,40 %	42
Consumer Staples	6,60 %	33
Energy	4,40 %	22
Materials	2,50 %	13
Real Estate	2,40 %	12
Utilities	2,40 %	12

Out of the 11 sectors, information technology is by far the largest in weighting. The second and third biggest sectors are health care and financials. The smallest weighting in the index is represented by the utilities, real estate, and materials sectors, while communication services, consumer products and industrials are all ranked in the middle. (S&P Dow Jones Indices LLC 2023)

3.2 Methods

The chosen quantitative research method for this thesis is a multiple linear regression model. The research questions can be answered with the help of this methodology. To obtain more information on the S&P 500 index and its sectors, Sharpe's Ratios will be calculated too, to present risk-adjusted performance numbers.

3.2.1 Linear regression model

The chosen quantitative research method for this thesis is linear regression analysis, with each regression test having a 90% confidence level. Linear regression analysis is a mathematical model that can be used to investigate the relationship between the response

variable and the predictor variables (Olive 2017). Through such mathematical models, it is also possible to calculate how strong the relationship is and how changes in variables affect the values of other variables. Linear regression analysis can be done for either a single or for multiple explanatory variables. (Nummenmaa, Holopainen, Pulkkinen & Kimpimäki 2019, 237) The formula for a simple linear regression can be written as follows (Hill, Griffiths & Lim 2018):

$$y = \beta_1 + x\,\beta_1 + e \qquad (2)$$

y = response variable
β_1 = constant
β_2 = regression effect of the predictor variable x
e = error term

The regression effect, also known as the regression coefficient, refers to the slope of the regression line, which reflects the change in the explained variable when the explanatory variables increase by one unit. The regression coefficient can be both positive and negative. However, it cannot be zero as a regression coefficient of zero indicates that there is no linear correlation between the variables. (Nummenmaa et al. 2019, 239) The error term, or residual, *e* represents all factors that have not already been included in the linear regression model (Hill et al. 2018). Due to the residual term, the linear regression model can estimate, but never explain the variation in the variables perfectly. (Kaakinen & Ellonen 2023)

The validity of a regression model can be assessed with the help of the coefficient of determination R^2. This coefficient indicates how well the model is able to explain the variation of the explained variable and has values ranging from 0 to 1, 1 meaning that it explains the variation perfectly. (Hill et al. 2018, 158) A high value for the coefficient tells us that the estimated values of the explained variable are close to the actual observed values. Besides the correlation coefficient, the statistical significance of both the model and explanatory variables should also be considered when analyzing the results. In a statistically significant model, the p-values of an F-test are below the chosen risk level. (Kaakinen & Ellonen 2023) As mentioned before, this study has a 90% confidence interval, meaning that p-values less than 10 percent are statistically significant.

The empirical part of this specific study requires a multiple regression model. Stock market returns will be explained with unexpected inflation, inflationary environment, and an

interaction term. To answer the main research question of this thesis, a dummy variable that reflects the level of inflation will be incorporated into the linear regression analysis. This variable gets a value of 1 (high inflation) when inflation exceeds 2% and 0 (low inflation) when inflation is 2% or less. This classification is based on the long term 2% inflation target set by the Federal Reserve (Board of Governors of the Federal Reserve System 2017).

Figures 6 and 7 display the need for the dummy-variable to be used. As can be seen, the linear relationship between unexpected inflation and the returns of the S&P 500 index vary a lot depending on the inflationary environment.

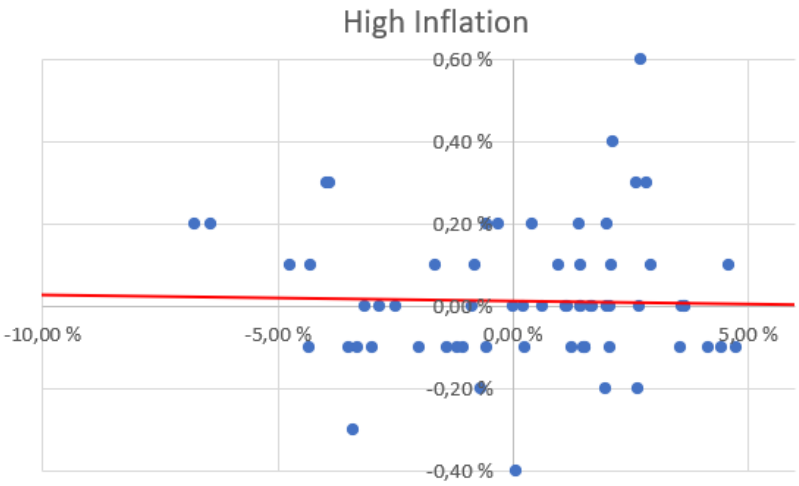

Figure 6. Linear relationship between unexpected inflation and S&P 500 index returns in 2010-2022 during times of high inflation.

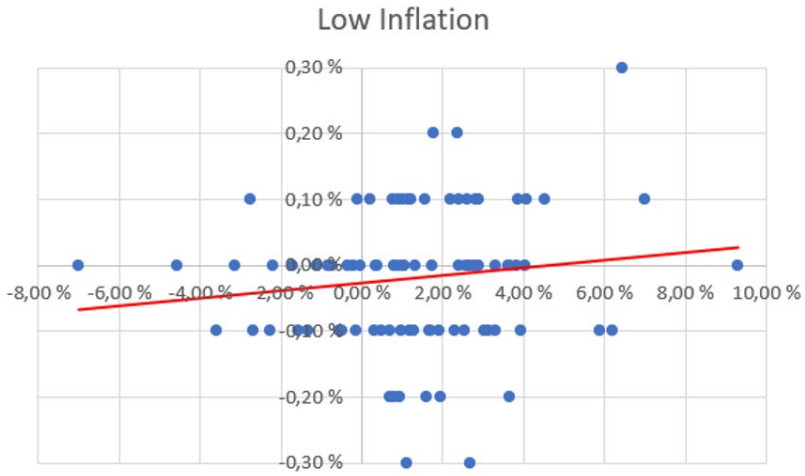

Figure 7. Linear relationship between unexpected inflation and S&P 500 index returns in 2010-2022 during times of low inflation.

The linear regression model for this study can be written as follows:

$$R_t = \alpha + \beta_1 U_t + \beta_2 D_t + \beta_3 (U_t D_t) + e_t \quad (3)$$

R = Stock market returns

α = Stock market returns during a low inflation period when unexpected inflation is zero

β_1 = Change in stock market returns when unexpected inflation occurs during a low inflation period

β_2 = Difference in stock market returns between high and low inflation periods

β_3 = Change in stock market returns when unexpected inflation occurs during a high inflation period

U = Unexpected inflation

D = Dummy variable (1=high inflation period, 0=low inflation period)

UD = Interaction term (unexpected inflation x dummy variable)

e = Error term (captures unobserved factors affecting stock market returns)

t = Time

The monthly returns of the S&P 500 index as well as all the 11 sectors will be analyzed separately to determine how they react to unexpected inflation during times of high and low inflation.

3.2.2 Return and risk

Besides to time, return and risk are the key elements to take into consideration when making investments. The simplest way to calculate the return of an investment, in this case an index, is to calculate the percentage return. Risk and return tend to go hand in hand: as an investment's risk-level rises, so does its potential returns. Volatility reflects the changes in the value of an investment and is calculated as the standard deviation of returns, or the square root of variance. (Puttonen & Repo 2011, 82)

The formula for standard deviation is as follows (Beers 2022):

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(R_i - \bar{R})^2} \quad (4)$$

Where,

S = standard deviation

n = number of observations

Ri = return

$\bar{R}$ = average return

The more volatile an investment, the greater its assumed risk as changes in value causes uncertainty for investors. (Puttonen & Repo 2011, 82)

3.2.3 Sharpe's Ratio

Sharpe's ratio is a metric used to compare the return of an investment and its total risk. Generally, the higher the number, the more attractive the risk-adjusted return of investment is. The Sharpe Ratio is calculated by dividing an investment's excess return by its volatility to measure the risk-adjusted performance and can be written as follows (Sharpe, 1966):

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p} \quad (5)$$

Rp = Return of investment p (%)

Rf = Risk free rate of return (%)

σp = Volatility of investment p (%)

The excess rate of return generally represents the additional return from an investment compared to a safe asset such as a Treasury bill or bond (Fernando 2023). As this study is focused on the United States market, the risk-free rate of return is also based on U.S. benchmarks. The chosen benchmark is the 3-month U.S. Treasury Bill (T-Bill), which is also backed by the U.S. government (Hayes 2023). The average monthly return between the years 2010 and 2022 has been 0,62%.

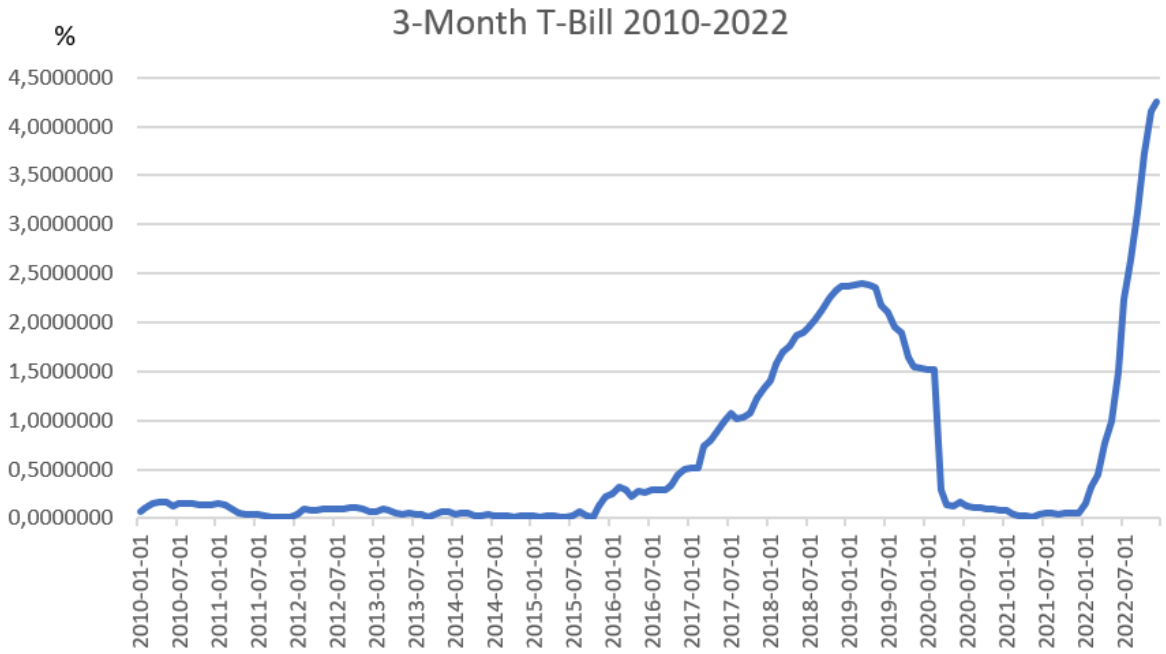

Figure 8. 3-Month T-Bill 2010-2022.

4 Results

This chapter introduces the findings from the study's analyses. To begin with, the key statistics associated with the S&P 500 index and its 11 sectors are examined. Following this, the risk-adjusted performance of the sectors is presented. Finally, this chapter includes an overview of the inflationary environment between the years 2010 and 2022 and the results of the regression analyses.

4.1 Key statistics

Table 3. Statistics of the S&P 500 and its 11 sectors.

	RATE OF RETURN				
VARIABLE	OBS.	MEAN	VOLATILITY	MIN	MAX
S&P 500 (whole index)	156	0,86 %	2,83 %	-10,19 %	9,29 %
DISCRETIONARY	156	1,11 %	4,26 %	-16,22 %	18,70 %
COMMUNICATION	156	0,35 %	3,89 %	-15,21 %	11,01 %
ENERGY	156	0,52 %	6,45 %	-28,41 %	22,01 %
FINANCIAL	156	0,82 %	4,45 %	-20,20 %	11,23 %
HEALTHCARE	156	1,01 %	3,08 %	-10,78 %	7,99 %
INDUSTRIAL	156	0,89 %	4,11 %	-20,00 %	12,51 %
INFOTECH	156	1,30 %	4,36 %	-12,94 %	13,97 %
MATERIALS	156	0,71 %	4,22 %	-15,42 %	10,77 %
REALESTATE	156	0,69 %	3,79 %	-16,24 %	11,52 %
STAPLES	156	0,72 %	2,59 %	-8,01 %	7,71 %
UTILITIES	156	0,59 %	3,13 %	-14,73 %	7,46 %

Table 3 presents the key statistics of the S&P 500 index and its 11 sectors. Each variable has 156 observations as the data was collected monthly from 2010 to 2022. The S&P 500 index had an average monthly return of 0.86%. Regarding sectors, highest average monthly returns were gathered from the information technology, consumer discretionary and health care sectors. On the other hand, lowest average monthly returns came from the communication, energy, and utilities sectors.

Highest volatility, over 6 percent, was encountered in the energy sector. Consequently, the maximum monthly loss and profit were also documented in the same sector and were -28.41% and +22.01%. Smallest volatility was recorded in the consumer staples sector, with a monthly maximum loss of -8.01% and profit of +7.71%. The volatility of the whole S&P 500 index was 2.83%, the maximum monthly loss being -10.19% and profit +9,29%.

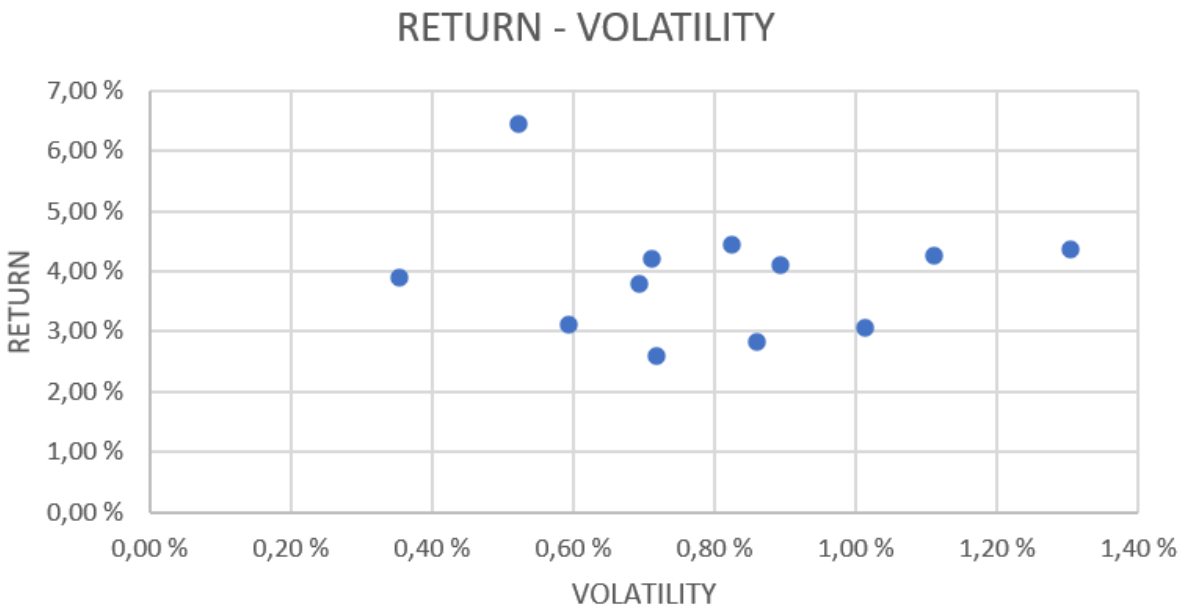

Figure 9. Monthly returns and volatilities for the S&P 500 and its 11 sectors.

4.1.1 Risk adjusted performance

To analyze the risk-adjusted monthly performance of the sectors and the S&P 500 index, Sharpe's Ratios were calculated for all of them separately. As the results in table 4 present, the health care sector stands out as the only sector outperforming the whole S&P 500 index with a Sharpe Ratio of 1.07. The information technology sector has a Sharpe Ratio of 1.0, which is also the ratio for the whole S&P 500 index. Worst performers when assessed this way are the energy and communication sectors with ratios of only 0.14 and 0.22.

Table 4. Sharpe's Ratios for the S&P 500 index and its 11 sectors.

	ANNUAL AVERAGE NUMBERS 2010-2022			
	RETURN	**EXCESS RETURN**	**STANDARD DEVIATION**	**SHARPE**
S&P 500	10,4 %	9,8 %	9,8 %	1,00
DISCRETIONARY	12,9 %	12,3 %	14,7 %	0,83
COMMUNICATION	3,5 %	2,9 %	13,4 %	0,22
ENERGY	3,7 %	3,1 %	22,3 %	0,14
FINANCIAL	8,9 %	8,3 %	15,4 %	0,54
HEALTHCARE	12,0 %	11,3 %	10,6 %	1,07
INDUSTRIAL	10,0 %	9,3 %	14,2 %	0,66
INFO TECH	15,6 %	15,0 %	15,1 %	1,00
MATERIALS	7,7 %	7,1 %	14,6 %	0,49
REAL ESTATE	7,9 %	7,3 %	13,1 %	0,56
STAPLES	8,5 %	7,9 %	8,9 %	0,89
UTILITIES	6,8 %	6,2 %	10,8 %	0,57

4.2. Inflationary environment

Figure 8 presents the relationship between unexpected inflation and S&P 500 index returns during times of high and low inflation. Red dots represent the index returns during times of low inflation (2% or less) and blue dots represent returns during times of high inflation (more than 2%). As can be seen from the figure, when there is no unexpected inflation combined with a time of low inflation, the index tends to yield a return between -5 and +5 percent. However, during times of high inflation, the returns can be up to -10%. The biggest negative difference between occurred and forecasted inflation was during a high-inflation period and the biggest positive difference during a low inflation period. The dummy variable, presented in the data and methods chapter, was created so that the inflationary environment could be considered when analyzing the results of the linear regression analyses.

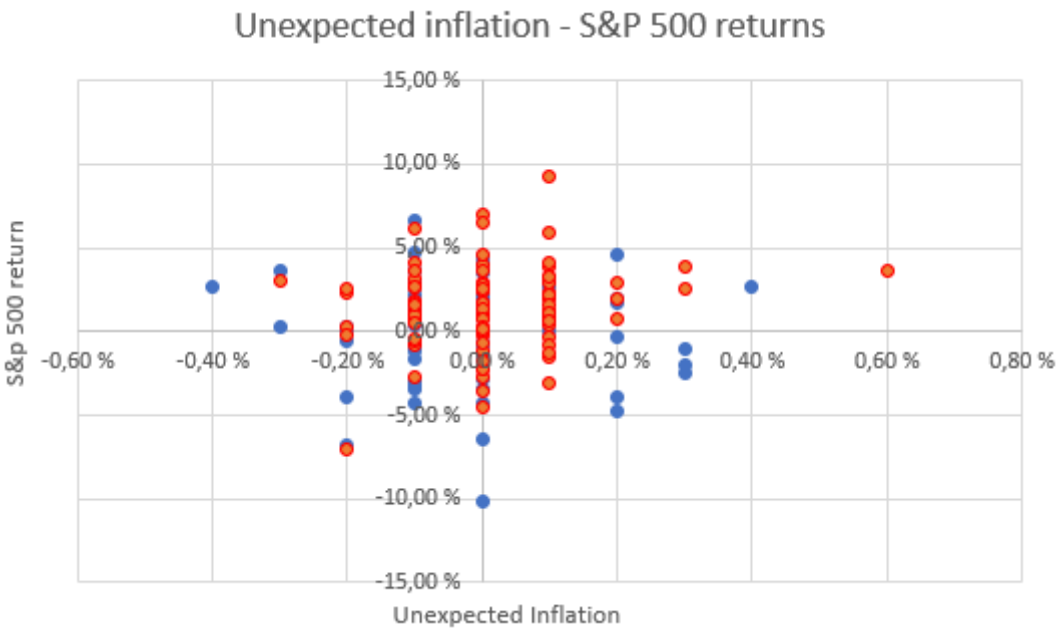

Figure 10. Relationship between unexpected inflation and S&P 500 index returns during times of high and low inflation between the years 2010 and 2022.

Between the years 2010 and 2022, low inflation occurred 89 times and high inflation, exceeding the long-term goal of 2%, occurred 67 times. Both low and high inflation were documented between the years 2010 and 2012 and in 2017. Between this, during the years 2013-2016, mainly only low inflation was recorded. 2018 was a year of high inflation and the years 2019-2022 of low inflation. After this, inflation-levels rose significantly in 2021 and 2022.

Table 5. High and low inflation 2010-2022.

Year	High Inflation (>2%)	Low Inflation (2%≥)
2010	5	7
2011	10	2
2012	6	6
2013	0	12
2014	2	10
2015	0	12
2016	0	12
2017	7	5
2018	12	0
2019	1	11
2020	3	9
2021	9	3
2022	12	0
=	**67**	**89**

4.3 Linear regression analyses

Table 6 presents the results of the multiple linear regression analyses. The explained variables were the S&P 500 index and its 11 sectors separately. The independent variables were unexpected inflation, inflationary environment (dummy-variable) and an interaction term. The unexpected inflation was calculated as the difference between actual inflation and forecasted inflation. The dummy-variable got a value of 1 if inflation was more than 2% and 0 if inflation was 2% or less. The interaction term was the product of unexpected inflation and the dummy variable meaning, that it received values only when inflation levels exceeded 2%. During times of low inflation, the interaction term does not receive values.

Table 6. Results of the multiple linear regression analyses.

	S&P 500*	DISCRE-TIONARY*	COMMUNI-CATION*	ENERGY	FINAN-CIAL*	HEALTH CARE
R squared	**5,14 %**	**5,67 %**	**7,73 %**	**1,51 %**	**5,45 %**	**1,32 %**
Adjusted R squared	**3,27 %**	**3,81 %**	**5,90 %**	**-0,43 %**	**3,58 %**	**-0,63 %**
coefficients						
Low + no unexpected	0,014	0,018	0,013	0,011	0,017	0,013
Low + unexpected	3,156	4,882	6,140	6,790	3,474	-1,278
Dummy (1 = high inflation, 0 = low inflation)	-0,012*	-0,013*	-0,020*	-0,012	-0,019*	-0,006
High + unexpected	-3,694	-11,155*	-7,774*	-8,684	-6,738	0,925

	INDUST-RIAL*	INFO TECH*	MATE-RIALS*	REAL ESTATE	STAPLES	UTILITIES
R squared	**7,85 %**	**4,48 %**	**7,68 %**	**3,29 %**	**2,56 %**	**0,96 %**
Adjusted R squared	**6,03 %**	**2,59 %**	**5,86 %**	**1,38 %**	**0,64 %**	**-0,99 %**
coefficients						
Low + no unexpected	0,017	0,019	0,017	0,011	0,010	0,009
Low + unexpected	4,386	5,698	6,341	2,371	2,632	0,221
Dummy (1 = high inflation, 0 = low inflation)	-0,017*	-0,013*	-0,020*	-0,008	-0,006	-0,006
High + unexpected	-10,571*	-10,373*	-10,426*	-7,252	-4,373	-1,028

**Indicates that the whole model and/or estimated coefficients are statistically significant.*

A *-marking indicates that the whole model (when marked next to the sector) or estimated coefficients (when marked next to a number) are statistically significant. The models for the energy, health care, real estate, consumer staples and utilities sectors did not obtain a high enough value for them to be statistically significant. The models for the S&P 500 index as well as the consumer discretionary, communications, financial, industrial, information technology and materials sectors are all statistically significant.

R squared is the coefficient of determination and indicates the amount of the explainable variables variation that is explainable by all the three independent variables together. Adjusted R squared was also included as it can be utilized in comparing different models since the independent variables remain the same (Kaakinen & Ellonen 2023). Out of the statistically significant models, the industrial sector has the greatest coefficient of determination (7.85%, adj. 6.03%), followed by the communications and materials sectors

(7.73%, adj. 5.90%; 7.68%, adj. 5.86%). The whole S&P 500 index gets a value of 5.14% (adj. 3.27%).

The estimated coefficients for the analyses are:

1) A coefficient when unexpected inflation is zero and during a low-inflation time (this is the intercept term).
2) A coefficient when unexpected inflation occurs during a low-inflation period.
3) A coefficient that explains the difference in baseline stock market returns between high and low inflation period, when unexpected inflation is zero.
4) A coefficient when unexpected inflation occurs during a high-inflation period.

When observing the statistically significant sectors, the baseline stock market returns vary between 1.3-1.9%. In more simpler terms, when no unexpected inflation occurs and inflation stays beneath the 2% goal, average monthly stock market returns are between 1.3% and 1.9%. On average, the whole S&P 500 yields a return of 1.4%.

However, if unexpected inflation enters the picture during a low-inflation time period, stock market returns seem to rise quite a bit. When assessing the statistically significant models, an increase in unexpected inflation by 1% results in stock market returns increasing by over 3-6 percent. Take for example the S&P 500 index, if inflation rose by 1%, returns would also increase by 3.156%. The materials and communications sectors seem to be most sensitive to unexpected inflation during a low-inflation time, offering increased returns of 6.341% and 6,140%.

The dummy-variable captures the difference in stock market returns between high and low inflation, when unexpected inflation is 0%. A negative coefficient indicates that stock market returns are generally lower during periods of high inflation. Regarding the statistically significant sectors, this would mean for instance, that during high inflation, the S&P 500 index returns would decrease by 1.2%. As this coefficient is negative for all the statistically significant models, high inflation does affect the stock market returns negatively. Interestingly enough, the same sectors that were positively most sensitive to unexpected inflation during times of low inflation, the materials, and communications sectors, are also

negatively most sensitive to high inflation (when all inflation is forecasted, and no unexpected inflation occurs).

The final coefficient reflects the additional effect of unexpected inflation during periods of high inflation. If this coefficient were to be positive, it would indicate that stock market returns would be positively affected by unexpected inflation during high inflation times. However, all statistically significant sectors as well as the whole S&P 500 index obtained a negative coefficient, meaning that in high-inflationary environments, unexpected inflation affected stock returns adversely. To present an example, an increase in unexpected inflation by 1% during a high-inflation period results in the S&P 500 index returns decreasing by -3,694%. The consumer discretionary sector suffers the biggest losses in return them being -11,155% for every 1% increase in unexpected inflation.

5 Conclusions

The aim of this thesis was to examine the relationship between unexpected inflation and stock market returns in different inflation environments. The time period of the study began in January 2010 and ended in December 2022. The research data was obtained as monthly time series data from Yahoo Finance database and analyzed using Microsoft Excel. The entire S&P 500 index as well as each of its 11 sectors were included in the study. Additionally, when calculating risk-adjusted returns, the three-month T-bill, which acted as the rate for risk-free return, was also included. The return-to-risk ratios for the S&P 500 index and the 11 sectors were calculated using the Sharpe ratio. The connection between unexpected inflation and stock returns was examined using a multiple linear regression analysis. The dependent variables were the S&P 500 index and the 11 sectors individually and separately. Unexpected inflation, calculated as the difference between occurred and forecasted inflation, inflation environment-dependent dummy variable, and an interaction variable, which was the product of the aforementioned variables, were used as the independent variables.

To begin with, the research findings revealed that risk had a significant impact in determining the true value of an investment. For instance, although information technology yielded the highest average return out of all the sectors during the review period, when examined with the help of the Sharpe ratio, health care provided the best risk-adjusted annual return. The energy sector produced the worst risk-adjusted annual return out of all the sectors.

The research results also showed that there were significant differences among the sectors and how they responded to unexpected inflation in different inflation environments. The S&P 500 index and all 11 sectors yielded a positive return in a low-inflation environment where unexpected inflation did not occur. All examined indices, except for healthcare, responded positively to unexpected inflation in a low inflation environment. Furthermore, all sectors reacted negatively to an increase in overall inflation level when unexpected inflation did not occur. However, if unexpected inflation did occur in a high inflation environment, the stock market returns immediately decreased significantly. Since the

regression models for the energy, health care, real estate, consumer staples, and utilities sectors did not produce a high enough p-value to be statistically significant, the results they provided cannot be relied upon.

As can be seen in appendices 1 and 2, some linear relationships are extremely weak and therefore, it cannot be said that all deviations from forecasted inflation had a linear effect on stock market returns in neither a high-inflation nor a low-inflation environment. In other words, it cannot be stated that unexpected inflation of 0.3% had three times the effect of a 0.1% deviation. Rather, the results of this thesis offer a foundational understanding of the relationship between stock market returns and unexpected inflation. However, further research is required to confirm the findings of this study and better investigate how unanticipated inflation affects stock returns.

In short, however, it can be stated that based on the regression analyses, stock market returns decrease in a high inflation environment, whether unexpected inflation occurs or not.

5.1 Answers to research questions

The sub-research question of the study was, *"Which sectors within the S&P 500 index are most and least sensitive to unexpected inflation in both high and low inflationary environments?"*. Answering this question is simple with statistically significant regression analysis results, as they revealed that different sectors indeed do react differently to unexpected inflation. The findings show that if unexpected inflation occurs during low inflation periods, stock returns generally increase, with the materials, communication, and information technology sectors offering the highest yields. The financial sector reacted in the least sensitive way. In the regression analysis, the energy sector showed the most significant reaction, and the utilities sector the least, but since these models were not statistically significant, one cannot rely on these results. The healthcare sector diverged from other observations, as its returns on average decreased during unexpected inflation in a low inflation environment, but this model too wasn't statistically significant.

When unexpected inflation occurred in a high inflation environment, stock returns declined, with the consumer discretionary, industrial, materials, and information technology sectors

reacting most sensitively. The financial and communication sectors showed the least reaction. If the utilities sector was statistically significant, it would have shown the least reaction in this context too. Moreover, the healthcare sector reacted contrary to others by yielding higher returns during unexpected inflation in a high inflation environment. Once again, as the health care sector too wasn't statistically significant, one cannot completely rely on the results.

The primary research question was, *"How does unexpected inflation affect the S&P 500 index during times of high and low inflation?"*. The sub-research question aids in answering the primary research question, as the index is composed of the 11 different sectors, each examined individually to provide an answer to the sub-question. In short, examining the entire S&P 500 index reveals that its returns increase when unexpected inflation occurs during low-inflation periods and decrease when unexpected inflation occurs during high-inflation periods.

5.2 Comparison with previous studies

The results of this thesis are mostly in line with previous studies. Several prior studies (Lintner 1975; Firth 1979; Campbell & Vuolteenaho 2004; Chiang & Chen 2023) had identified a negative correlation between inflation and stock returns, and this thesis supports these findings.

This study's findings observe differences among sectors when examining the impact of varying inflation on their returns; for instance, the industrial sector seems to be very sensitive to inflation. These findings align with previous studies (Boudoukh et al. 1994; Chiang & Chen 2023; Masturzo & Mazzoleni 2021), which suggest that the industry, its volatility, and capital needs influence stock returns in different inflationary environments. In this thesis, a strong negative correlation was also observed between the consumer discretionary sector and unexpected inflation in a high inflation environment. This observation supports previous research findings (Fischer & Modigliani 1978; Firth 1979), which state that inflation erodes consumers' purchasing power. Consequently, luxury goods are consumed less, which most likely leads to a decline in returns in the consumer discretionary sector. However, this study's results are not in line with the findings of Chiang & Chen (2023), which reported

that the energy sector performed best during high inflation. Nonetheless, their research was conducted during the COVID-19 pandemic and was also influenced by geopolitical uncertainties, and therefore, the findings of this thesis are not easily comparable.

The results of this thesis also highlight the need to maintain a stable economy and keep inflation below the 2% target level, as stock returns, on average, suffer in a high inflation environment. Achieving this requires both fiscal and monetary policies, and decision-makers need to be mindful of their actions. These research findings also align with earlier studies (Fischer & Modigliani 1978; Firth 1979; Geske & Roll 1983; Bekaert & Engstrom 2010).

Moreover, this study's results also emphasize the need for effective portfolio diversification, as inflation impacts different environments and sectors differently. Moreover, this observation too, is consistent with previous research (Lintner 1975; Campbell & Vuolteenaho 2004; Boudouk et al. 2010; Masturzo & Shakernia 2022).

5.3 Use of results

Understanding how inflation affects stock market returns in different inflationary environments can be crucial when making investment decisions. Understanding that varying sectors yield different returns and are influenced differently by unexpected inflation aids in building new or altering already existing investment portfolios as investors can better allocate assets and maximize profits.

Businesses, especially those that operate in volatile and sensitive industries, can also benefit from understanding the relationship between inflation and stock returns as it allows them to better plan and adjust strategies. For instance, businesses can develop flexible and easy-to-change operational strategies to better navigate through economic uncertainties. Moreover, understanding how a competitor’s business, leverage ratio and equity may be affected by unexpected inflation can also be valuable knowledge.

The results of this study support previous findings (Modigliani & Cohn 1979; Pearce & Roley 1988) and highlight the importance of economic stability. Therefore, the findings of

this thesis also serve as a good reminder for policymakers to understand the impacts reckless fiscal or monetary policies can have on inflation and thus, on stock market returns.

5.4 Reliability and suggestions for further research

The purpose of evaluating reliability is to critically examine the research data and consider the progression of the research process. For this thesis, reliability is enhanced by the long time period of 2010–2022, which includes multiple cycles of economic growth and decline. By examining various economic cycles, it can be confirmed that the S&P 500 index and its 11 sectors did not perform neither well nor poorly solely by chance during specific periods. The use of easily accessible data, available to anyone on the internet, also increases reliability. This means anyone could replicate this study using the same research methods.

Although this thesis was limited to the United States stock markets, including stocks from other global markets could enhance reliability. The more indices and stocks considered in the study, the more reliable it would become. Because this thesis focused only on one single index, even though the S&P 500 is a large and trustworthy index, it decreases the research's reliability significantly.

A potential interesting idea for further research could be to conduct a similar study, but with the addition of more independent variables. In this way, all the regression analyses of the sectors could hopefully become statistically significant, and greater confidence could be placed in their results. Furthermore, a different regression model, for instance a polynomial regression model could also be conducted instead of a linear model. On the other hand, changing the whole research method into an event study could also be beneficial, as this would allow one to investigate the immediate effects of unexpected inflation much better. Moreover, the study could be replicated in another market area, for example in Europe or perhaps in emerging markets, as this could potentially offer different research results. One could also take geographical and regulatory factors into account to provide a more comprehensive understanding of which factors influence inflation and stock market returns.

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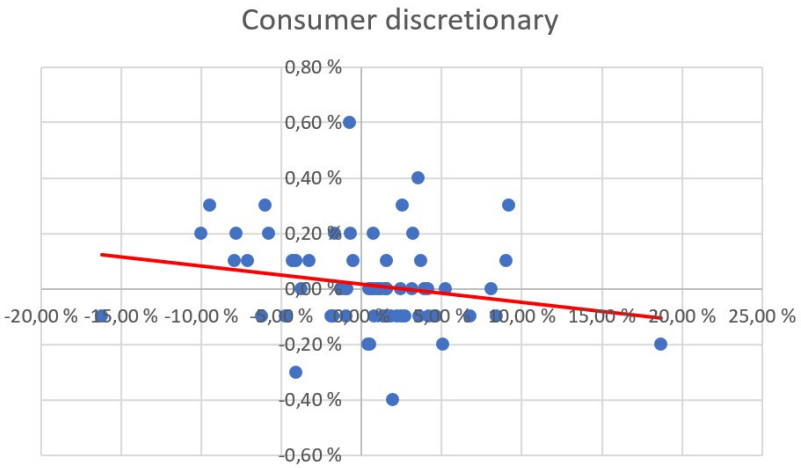
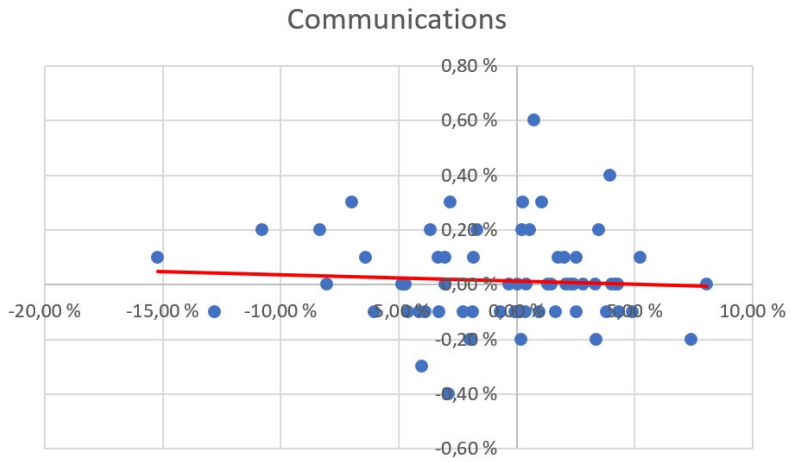
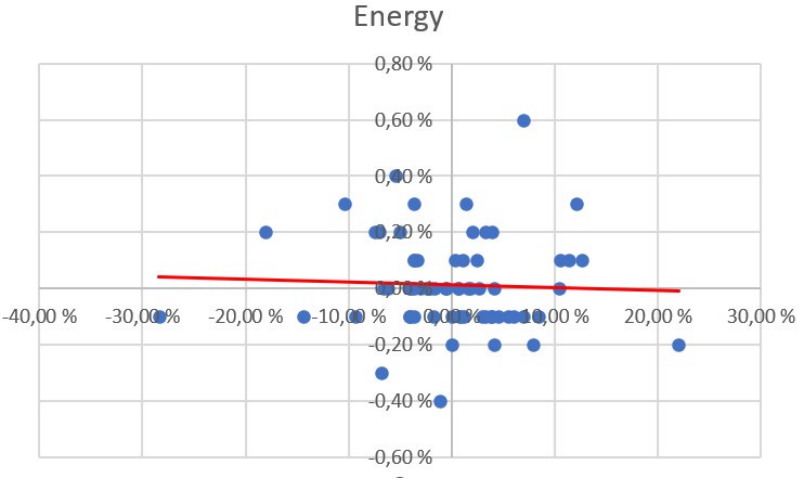
Appendix 1. Linear relationships between sector returns and unexpected inflation during times of high inflation.







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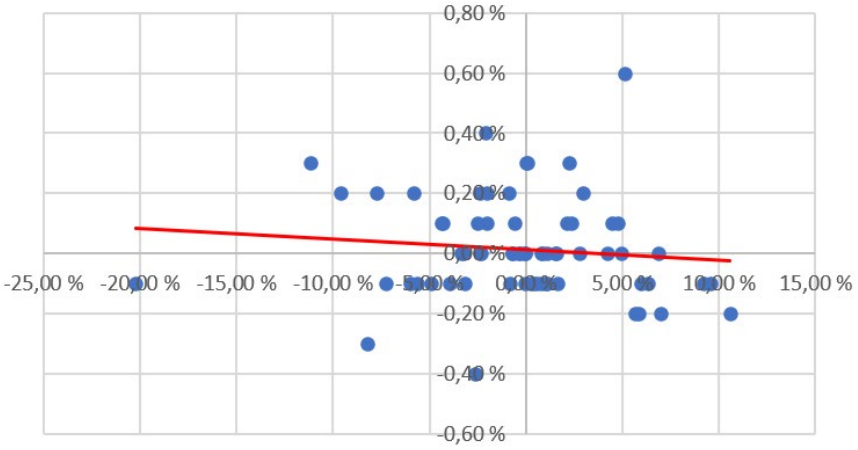

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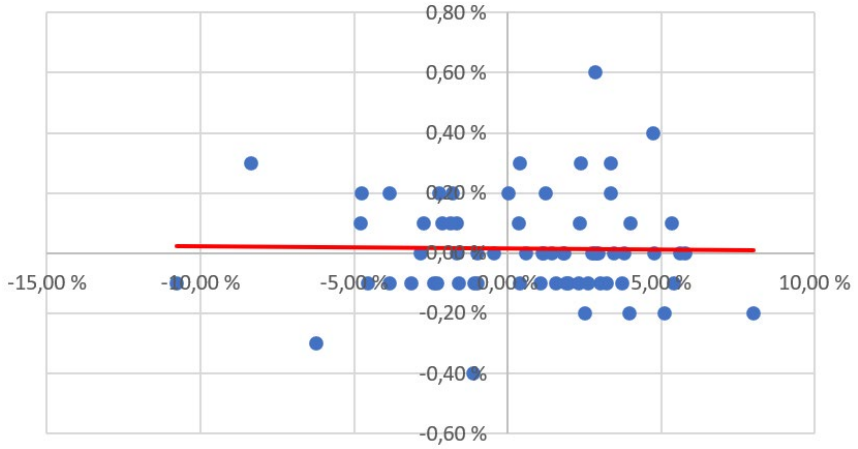

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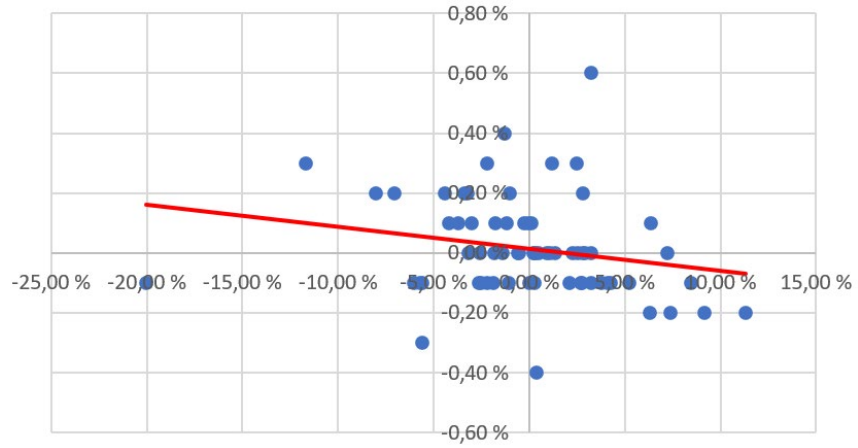

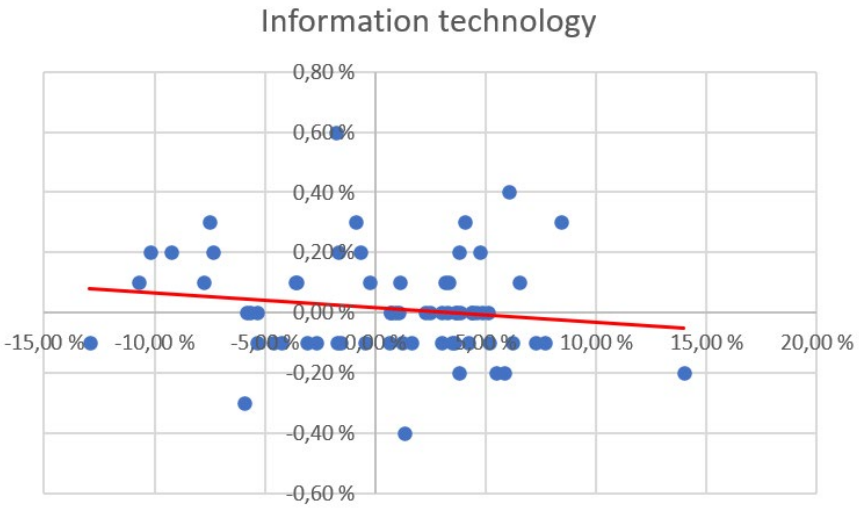
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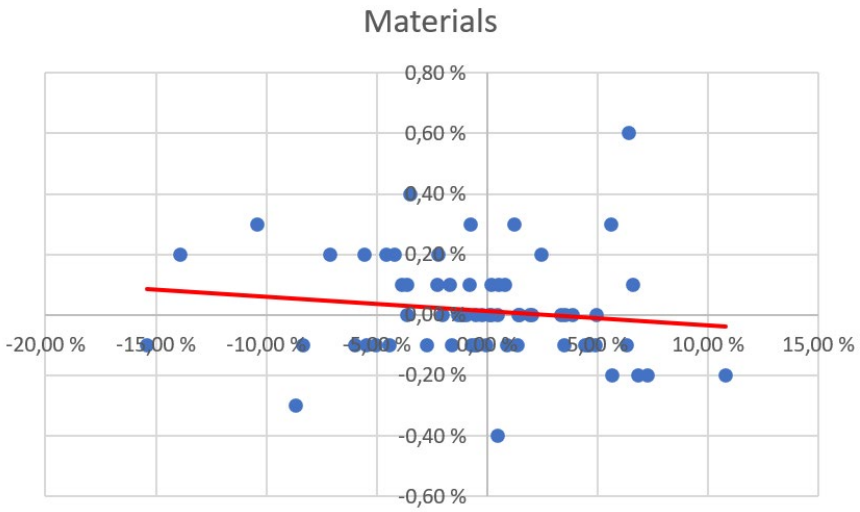
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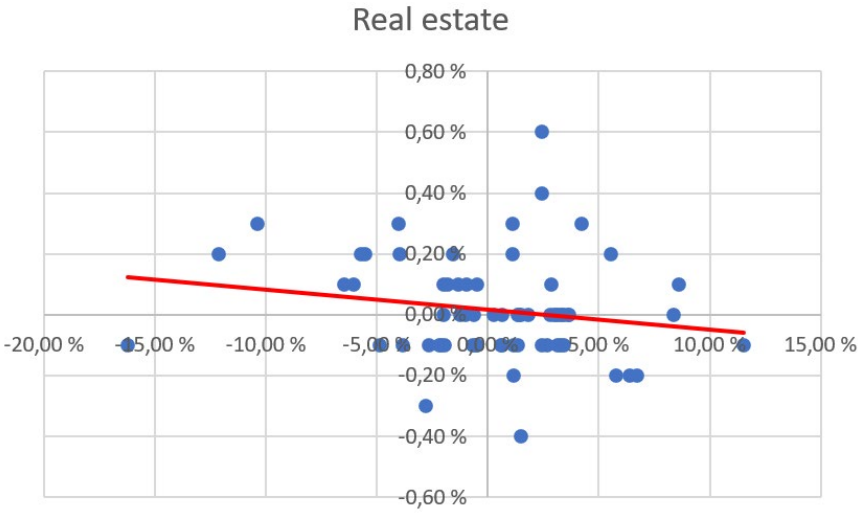
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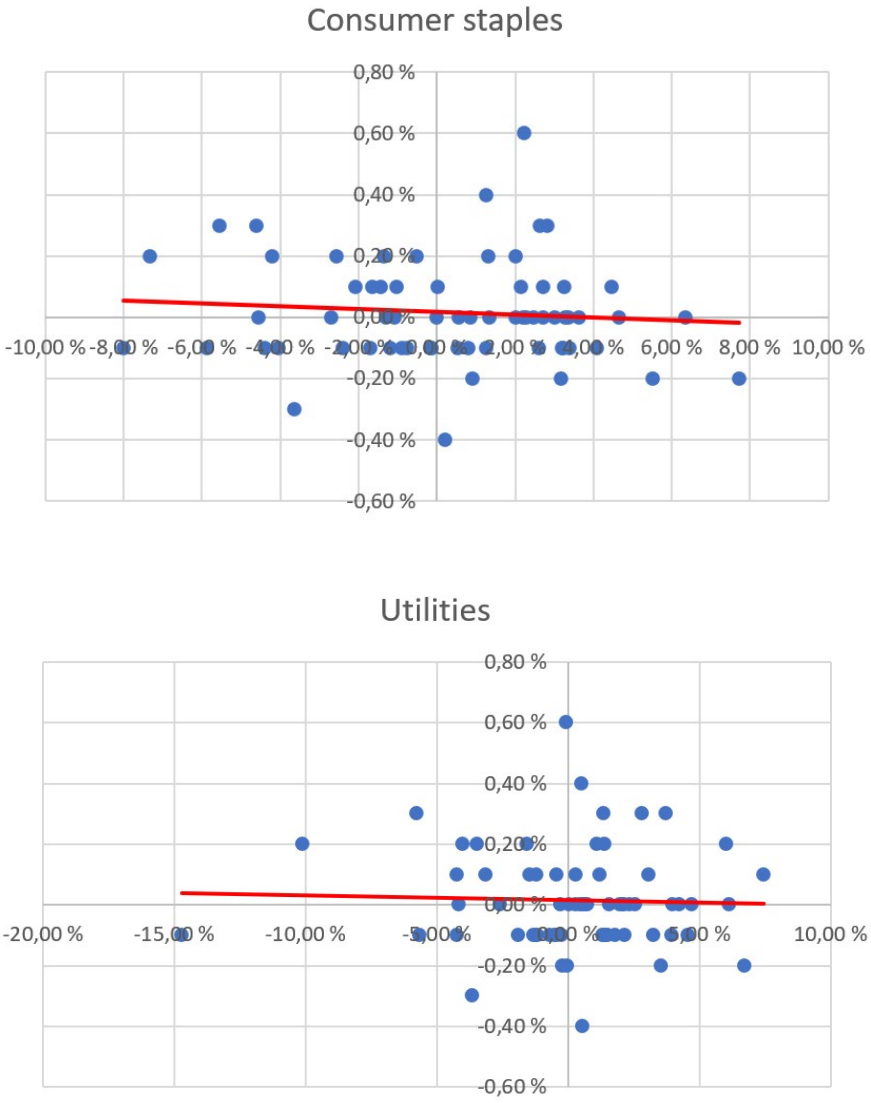
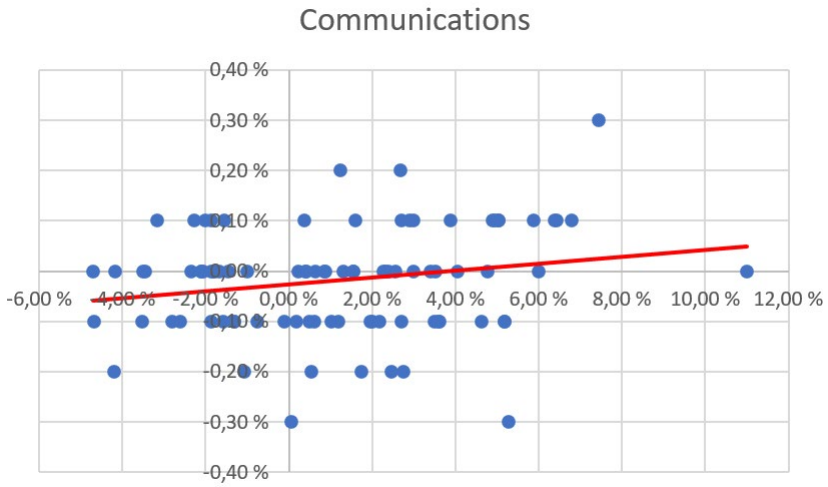
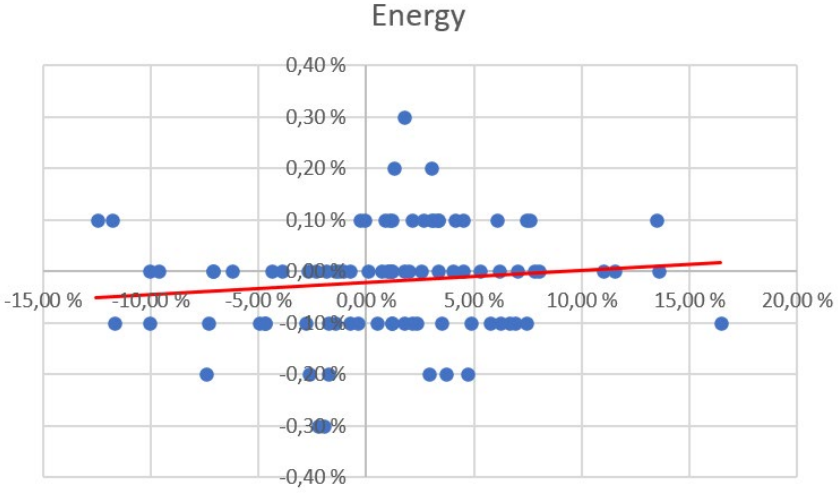
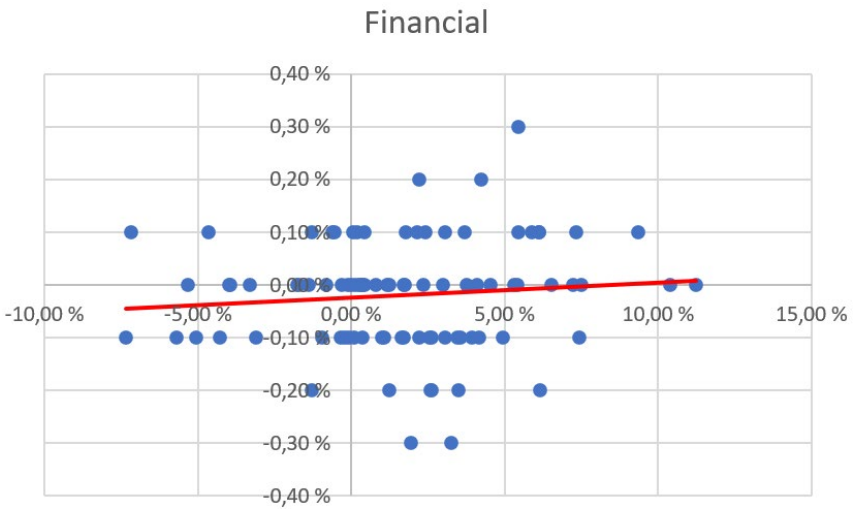


Scatter plots for all the 11 sectors during a high-inflation environment. The blue dots represent returns from each sector, and the red line is the linear trendline.

Appendix 2. Linear relationships between sector returns and unexpected inflation during times of low inflation.



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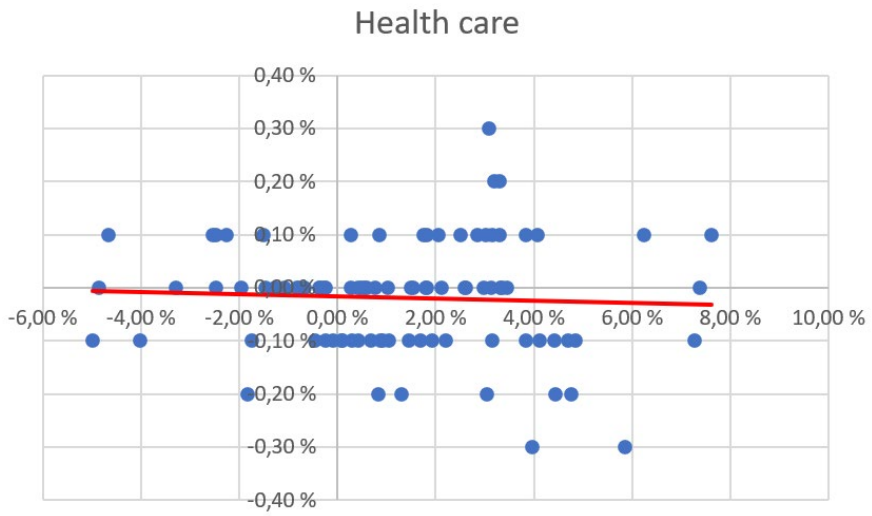
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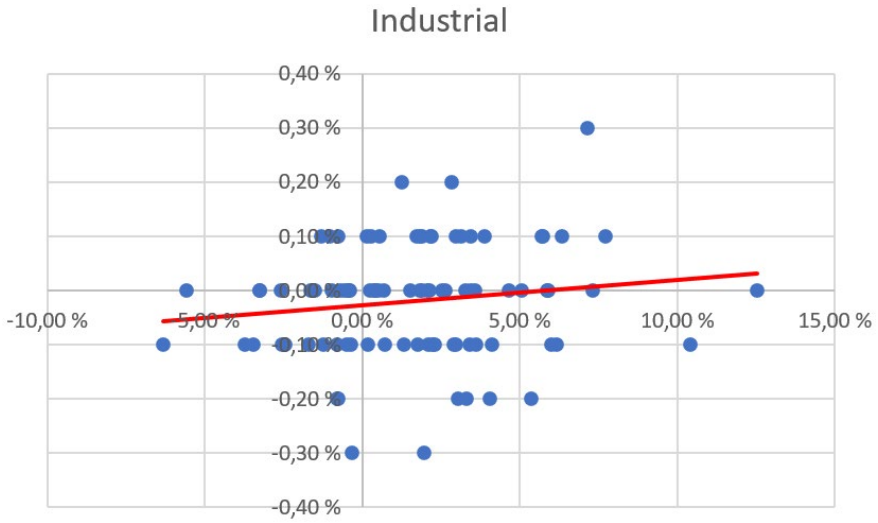
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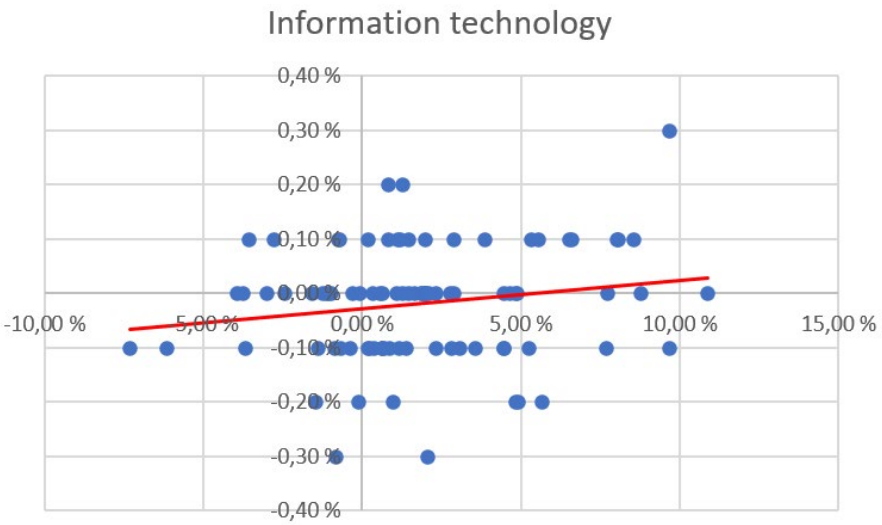
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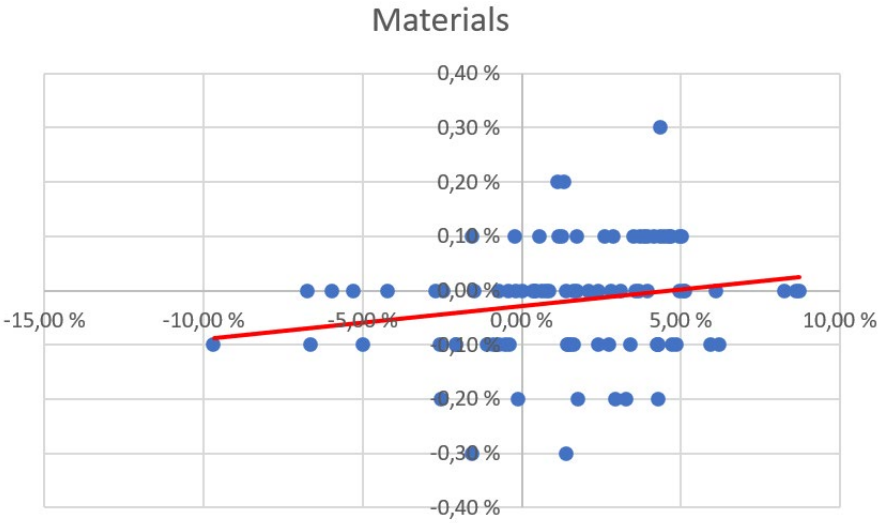
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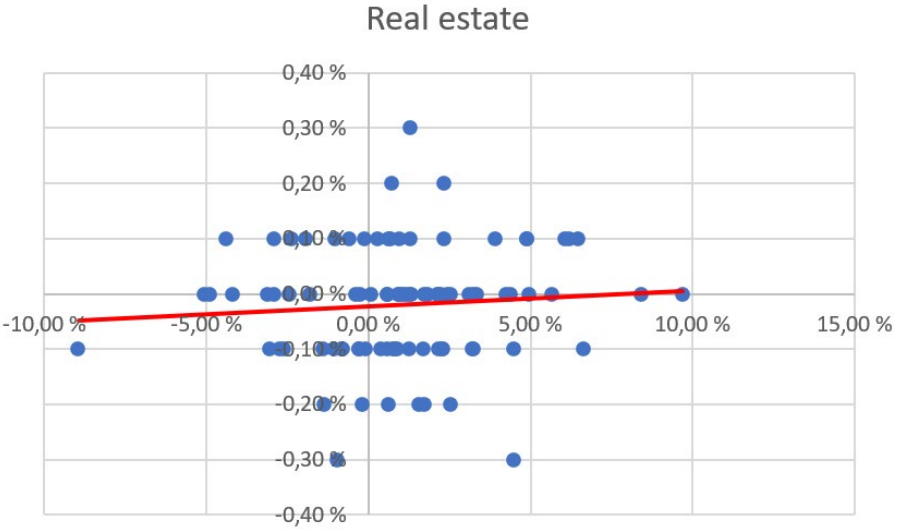
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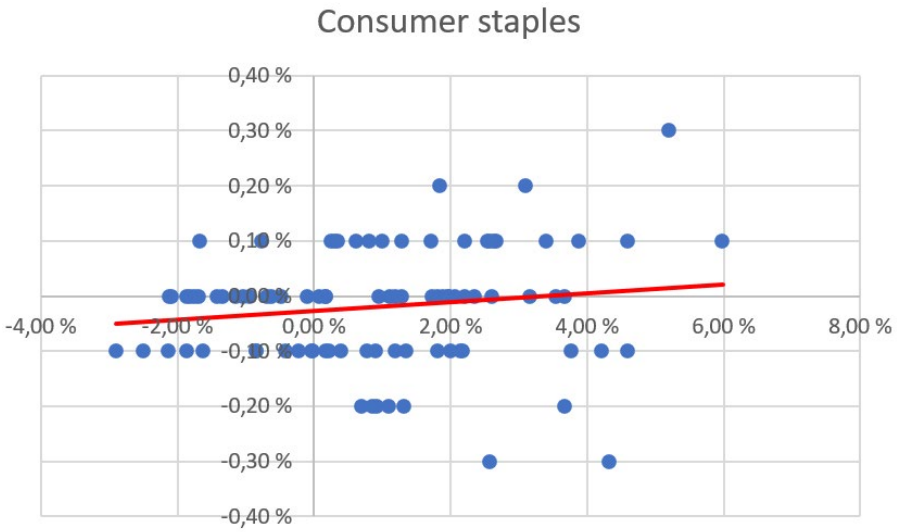

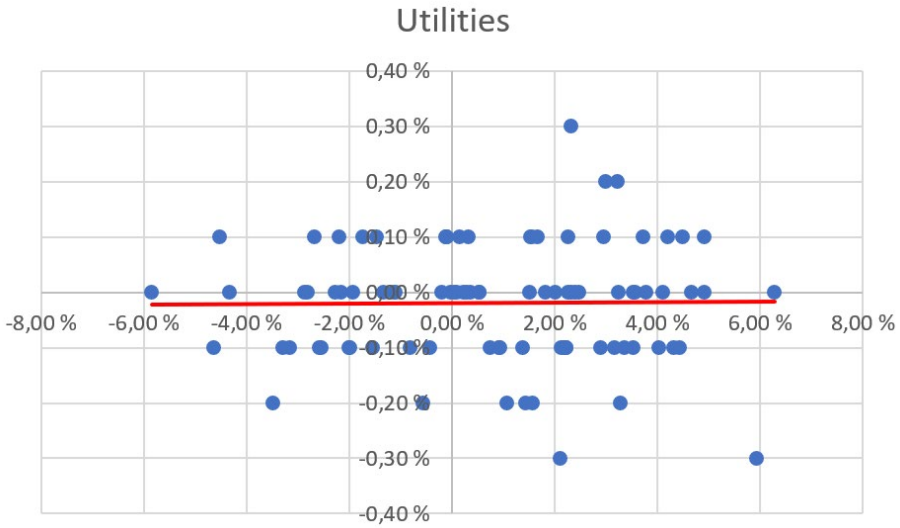

Scatter plots for all the 11 sectors during a low-inflation environment. The blue dots represent returns from each sector, and the red line is the linear trendline.