



Nottingham Business School

Nottingham Trent University

The effect of unexpected interest rate changes on different stock market sectors

Dissertation thesis



Nottingham Business School

Nottingham Trent University

The effect of unexpected interest rate changes on different stock market sectors

Dissertation thesis

Author:	Arthur Csaba Varga
Student ID:	N1171812
Academic year:	2022/2023
Module Title:	Dissertation
Module code:	BUSI48170
Word count:	10 778
Supervisor NTU:	Alper Cenesiz Ph. D.
Supervisor EUBA:	doc. Ing. Kotlebová Jana PhD.
Study program:	MSc. International Finance



Nottingham Business School

Nottingham Trent University

ABSTRACT

The aim of this thesis is to analyse the relationship between stock returns on a sector level and the unexpected component of the changes in the federal funds rate. The literature review looks into the literature already conducted on the topic and provides a starting point for our research. The gap in the literature we try to fill is the analysis of the relationship between stock returns on a sector level and interest rates in times of unconventional monetary policies. Using OLS regressions, we find a negative and significant relationship for some sectors mostly in our expansion sub-periods, while the results for the whole period and recession sub-periods are mostly statistically insignificant. This statistical insignificance can be partly due to the presence of unconventional monetary policies. Further research should be conducted to corroborate our results.

Keywords: interest rates, stocks, stock market sectors, interest rate sensitivity, unexpected component, federal funds rate

ACKNOWLEDGEMENT

I would like to thank my supervisor Alper Cenesiz Ph. D who guided me while writing this thesis and gave me many useful tips and pointers.

CONTENT

ABSTRACT	3
ACKNOWLEDGEMENT	3
CONTENT	4
INTRODUCTION	5
1 LITERATURE REVIEW	8
1.1 <i>Theoretical background</i>	8
1.2 <i>Interest rates and the stock market</i>	8
1.2.1 <i>Theoretical models</i>	8
1.2.1.1 <i>Capital Asset Pricing Model (CAPM)</i>	9
1.2.1.2 <i>Arbitrage Pricing Model (APM)</i>	9
1.2.1.3 <i>Black-Scholes Option Pricing Model (BSM)</i>	11
1.2.2 <i>Empirical evidence</i>	12
1.2.2.1 <i>Interest rates sensitivity of the stock market</i>	12
1.2.2.2 <i>Interest rates sensitivity of growth and value stocks</i>	14
1.2.2.3 <i>Interest rates sensitivity of different industry sectors</i>	15
2 DATA & METHODOLOGY	18
2.1 <i>Research questions and hypotheses</i>	18
2.2 <i>Data</i>	20
2.3 <i>Research methods</i>	23
3 RESULTS AND FINDINGS	26
3.1 <i>Full sample results and findings</i>	26
3.2 <i>Expansion sub-periods results and findings</i>	27
3.3 <i>Recession sub-periods results and findings</i>	29
4 DISCUSSION AND FUTURE RESEARCH	31
4.1 <i>Research limitations</i>	31
4.2 <i>Conclusions</i>	32
4.3 <i>Implications for further research</i>	33
REFERENCES	34
Appendix	37

INTRODUCTION

Interest rates as one of the main tools of monetary policy play an important role in the macroeconomic environment. Policymakers all around the world use interest rates as a tool to respond to different challenges their countries face. They can help battle inflation, weak economic growth, and recessions, or on the other hand, if the economy is overheating interest rates can be used as a tool for cooling the economy down. During all stages of the economy, the stock market is always active and market participants closely watch and analyse interest rates as they often signal future price movements in the stock market. One of the interest rates that is decided by the Federal Reserve in the United States (US) is the federal funds target rate. This is the most important and most watched interest rate decision in the world that has an effect on markets worldwide. In this paper, we try to analyse how the changes in this particular rate affect the stock market in the US on a sectoral level. First, we must distinguish between the expected and the unexpected part of the change in the federal funds rate. This is important because market participants often read signals leading up to the actual interest rate decision and some part of the change announced can be already priced in the markets when the change in the federal funds rate is announced. Therefore, most studies focus on the unexpected component of interest rates when establishing a relationship between interest rates and the stock market. The general hypothesis, that the relationship between interest rates and stock returns is negative was broadly supported by many authors ((Modigliani, 1971; Mishkin, 1977; Thorbecke, 1997; Conover, Jensen and Johnson, 1999; Basistha and Kurov, 2008). There are, however, studies that find a positive relationship between interest rates (Eldomiaty et al., 2019; Lee, 1997) and in some cases authors also find insignificant results (Kontonikas, MacDonald and Saggiu, 2013). These results show that the relationship between interest rates and stock returns varies based on the methodology used as well as the time period chosen as there are external factors that alter the relationship as well. We also show the complexity of the relationship on a theoretical level, where we try to establish a relationship between interest rates and stocks based on the Capital Asset Pricing Model, Arbitrage Pricing Model and the Black-Scholes Option Pricing Model. After looking into these pricing models, we could not establish a straightforward relationship that would hold when other variables change. Therefore, we conclude that on the theoretical level, the relationship is as complex as on the empirical level.

Our study looks into the relationship between unexpected changes in the federal funds rate and stock returns on a sector level. There is previous literature conducted on this topic (Bernanke and Kuttner, 2005; Conover et al., 2005; González, Jareño and Skinner 2017) either for industries or sectors of the stock market. We contribute to this

body of existing literature by researching the relationship for the S&P 500 and its sectors. The main contribution of our research is the time period it is conducted for as it involves multiple periods of unconventional monetary policy (UMP) usage. Therefore, we measure how this relationship differs in times of UMPs from the results of studies conducted before the introduction of UMPs in the US/with a smaller proportion of the time period including UMPs.

We use daily data for ETFs tracking the performance of the S&P 500 and its sectors for the time period 1999-2023. We calculate the returns for each of these variables using a methodology based on the one used by Kontonikas, MacDonald and Saggiu (2013) both for daily and monthly returns. The unexpected component of the change in the federal funds rate is calculated based on data from thirty-day fed funds futures, where the calculated difference is scaled by a factor related to the number of days in a month affected by the change. This methodology is in line with the one used by Bernanke, Kuttner (2005) and Kontonikas, MacDonald and Saggiu (2013). We then estimate our model, for which we choose an OLS regression model. We include heteroskedasticity and autocorrelation consistent HAC robust errors in our models.

The results of our study can be divided into three categories based on the sample periods included in the models. The three categories are full sample models, expansions sub-period models and recessions sub-sample models. Out of the 10 daily and 10 weekly models (S&P 500 and 9 sectors) we find, for the full sample period, that only one observation is statistically significant. The consumer discretionary sector on a daily basis shows a statistically significant and negative relationship to the unexpected component in the federal funds rate change. For the expansions sub-period, we conduct the same set of models with five variables (S&P 500, industrials sector, materials sector, health care sector, consumer discretionary sector) showing a statistically significant negative relationship towards the unexpected component of the federal funds rate change. All of these statistically significant results are daily returns. The last sub-period, the recessions sub-period included 20 OLS estimations, similar to the previous parts. This sub-period shows no statistically significant results. While, the results that are statistically significant all confirm the negative relationship hypothesis, the main finding of our study lies in the statistically insignificant results. We provide evidence, that for most sectors, especially for the monthly returns (where all observations show statistically insignificant results) the relationship between interest rates and stock returns is not straightforward in times of UMPs. This observation is also true for the recession sub-period where all the results show no statistically significant relationship between the S&P 500 and its sectoral returns to the unexpected component of the federal funds rate change.

In the next section, we provide a brief overview of the remaining outline of this paper. The first chapter, which is the literature review summarizes both theoretical models of asset pricing and how they are connected to interest rates and an overview of the empirical literature conducted on the topic of the relationship between interest rates and stock returns. The part that focuses on the empirical studies first looks at the general relationship between interest rates and stock returns on a market level, then summarizes results on the interest rate sensitivity of growth and value stocks and finally provides a literature overview on the sectoral level of stock returns in relation to interest rate changes. We then summarize the findings of literature conducted on the topic and explain how our study can contribute to the existing body of research.

Our second chapter, methodology, contains the research questions and hypotheses of our study as well as explanations behind the choice of these particular hypotheses. We then explain our data and data sources in detail. We provide descriptive statistics of various interest rate data to better explain the differences between the unexpected and total change in the federal funds rate. After explaining the data, we thoroughly describe the steps we take in modelling our research methods. In this section, we provide a summarized table of our model variables used in our econometric estimations. Finally, we present the formula, based on which we estimate the relationship between the unexpected component of the federal funds rate change and stock returns on a sector level. We also describe the type of model and its specifications that we implement in our study as well as supporting arguments for choosing this particular model.

The results and findings, which are included in the third chapter of our paper are divided into three sub-sections: the full sample results and findings, the expansion sub-periods results and findings and the recession sub-periods results and findings. Each of the sections analyses the results of our models and compares them with our hypotheses and evaluates if they are accepted/rejected. A summary of all results can be found at the end of this section.

Discussion and further research are presented in the last and fourth chapter of this paper. It starts by specifying the limitations of our research. Once having clearly stated the limitations we move to the conclusions section. Here we evaluate our results, connect them to the existing literature and address, how these findings contribute to the existing research. Lastly, we present our implications for further research. This section provides ideas on how future research can build on our findings and how different approaches can be used to research similar topics.

1 LITERATURE REVIEW

1.1 Theoretical background

The understanding of the literature on the relationship between interest rates and movements in the financial markets is based on the knowledge of economic theory. To understand these relationships we must first briefly describe the transmission mechanisms of monetary policy. Monetary authorities around the world set interest rates for their countries, which signalize the direction the monetary policy is taking and simultaneously they affect a lot of variables. The official interest rate decisions have a direct impact on market rates, asset prices and exchange rates, which then further affect demand and finally inflation. The complexity of these mechanisms is important as the relationships between variables such as interest rates, inflation and exchange rates are often discussed in studies that measure the effects of monetary policy on the financial markets.

Once having an understanding of the monetary policy transmission, it is of importance to distinguish between different exchange rate regimes in the world. The end of the Gold Standard in 1971 marks the beginning of an era, in which the U.S. dollar became a floating currency. This event divides the literature on the effects of interest rates on the financial markets into a period before and after the end of the Gold Standard. For the purposes of this study, we mainly focus on the post-Gold Standard era.

1.2 Interest rates and the stock market

1.2.1 Theoretical models

Before looking at empirical evidence of the relationship between interest rates and the stock market we provide a theoretical framework of asset pricing models that calculate with interest rates. These models provide a basis for the empirical results presented later. The topic of asset pricing models has been researched heavily in the past (Markowitz, 1953; Sharpe, 1964; Lintner, 1965; Sorensen and Williamson, 1985; Shefrin and Statman, 1994). However not all asset pricing models incorporate interest rates so for the purpose of this study we will focus on the Capital Asset Pricing Model, Arbitrage Pricing Model and the Black-Scholes Option Pricing Model.

1.2.1.1 Capital Asset Pricing Model (CAPM)

One of the most recognized and taught asset pricing models is the CAPM which was first introduced by Sharpe (1964) and Lintner (1965) independently of one another. The CAPM model builds on the mean-variance portfolio model of Markowitz (1953,1959). Before examining the CAPM formula and how it connects asset prices and interest rates we look at the assumptions of the model. This is important because the assumptions also present limitations of the applicability of the model in real market conditions. The assumptions presented by Krause (2001) are:

- Absence of transaction costs and taxes
- Assets are indefinitely divisible
- Each investor can invest in every asset without restrictions
- Investors maximize expected utility by using the mean-variance criterion
- Prices are given and cannot be influenced by the investors
- The model is static (only a single time period is considered)
- Unlimited short sales Homogeneity of beliefs All assets are marketable

Once knowing the assumptions of the model we look at the CAPM formula based on Fama and French (2004):

$$E(R_i) = R_f + [E(R_M) - R_f]\beta_{iM}, \quad i = 1, \dots, N,$$

where, $E(R_i)$ is the expected return on an asset which is equal to the risk-free rate R_f plus a risk premium. The risk premium is the assets market β times the per unit premium of beta risk $E(R_M) - R_f$. If the risk-free rate rose as a result of a monetary tightening (rising interest rates) the expected return on the asset would rise as well. A rate cut by monetary authorities on the other hand would lower the risk-free rate and therefore bring the expected return on assets down as well. This positive relationship, however only holds if all other variables remain unchanged (ceteris paribus) and $\beta_{iM} < 1$. If $\beta_{iM} > 1$ and all other variables remain unchanged the relationship between the expected return and the risk-free rate becomes negative. This shows, that without knowing the values of other variables than the risk-free rate, it is impossible to establish a unified relationship.

1.2.1.2 Arbitrage Pricing Model (APM)

Another capital asset pricing model is the Arbitrage Pricing Model built on the arbitrage theory of capital asset pricing. This model, developed by Ross (1971) is an alternative to the CAPM model. While the CAPM model calculates the expected return by

only using the risk-free rate and a risk premium the APM is a multi-factor model. The multiple factors influencing the price of equities used by the APM can vary based on the preference of the researcher constructing the model. Based on the variability the model provides the assumptions might change as well. The underlying assumptions stated by Ross (1976) who first developed the theory are:

- Liability limitations
- Non-negligibility of Type B agents
- Homogeneity of expectations
- Extent of disequilibria
- Boundedness of expectations

These assumptions, however, are not as easy to interpret as the ones provided for the CAPM model. For a better understanding see Ross (1976).

As mentioned, the model provides certain variability when it comes to choosing the factors, which influence the expected returns. A general formula can be found in Roll and Ross (1980):

$$E_i = \lambda_0 + \lambda_1 b_{i1} + \dots + \lambda_k b_{ik}, \text{ for all } i.$$

Where, E_i represents the expected return, λ_0 represents the risk-free return and $\lambda_1 b_{i1} + \dots + \lambda_k b_{ik}$ are the factors that represent the systemic risk and are variable. The factors can include any economic factors such as inflation, changes in interest rate, consumption, industrial production and others. The variability of this model makes the model more profound and complex than the CAPM but the relationship between interest rates and the APM is less straightforward. We can see that the variable representing the risk-free rate is still present so as the risk-free rate raises (based on monetary decisions to hike interest rates) the basis for the expected return raises as well. However, depending on the chosen factors this can be outweighed. If for example a direct change in interest rates was applied and a negative relationship was anticipated, then the initial risk-free movement could be overshadowed and the relationship between the expected price and interest rates in the APM would become negative. If additional factors, that are affected by interest rates were considered, the negative relationship between interest rates and the expected price of equity would become even more noticeable. An example of this would be the inclusion of consumption as a factor as higher interest rates have a negative effect on consumption, while a rate cut is associated with a rise in consumption. Consumption can then affect corporate earnings and finally the price of stocks.

1.2.1.3 Black-Scholes Option Pricing Model (BSM)

A different type of asset pricing model is the Black-Scholes Option Pricing Model developed by Black and Scholes (1973). While this model is used strictly for option pricing- European call options, it also has relevance for American call options. The changes in prices of options are closely linked to the price changes in the underlying asset- stock, which explains the relevance of discussing the BSM. MacBeth and Merville (1979) summarize the assumption of the model as follows:

- The underlying security pays no cash distributions
- No transaction costs
- No taxes
- No restrictions on short sales

The formula for the BSM model based on MacBeth and Merville (1979) and Chance and Brooks (2011) is the following:

$$C_e(S_0, T, X) = S_0 \mathcal{N}(d_1) - \frac{X}{e^{r_c T}} \mathcal{N}(d_2)$$

Where, $C_e(S_0, T, X)$ is the estimated price of a call option, S_0 is the current stock price, $\mathcal{N}(d_1)$ and $\mathcal{N}(d_2)$ stand for the cumulative probability of the standard normal distribution for the values d_1 and d_2 . The variables d_1 and d_2 are in principle the z values of a standard normal distribution. X is the strike price. In $e^{r_c T}$, r_c stands for the continuously compounded interest rate and T is the time to expiration as a fraction of the year. If all other variables remain unchanged (*ceteris paribus*), the effect of an interest rate is the following. An increase in interest rates will result in a higher estimated option price while a decrease will result in a lower estimated option price. Based on the BSM formula the relationship between the call option price and the underlying stock price is positive. This means, *ceteris paribus*, that an increase in the stock price is associated with an increase in the call option price and vice versa. Based on this assumption we can say that an increase in interest rates is associated with an increase in the stock price and a decrease in interest rates is associated with a decrease in stock prices. Stock and option prices in reality do not operate in the conditions “*ceteris paribus*”. The economic reality is much more complex and this assumed relationship might lose relevance in the economic reality.

The models chosen in this section were selected based on their differences. We wanted to provide an understanding of different theoretical approaches to the relationship between interest rates and asset prices. The simplest, yet most well-known CAPM model shows a non-unified relationship between interest rates and asset prices (stocks). The APM,

which is more complicated does not provide a straightforward answer either. The relationship between interest rates and asset prices varies based on the factors chosen in the APM. The BSM supports a positive relationship between interest rates and asset prices if certain assumptions are fulfilled. These results show, that even in different asset pricing models there is no consensus on the relationship between interest rates and asset prices. The complexity of real stock price movements makes it hard to establish a uniform relationship with interest rates, which is also presented on an empirical level in the next section.

1.2.2 Empirical evidence

1.2.2.1 Interest rates sensitivity of the stock market

The effects of interest rates on the stock market have been researched extensively using different methods, time periods, and variables. In this section, we provide a brief overview of the existing literature and compare the results achieved. Ioannidis and Kontonikas (2006) studied the effect of monetary policy on stock returns. They researched this effect in thirteen OECD countries for the time period 1972-2002 using monthly data. The results show a significant effect of monetary policy shifts on the stock market with 80% of the countries researched in the study showing a decline in the stock market in times of restrictive monetary policy. The short-term interest rates are proxied by the three-month Treasury Bill rate. The authors also employ an alternative proxy, a binary dummy variable that is based upon changes in the discount rate. Bernanke, Kuttner (2005) show similar results while using different variables. They use the federal funds futures data to gauge policy expectations and a broad stock market measure, the CRSP value-weighted index. The results show, that a surprise rate cut of 25 basis points leads to an increase of one percent in stock prices. The results of this study are robust to the exclusion of outliers. Assefa, Esqueda, Mollick (2017) used dynamic panel data for 40 countries over the period of 1999-2013. They found a statistically significant negative effect of interest rates on the stock market in developed countries. Based on a System Generalized Method of Moments (SGMM) model a 10% increase in interest rates would result in a 1% decrease in stock returns if all else remains constant. A similar research to the ones already mentioned conducted on a different set of countries shows similar results- a significant and negative relationship between interest rates and share prices (Alam and Uddin, 2009). The coefficients of the independent variable, which is the interest rate represented by the Bank Deposit Rate, when using fixed effects, is -2,08 for one-way fixed effects and -0,95 for two-way fixed effects. All of these studies support the underlying theory that lowering interest rates leads to higher capital flows and therefore more money goes into the stock market. As a result of this, the prices of stocks rise. In case of rate hikes, investors move

away from stocks and move towards bonds or other types of savings. The hypothesis, by which the stock market and interest rates have a negative relationship was supported broadly by many other authors (Modigliani, 1971; Mishkin, 1977; Thorbecke, 1997; Conover, Jensen and Johnson, 1999; Basistha and Kurov, 2008). These findings are important from the viewpoint of monetary policymakers as they have the tools to alter the direction in which the markets are moving. There is an ongoing debate on whether monetary authorities should act proactively or reactively. Both, a proactive and a reactive approach can be useful if it is used correctly and the important foundation for them is that the stock market can be influenced by monetary policy (Ioannidis and Kontonikas, 2006).

Contradicting most empirical research, there are some studies that have found a positive relationship between interest rates and the stock market. Eldomiaty et al. (2019) used quarterly data for non-financial stocks from the NASDAQ100 and DJIA30 for the period 1999-2016. The interest rate used was the interest rate on T-bills. Their regression model presented a coefficient of changes in stock prices caused by interest rates which was significant with a positive value of 0,0147. Lee (1997) also finds a positive relationship between stock prices and interest rates, however, this is only true for a certain part of the research period.

The discrepancy between these findings can be explained by various factors. Stocks, to an extent, tend to follow a random walk. By this hypothesis, the movements in the price of stocks are random and not predictable. This hypothesis was supported by various authors including Shiller (1989), who provides evidence for the randomness of stock price movements. Other authors including Fama (1965) and Samuelson (1965) also did not reject the random walk argument. Other research, however, found evidence that stock returns do not follow a random walk (Lo and MacKinlay, 1988; Poshakwale, 1996). Based on the different results, the random walk argument can explain the discrepancy to some extent, but should not be binding. Rather than the random walk argument, we lean towards the fact, that the stock market is a complex mechanism influenced by different factors, not only from the monetary decisions and other economic factors. One example of external factors influencing the relationship between stock prices and interest rates is financial crises. Kontonikas, MacDonald and Saggi (2013) examined the impact of the Federal Funds rate surprises on the U.S. stock market over the period 1989-2009. While in the pre-crisis period, an expansionary monetary surprise consisting of a 100 basis-point cut was associated with a 4% increase in the S&P 500, during the financial crisis some estimates indicate a statistically significant and negative response of the stock market to expansionary monetary policy- interest rate cuts. These results show the limits of conventional monetary policy when interest rates are at the zero lower bound. They also indicate that investor behaviour patterns change in normal and crisis times. While in times

of global economic stability the hypothesis that monetary expansion results in an increase in prices on the stock market, this might not be the case during crises. Investors might see expansionary monetary policies as confirmations of crises and therefore react negatively, in agreement with the results of Kontonikas, MacDonald and Saggiu (2013).

1.2.2.2 Interest rates sensitivity of growth and value stocks

For a more in-depth understanding of the connections between interest rates and segments of the stock market, an overview of the economic literature on the effects of interest rates on growth and value stocks is beneficial. The main difference between value and growth stocks is the ratio of price to the fundamental value. Value stocks have a lower ratio of price to fundamental value and growth stocks are known to have a higher ratio of price to the fundamental value. The performance of both groups of stocks has been studied repeatedly with most authors agreeing on the fact that value stocks tend to outperform growth stocks (DeBondt and Thaler, 1985; Fama and French, 2012). Christian, Woltering and Sebastian (2017) analysed how interest rates affect the returns of value and growth stocks on a global sample of 487 companies in 24 countries. The size of the sample offers large heterogeneity, which is beneficial for the credibility of the findings. They found, that value stocks tend to be more sensitive to short-term interest rates. Growth stocks, on the other hand, are more sensitive the changes in long-term interest rates. The higher sensitivity of value stocks to short-term interest rates was also confirmed by Lioui and Maio (2014), who concluded that value stocks have a stronger interest rate risk, compared to growth stocks. Their research finds that value stocks load negatively on monetary policy, which was represented by the federal funds rate and the short-term 3-month T-bill rate. Value stocks are often characterized as past losers and growth stocks as past winners. Based on these the higher interest rate sensitivity of value stocks might be to some extent caused by the worsening financial situation of such "loser" stocks which can lead to negative shocks in their cash flows, which are sensitive to changes in interest rates. This argument is mentioned by Lioui and Maio (2014) to some extent. Christian, Woltering and Sebastian (2017), however, present a different approach to explaining the interest rate sensitivity difference between growth and value stock. Based on value stocks having a larger price-to-earnings ratio they have higher dividend yields. When short-term interest rates fall, investors seek value stocks because, in the short term, they are able to generate higher dividend income.

1.2.2.3 Interest rates sensitivity of different industry sectors

Historical examples of stock market reactions as well as the difference between the reaction of value and growth stocks to changes in interest rates provide a basis for the understanding of industry-specific effects of interest rates. The stock market as a whole is, as supported by previous studies, affected by changes in interest rates. Industry-level interest rate sensitivity can be useful for investors as it can provide valuable information for choosing the right investing strategy. González, Jareño and Skinner (2017) have studied the industry-level interest rate sensitivity. They used monthly data from 1989 to 2014 and classified the industries based on the Global Industry Classification Standard. The study provides great insight and in-depth analysis as it not only analyses the sample period as a whole but also analysis sub-periods of expansions and recessions. While most sectors react in line with the general stock market, some industries show different results. The diversified metals and mining industry shows a significant and positive relationship between the returns in the sector and unexpected changes in nominal interest rates. This relationship holds for the whole sample period and it holds even for sub-periods of recessions and expansions. In agreement with the authors, we conclude that such a relationship can make stock from this sector interesting for investors as they act like a safe haven against unexpected changes in nominal interest rates. Another finding made by González, Jareño and Skinner (2017) was that the industries of integrated oil and gas as well as the diversified metals have a significant positive relationship between returns and the unexpected changes in the real interest rate. Another study conducted by Conover et al. (2005) uses a different classification of industry sectors, for which the authors analysed sector returns over periods of monetary expansions and restrictions. They analysed annual sector returns for the period 1973-2001, for which restrictive and expansive periods were specified. The results show that cyclical stocks, specifically cyclical consumer goods and cyclical services show are greatly influenced by monetary policy changes as they show above-average returns in expansionary periods and below-average returns during restrictive periods. Another industry that shows similar results is the information technology sector which also shows great interest rate/monetary policy sensitivity. In restrictive periods the annual return of the information technology sector was below average while in times of expansion, the returns were above average. Among the sectors with the lowest interest rate sensitivity, we can find resources, noncyclical consumer goods and utilities. These findings can be useful for investors, which can incorporate the historical data into the approach they choose while constructing a portfolio. Generally, if an expansionary period is expected, the more sensitive market sectors seem more lucrative but in times of uncertainty or for a long-term investment horizon the sectors with lower interest rate sensitivity might present a better choice. Bernanke and Kuttner (2005) also

studied the interest rate sensitivity of different market sectors. They used a different approach where the monthly sector returns for the period 1989-2002 were compared to the one-month change in the federal funds rate. The authors also distinguished anticipated and unanticipated interest rate changes. The response of each sector to anticipated changes in the federal funds rate is generally lower than to unanticipated changes. This is mostly due to the fact that investors pay close attention to the monetary authorities and the representatives, which announce these changes. Therefore, any signs of interest rate changes are to some extent already accounted for in the prices of stocks at the moment of the actual change of the rate. The results show that for unanticipated changes the highest interest rate sensitivity is among stocks from the high-tech and telecommunications sector. The sectors that are the most resistant towards unanticipated interest rate changes are the energy and utilities sectors. The implications for investors are similar to the ones mentioned when discussing the work of Conover et al. (2005). Both studies (Bernanke and Kuttner, 2005; Conover et al., 2005) have some similar findings. In both cases, the utility sector is among the least sensitive to interest rate changes even though both studies use different methodologies of research. As for interest rate-sensitive sectors, both studies have found the technology sector as one of the most sensitive ones however, due to a different classification they are not exactly identical. These similarities give investors even more reason to consider the relationship between changes in interest rates and these sectors when constructing a portfolio. Conover et al. (2005) also use a different classification of stocks, which does not divide stocks into specific industries but rather categorize stocks based on market capitalisation and style (growth/value) we find the results valuable in the context of industry-based research. The reason for that is that with the knowledge of the interest rate sensitivity of both the specific industry and the capitalisation plus value/growth features of stocks, we can construct portfolios even more accurately. The findings of Conover et al. (2005) show that small-value stocks are generally associated with the highest yearly return both for restrictive periods and expansive periods. These stocks in combination with the right industry sector, based on historical information, might generate above-market returns.

The literature discussed in this section provides valuable information on the relationship between interest rates and stocks, whether they focus on the market as a whole, sectors or industries. Most studies show a negative relationship between interest rate changes, especially unexpected changes and stock returns. This relationship also depends on other economic factors. Recessions and crises periods create uncertainty in the financial markets and during these periods the relationship might change in line with the literature discussed previously. After the 2007-2008 financial crisis new policy tools were introduced with interest rates being at the lower-zero bound.

We want to contribute to existing literature with a sector-level analysis that incorporates not only pre-crisis times but a long time period after the financial crisis of 2007-2008 as well. A sector review in a world of new unconventional monetary tools being introduced might present results that are contradicting most existing research from older time periods.

2 DATA & METHODOLOGY

2.1 Research questions and hypotheses

Based on the existing literature discussed in the previous section we state our research question: "How do unexpected changes in the federal funds rate influence stock returns on a sector level? Is the relationship between interest rates and stock returns still significant in times of unconventional monetary policy?"

Our research questions build on the existing literature and the results it shows. While the widely accepted negative relationship between stock returns and interest rates was confirmed repeatedly, it is unclear if this still holds in present times. This uncertainty largely shapes the hypotheses that we aim to either accept or reject. The hypotheses of this study are:

H₁: The relationship between stock returns measured by the S&P 500 and the unexpected change in the federal funds rate is negative and significant over the full sample period for both daily and monthly returns.

H₂: The statistically significant sector returns over all sample periods (separately) remain consistent on the daily and monthly basis. If a sector shows a positive (negative) relationship to unexpected changes in the federal funds rate on the daily basis then it will show a positive (negative) relationship on the monthly basis as well.

H₃: The overall statistical significance of the negative relationship between sector returns and the unexpected change in the federal funds rate, measured by the number of statistically significant models, is the highest over the expansion sub-periods.

H₄: The relationship between the S&P500 as well as all other sectors and the unexpected change in the federal funds rate is insignificant over the recession sub-periods.

While in times before the financial crisis of 2007-2008, interest rates were the primary tool of central banks, in the US of the Federal Reserve to react to macro-economic development after the financial crisis a new era began. In some countries, such as Japan, unconventional monetary policies existed also prior to the financial crisis, however in the US, unconventional monetary policies (UMPs) were first implemented in reaction to the financial crisis of 2007-2008. This included multiple quantitative easing (QE) programmes announced during the crisis but also in later years. These QE programmes include massive purchases by the FED, which were previously non-existent. The introduction of UMPs changed the way interest rate decisions are viewed by investors as there is a new variable

(UMPs) influencing the markets. Several asset purchasing and lending programmes were implemented also during the 2020 recession caused by Covid-19, which were aimed to lower the effects of the Covid-19 crisis on the economy. Even though times of recession recognized by the National Bureau of Economic Research (NBER) are not the only times of UMPs being present in the US, they are usually the drivers for the FED to implement UMPs. The research questions, as well as the hypotheses stated above both reflect this new economic reality and are aimed to answer some of the assumptions we make about the relationship between unexpected interest rate changes and stock returns.

For H_1 we assume that the negative and significant relationship between the S&P 500 and the unexpected change in the federal funds rate holds in our full sample period. As our time period consists of more than 90% expansions we believe, that the relationship that has been accepted by numerous previous papers (Modigliani, 1971; Mishkin, 1977; Thorbecke, 1997; Conover, Jensen and Johnson, 1999; Basistha and Kurov, 2008). Because UMPs are mostly implemented in times of crises and recessions we believe that the whole sample is not affected by these policies to an extent that would cause the relationship to be either positive or insignificant.

The H_2 is more questionable as the results for sectors may vary on a daily and monthly basis. We want to establish a relationship that shows that the daily and monthly results show results of the same direction. This is a hypothetical assumption as there are many factors making the daily and monthly results different. As the time period from the actual rate decision is longer for the monthly observations, there is more room for other factors to weigh on the stock returns. In some cases, multiple rate changes happen within a 1-month period. This can also alter the results in comparison to the daily results.

H_3 builds on the inclusion of UMPs that is discussed above. As most of the UMPs occur during recessions and crises, the hypothesis builds on this fact. As the relationship between unexpected interest rate changes and stock returns is mostly significant and negative in the pre-UMP era, we believe that it is most likely that this relationship holds during our sub-period of economic expansion.

On the other hand, we believe there is a high probability that mainly because of the presence of UMPs the statistical significance of the results will be lower during our recession sub-period. We assume this in our H_4 . Not only do we believe that the UMPs can negatively affect the significance of the results but we also believe, that investors react differently to unexpected interest rate changes in normal times and in times of higher economic uncertainty. Kontonikas, MacDonald and Saggi (2013) conduct a similar research to ours

for a time period from 1989 to 2009. Their results for the relationship between the S&P 500 and the unexpected change in the federal funds rate on the full sample period show an insignificant result, but with the exclusion of the 2007-2008 financial crisis, the results are statistically significant. Hence, it appears that the crisis period being included in the sample leads to statistically insignificant results. In our recession sub-period, we include different crises periods and therefore assume, that the results are likely to be insignificant.

2.2 Data

For establishing a relationship between stock sector returns and unexpected changes in the federal funds rate we first describe the data used to calculate these variables. The data used for further calculation and econometric modeling include the time period, the S&P 500 and its sectoral daily prices and federal funds rate data.

The time period of our analysis is between June 1999 and February 2023. This period is chosen for two main reasons. The first reason is that it incorporates the last three recessions of the US economy based on the National Bureau of Economic Research (NBER's) classification. The inclusion of these sub-periods is important because as Gonzáles, Jareño and Skinner (2017) we assume that the state of the economy in which interest rate decisions are made has an impact on how the markets react to these decisions, specifically to their unexpected component. The sub-periods of our research can be divided into expansion sub-periods and recession sub-periods. The expansion sub-periods are June 1999 - March 2001, February 2001 - December 2007, July 2009 - February 2020 and May 2020 - February 2023 with a total of 257 months. The recession sub-periods are April 2001 - November 2001, January 2008 - June 2009, March 2020 - April 2020 totaling 28 months. Based on these results we see that recessions only account for 9,82% of the whole period but can play a very important role in the research design and therefore it is important to include them. The second reason for choosing this period specifically is the data availability for certain variables.

Next, we obtain data on the federal funds rate and the federal funds futures. The federal funds rate data are obtained directly from the Federal Reserve. We obtained the dates of the rate decisions for our chosen time period as well as the magnitude of the change happening on these decision days. During our time period, there are 67 rate changes with 40 being contractionary (rate hikes) and 27 being expansionary (rate cuts). The 17 September 2001 target rate announcement, which took place on the first day of trading after the 11 September 2001 terrorist attacks is excluded. This exclusion is done in agreement with previous studies (Jansen and Tsai, 2010; Kontonikas, MacDonald and Saggiu, 2013). Next, we obtain data for the thirty-day fed funds futures from Stooq cross-

checked with data from Yahoo Finance to ensure data accuracy. The data for the thirty-day fed funds futures include closing prices on the day before the rate decision and the closing price on the day when the rate is decided. The change in the price of the futures contract on the day of the FOMC decision relative to the price on the day before the decision, after being scaled by a factor related to the number of days in a month that were affected by this change gives us the unexpected component of the target rate change Δi_t^u :

$$\Delta i_t^u = \frac{D}{D-d} (f_{m,t} - f_{m,t-1}) ,$$

where Δi_t^u stands for the unexpected component of the change in the federal funds rate change, $f_{m,t}$ is the current-month thirty-day fed funds futures (100 minus the futures closing price on the day of the decision), $f_{m,t-1}$ is the current-month thirty-day fed funds futures (100 minus the futures closing price on the day prior to the decision). $\frac{D}{D-d}$ is the scaling factor, where D is the number of days in the month, in which the decision was made and d is the day of the change. The calculation of the unexpected component of the target rate change Δi_t^u is in line with Bernanke, Kuttner (2005) and Kontonikas, MacDonald and Saggiu (2013). Both of these papers use the same calculation and define it in more detail. The methodology behind the scaling excludes the interest rate changes that are decided within the last three days of the month in order to minimize the effects of any noise at the end of the month. Another adjustment is made when the interest rate change falls on the first day of the month. In that case the prices of the last trading day of the previous month are used instead of $f_{m,t}$ and the day before that is used instead of $f_{m,t-1}$. The scaling is needed because the thirty-day federal funds futures are based on the monthly average federal funds rate.

Once having deconstructed the methodology behind the calculation of the unexpected component of the target rate change, we can look at the descriptive statistics for both the unexpected component and the actual rate changes.

Table 1: Descriptive statistics for FFR changes and unexpected changes

	Obs	Min	Max	Mean	St.Dev
All changes					
Δi	67	-1,000	0,750	-0,002	0,437
Δi^u	67	-0,741	0,240	-0,035	0,167
Contractionary					
$\Delta i > 0$	40	0,250	0,750	0,319	0,160
Δi^u	40	-0,111	0,240	0,030	0,082
Expansionary					
$\Delta i < 0$	27	-1,000	-0,250	-0,477	0,230
Δi^u	27	-0,741	0,167	-0,132	0,212

Source: Own processing in Microsoft Excel (2023)

The descriptive statistics from Table 1 show that in our research period, there are 67 rate changes. When looking at the descriptive statistics for all the changes we observe a range from -1 percentage point to 0,75 percentage points. We can see that in all three cases (all changes, contractionary, expansionary) the standard deviation of the unexpected component is smaller than the standard deviation of the actual change. This indicates that, generally, some part of the change is already priced in and expected by the market which shows the importance of calculating the unexpected component and using it in our research instead of using the data from the actual change. Even in cases of contractionary times, we see that the unexpected component can be negative. This happens when the expected change in the federal funds rate is higher than the actual change. A similar observation can be concluded from the expansionary data statistics, as we observe positive values of the unexpected component here while all actual rate changes are negative. Such a scenario arises when the actual rate cut is lower than it was expected by the thirty-day fed funds futures. The employment of the unexpected component of the federal funds rate change shows, that the direction of the actual change (whether it is contractionary or expansionary) might not be as relevant for stock returns. What is relevant is how this change differs from market anticipations.

The data collected to calculate the returns of the S&P 500 and the sectoral returns are based on the closing prices of exchange-traded funds (ETFs). The ETF chosen to represent the S&P 500 is the SPDR S&P 500 ETF Trust (ticker SPY). All of the sectoral SPDR ETFs chosen are administered by State Street Global Advisors Funds Management Inc. and the investment manager of these ETFs is the SSGA Funds Management, Inc. Two sectors are excluded from this study because of the lack of data which results from their late inception. One is the real estate sector, for which the corresponding ETF was only incepted in 2015 and the second one is the communication services sector which was incepted in 2018. The data for all the remaining sectors as well as for the SPY ETF is acquired from

Yahoo Finance. These ETFs are chosen to represent the sectors of the S&P 500 as they are well known and have good data availability for a long enough time period. These are the data mentioned earlier that also play a role in the time period selection as all of the sectoral ETFs used were incepted in December 1998. As the first date of a change in the federal funds rate after this inception is only on June 1999 that is where our time period starts.

2.3 Research methods

Before describing the research methodology and the econometric models used, we must describe how the data was adjusted for our econometric modeling. In the data section, we show how the unexpected component of the federal funds rate change used in our model is calculated. Now we describe how we calculate the returns for both the S&P 500 and its sectors on a daily returns basis in line with Kontonikas, MacDonald and Saggiu (2013):

$$r_{i,t} = 100 * (\ln S_{i,t} - \ln S_{i,t-1}) ,$$

where $r_{i,t}$ represents the daily returns on asset i defined as the difference of natural logarithms for the closing price $S_{i,t}$ on the day of the interest rate decision and the price on the previous trading day $S_{i,t-1}$.

The monthly returns we use in our models are calculated similarly:

$$r_{i,m+1,t} = 100 * (\ln S_{i,m+1,t} - \ln S_{i,m,t-1}) ,$$

where $r_{i,m+1,t}$ represents the monthly returns on asset i defined as the difference of natural logarithms for the closing price $S_{i,m+1,t}$ one month after the interest rate decision and the price on the trading day previous to the interest rate decision $S_{i,m,t-1}$.

Having calculated the returns and the unexpected component of the interest rate change, we present an overview of variables used in our models:

Table 2: Model variables defined and data sources

Variable	Description	Data source
UNEXPECTED_COMPONENT	The unexpected component of the Federal Funds Rate change	Stooq (2023)
SP500_DAILY	S&P 500 daily returns calculated from the SPRD S&P 500 ETF	Yahoo Finance (2023)
INDUSTRIALS_DAILY	Industrial sector daily returns calculated from the Industrial Select Sector SPRD ETF	Yahoo Finance (2023)
MATERIALS_DAILY	Materials sector daily returns calculated from the Materials Select Sector SPRD ETF	Yahoo Finance (2023)
UTILITIES_DAILY	Utilities sector daily returns calculated from the Utilities Select Sector SPRD ETF	Yahoo Finance (2023)
HEALTHCARE_DAILY	Health Care sector daily returns calculated from the Health Care Select Sector SPRD ETF	Yahoo Finance (2023)
ENERGY_DAILY	Energy sector daily returns calculated from the Energy Select Sector SPRD ETF	Yahoo Finance (2023)
FINANCIALS_DAILY	Financial sector daily returns calculated from the Financial Select Sector SPRD ETF	Yahoo Finance (2023)
TECHNOLOGY_DAILY	Technology sector daily returns calculated from the Technology Select Sector SPRD ETF	Yahoo Finance (2023)
CONSUMERSTAPLES_DAILY	Consumer Staples sector daily returns calculated from the Consumer Staples Select Sector SPRD ETF	Yahoo Finance (2023)
CONSUMERDISCRETIONARY_DAILY	Consumer Discretionary sector daily returns calculated from the Consumer Discretionary Select Sector SPRD ETF	Yahoo Finance (2023)
UNEXPECTED_COMPONENT	The unexpected component of the Federal Funds Rate change	Stooq (2023)
SP500_MONTHLY	S&P 500 monthly returns calculated from the SPRD S&P 500 ETF	Yahoo Finance (2023)
INDUSTRIALS_MONTHLY	Industrial sector monthly returns calculated from the Industrial Select Sector SPRD ETF	Yahoo Finance (2023)
MATERIALS_MONTHLY	Materials sector monthly returns calculated from the Materials Select Sector SPRD ETF	Yahoo Finance (2023)
UTILITIES_MONTHLY	Utilities sector monthly returns calculated from the Utilities Select Sector SPRD ETF	Yahoo Finance (2023)
HEALTHCARE_MONTHLY	Health Care sector monthly returns calculated from the Health Care Select Sector SPRD ETF	Yahoo Finance (2023)
ENERGY_MONTHLY	Energy sector monthly returns calculated from the Energy Select Sector SPRD ETF	Yahoo Finance (2023)
FINANCIALS_MONTHLY	Financial sector monthly returns calculated from the Financial Select Sector SPRD ETF	Yahoo Finance (2023)
TECHNOLOGY_MONTHLY	Technology sector monthly returns calculated from the Technology Select Sector SPRD ETF	Yahoo Finance (2023)
CONSUMERSTAPLES_MONTHLY	Consumer Staples sector monthly returns calculated from the Consumer Staples Select Sector SPRD ETF	Yahoo Finance (2023)
CONSUMERDISCRETIONARY_MONTHLY	Consumer Discretionary sector monthly returns calculated from the Consumer Discretionary Select Sector SPRD ETF	Yahoo Finance (2023)

Source: Own processing in Microsoft Excel 2023

Our empirical research is done by regressing the returns for both the S&P 500 and its sectors ($r_{i,t}$) on a constant (α) and the unexpected component of the federal funds rate change (Δi_t^u) with an error term ($e_{i,t}$) in line with the methodology used by Kontonikas, MacDonald and Saggiu (2013):

$$r_{i,t} = \alpha + \beta \Delta i_t^u + e_{i,t},$$

The data for our models is categorized as time-series. As we work with a methodology similar to the one implemented by Kontonikas, MacDonald and Saggiu (2013) we use Ordinary Least Squares (OLS) models to estimate our results. We include heteroskedasticity and autocorrelation consistent HAC robust standard errors in all of our observed models. The OLS model methodology is used in a variety of papers researching the relationship between interest rates and stock returns (Ioannidis and Kontonikas, 2006; Alam and Uddin, 2009; Gonzáles, Jareño and Skinner, 2017) and is one of the most common models for regressions of this type. In line with our research question and the studies that used the OLS models previously, we see it as the best option for our research. The error term $e_{i,t}$ represents all other factors than interest rate decisions that affect the stock returns of our dependent variables both for the daily and monthly observations. In

line with Bernanke, Kuttner (2005), we assume the factors represented by the error term $e_{i,t}$ to be orthogonal to the unexpected component of the federal funds rate change.

3 RESULTS AND FINDINGS

In our regressions, we analyse three different time periods. The first is the full sample period with 67 observations. For this period, we estimate 20 OLS models, one for each of the return variables shown in table 2. Similarly, we estimate OLS models for sub-periods of recessions and expansions. The results are presented and discussed followingly: First, we look at the results for the whole sample period in table 3. Table 4 shows the results for the expansion sub-period. Finally, we look at the results in table 5 to discuss the results for the recession sub-period.

3.1 Full sample results and findings

The results for our full-sample OLS regressions are summarized in table 3:

Table 3: Response of S&P500 returns by sector (full sample period), OLS estimates

Independent variable:		UNEXPECTED_COMPONENT							
Time period:		6/1999-2/2023							
Dependent variables	Obs	α	β	Adj R^2	Dependent variables	Obs	α	β	Adj R^2
SP500_DAILY	67	-0,159638	-1,081000	-0,008748	SP500_MONTHLY	67	-0,530016	3,859200	-0,001802
INDUSTRIALS_DAILY	67	-0,059626	-2,053250	0,006500	INDUSTRIALS_MONTHLY	67	-0,848565	1,349050	-0,014304
MATERIALS_DAILY	67	0,028438	-2,381030	0,012614	MATERIALS_MONTHLY	67	-0,725960	-3,547190	-0,009477
UTILITIES_DAILY	67	-0,148722	2,364300	0,024362	UTILITIES_MONTHLY	67	0,333150	5,841660	0,020405
HEALTHCARE_DAILY	67	0,020984	-0,484102	-0,013931	HEALTHCARE_MONTHLY	67	0,066609	-0,930238	-0,014651
ENERGY_DAILY	67	-0,168991	1,194500	-0,009309	ENERGY_MONTHLY	67	0,221663	2,651700	-0,012971
FINANCIALS_DAILY	67	-0,241937	-1,933930	-0,004864	FINANCIALS_MONTHLY	67	-2,45975**	6,375410	0,412000
TECHNOLOGY_DAILY	67	-0,178841	-3,023860	0,006106	TECHNOLOGY_MONTHLY	67	-0,157153	8,159150	0,009121
CONSUMERSTAPLES_DAILY	67	-0,254620	1,706660	0,021400	CONSUMERSTAPLES_MONTHLY	67	-0,096123	-0,039598	-0,015382
CONSUMERDISCRETIONARY_DAILY	67	-0,142490	-4,03614**	0,043377	CONSUMERDISCRETIONARY_MONTHLY	67	-1,204640	-0,791164	-0,015065

Source: Own Analysis in Gretl processed in Microsoft Excel 2023

In the full-sample period of June 1999 to February 2023, we analyse 67 observations both in the context of daily and monthly returns. From table 3 we can see that from all the observations that examined the relationship between the unexpected component of the federal funds rate change and the S&P 500 daily sector returns only one sector is show statistically significant results. The consumer discretionary sector shows a negative statistically significant relationship on the 5% level (* indicates statistical significance at the 10% level, ** indicate statistical significance at the 5% level and *** indicates statistical significance at the 1% level). As both the independent and the dependent variable data are in a percentage format, the interpretation of the results is in percentage points. For the consumer discretionary sector a 1 percentage point increase in the unexpected component of the federal funds rate results in a decrease of 4,036 percentage points in the sector returns (ceteris paribus). This result is in line with the negative relationship between interest rates and stock returns that was confirmed by various researchers ((Modigliani, 1971; Mishkin, 1977; Thorbecke, 1997; Conover, Jensen and Johnson, 1999; Basistha and Kurov, 2008). The negative relationship is, however,

the main assumption of our H_1 hypothesis for the S&P 500. The results do not support this hypothesis in either the daily or the monthly results. The monthly results show an insignificant positive relationship which is the opposite of our H_1 hypothesis therefore we reject the H_1 hypothesis. We anticipated that a period covering mostly times of expansion would confirm the negative significant relationship. However, there are studies showing a significant positive relationship such as Eldomiaty et al. (2019). The research period of this study is 1999-2016 and it does not follow the S&P 500 but non-financial stocks from the NASDAQ100 and DJIA30. Even though the research variables are different it shows, that the theory of UMPs having an effect on the negative relationship between stocks and interest rates can have some relevance as the study conducts research until 2016. Kontonikas, MacDonald and Saggiu (2013) find an insignificant result using a methodology very similar to ours for their full period of 1989-2009. Both these studies and our results indicate that the negative significant relationship between the unexpected component of the federal funds rate change and stock returns is less straightforward in present times of UMPs. All other variables that represent the sector returns are insignificant both on a daily and monthly return basis (with the exception of consumer discretionary daily returns). The R^2 , which represents the coefficient of determination is also low throughout the results. The coefficient of determination represents the proportion of variation in the dependent variable explained by the independent variables. As our models only have one independent variable, it was expected that the R^2 would be low but we can still see that the highest R^2 is associated with the only significant result for this time period. In our H_2 hypothesis, we look at the consistency of each sector on a daily and monthly basis. As the consumer discretionary sector in the daily observations is the only statistically significant sector we conclude that the hypothesis holds partially. The reason is that the monthly results observed for the consumer discretionary sector also show a negative relationship, however, this result is statistically insignificant.

3.2 Expansion sub-periods results and findings

The sub-period of expansions classified by the National Bureau of Economic Research (NBER) includes 52 observations for both the daily and monthly models. The results for this sub-period can be found in table 4.

Table 4: Response of S&P500 returns by sector (Expansion sub-periods), OLS estimates

Independent variable: UNEXPECTED_COMPONENT									
Time period: 6/1999-2/2023									
Dependent variables	Obs	α	β	Adj R^2	Dependent variables	Obs	α	β	Adj R^2
SP500_DAILY	52	-0,059179	-2,94338*	0,049186	SP500_MONTHLY	52	-0,168559	5,881900	0,020983
INDUSTRIALS_DAILY	52	-0,083838	-3,45978**	0,066026	INDUSTRIALS_MONTHLY	52	-0,436362	4,698930	-0,001165
MATERIALS_DAILY	52	-0,081388	-3,71886**	0,069489	MATERIALS_MONTHLY	52	-0,747804	-0,792640	-0,019719
UTILITIES_DAILY	52	0,069979	0,069701	-0,019937	UTILITIES_MONTHLY	52	0,786401	1,160900	-0,018768
HEALTHCARE_DAILY	52	0,154836	-3,89026**	0,096100	HEALTHCARE_MONTHLY	52	0,418093	-3,403690	-0,008517
ENERGY_DAILY	52	-0,134161	-1,204430	-0,011695	ENERGY_MONTHLY	52	0,726509	-2,800810	-0,017356
FINANCIALS_DAILY	52	-0,158087	-2,713400	0,021344	FINANCIALS_MONTHLY	52	-1,084160	5,594040	-0,000668
TECHNOLOGY_DAILY	52	0,073203	-6,010220	0,066732	TECHNOLOGY_MONTHLY	52	0,086733	14,871000	0,053607
CONSUMERSTAPLES_DAILY	52	-0,166882	1,014230	-0,006961	CONSUMERSTAPLES_MONTHLY	52	-0,109397	-0,834485	-0,019092
CONSUMERDISCRETIONARY_DAILY	52	0,021008	-6,26837***	0,155745	CONSUMERDISCRETIONARY_MONTHLY	52	-0,832296	1,986290	-0,017570

Source: Own Analysis in Gretl processed in Microsoft Excel 2023

The daily results for the expansion sub-periods provide more statistically significant results than the daily results for the whole sample period. We can see that 5 of the 10 researched models in the daily observations show statistically significant results. The average R^2 is also higher compared to the daily results from the full sample period. This means that on average a larger proportion of variance in the dependent variable is explained by the independent variable in the model. The S&P 500 shows a significant negative relationship to the unexpected component of the federal funds rate change, as do the following sectors: industrials, materials, healthcare, and consumer discretionary. Out of these results, the S&P 500 is significant at the 10% level. All of the significant sectors are significant on the 5% level except the consumer discretionary which is significant on the 1% level. At the same time, this is the only sector that shows a significant negative relationship for both the full period and the sub-periods of expansion. Out of all the statistically significant sectors, the consumer discretionary sector is also the most responsive one with a 6,268-percentage point decrease as a reaction to a 1 percentage point increase in the unexpected component of the federal funds rate (*ceteris paribus*). Among the least responsive sectors, we can find the industrials sector that would decrease by 3,46 percentage points in reaction to a 1 percentage point increase in the unexpected component of the federal funds rate (*ceteris paribus*). The results of the monthly returns show no statistically significant results. In comparison to the daily results, this may be due to external factors influencing the price development in the monthly period. In some cases, there are more interest rate decisions within a month which can also influence the results. Our H_2 hypothesis can therefore not be fully accepted for any of the sectors, as no sector is statistically significant in both measured time periods. If we still consider the results, even if they are not statistically significant we get very mixed results with 3 results showing a positive relationship in the monthly returns period (S&P 500, industrials, consumer discretionary) while the other 2 (materials, healthcare) are in line with their statistically significant equivalents from the daily observations. These results are however not as relevant as statistical significance is missing.

Overall, we can say that the expansion sub-periods provide more statistically significant results confirming the negative relationship between the unexpected component of the federal funds rate change and stock sector returns. This supports the theory that UMPs weaken this relationship in modern times after the 2007-2008 financial crisis in the US as most UMPs are implemented in times of recession and crises or at least they originate in those times.

3.3 Recession sub-periods results and findings

The sub-period of recessions classified by the National Bureau of Economic Research (NBER) includes 15 observations for both the daily and monthly models. The results for this sub-period can be found in table 5.

Table 5: Response of S&P500 returns by sector (Recession sub-periods), OLS estimates

Independent variable: UNEXPECTED_COMPONENT									
Time period: 6/1999-2/2023									
Dependent variables	Obs	α	β	Adj R^2	Dependent variables	Obs	α	β	Adj R^2
SP500_DAILY	15	-0,330786	0,314281	-0,076577	SP500_MONTHLY	15	-2,703280	-2,694940	-0,072472
INDUSTRIALS_DAILY	15	0,312872	0,072181	-0,076906	INDUSTRIALS_MONTHLY	15	-3,513190	-7,509380	-0,056165
MATERIALS_DAILY	15	0,817894	0,570013	-0,075860	MATERIALS_MONTHLY	15	-1,108230	-6,968020	-0,057712
UTILITIES_DAILY	15	-0,835503	3,066930	-0,036112	UTILITIES_MONTHLY	15	-1,103520	7,198710	-0,017997
HEALTHCARE_DAILY	15	-0,041953	2,601920	-0,048336	HEALTHCARE_MONTHLY	15	-1,253940	-1,412130	-0,075725
ENERGY_DAILY	15	0,084683	4,004420	-0,033643	ENERGY_MONTHLY	15	-1,335890	4,480240	-0,071140
FINANCIALS_DAILY	15	-0,523151	-1,797580	-0,072140	FINANCIALS_MONTHLY	15	-9,21671*	-7,317570	-0,063973
TECHNOLOGY_DAILY	15	-0,909279	-1,760420	-0,071148	TECHNOLOGY_MONTHLY	15	-2,578160	-3,357590	-0,073121
CONSUMERSTAPLES_DAILY	15	-0,570867	1,685880	-0,046424	CONSUMERSTAPLES_MONTHLY	15	0,112343	1,157200	-0,073541
CONSUMERDISCRETIONARY_DAILY	15	-0,563644	-2,825130	-0,057772	CONSUMERDISCRETIONARY_MONTHLY	15	-3,567260	-8,463340	-0,051749

Source: Own Analysis in Gretl processed in Microsoft Excel 2023

The sub-periods of recession show statistically insignificant results for all of the OLS models described in this period. All sectors show insignificant results with very low (negative) R^2 . Based on these results we cannot establish either a positive or negative relationship between the dependent and independent variable in our models. However, these results are still valuable in terms of our hypotheses and the overall research. In our H_4 hypothesis, such non-significant results are anticipated and as they are in line with our hypothesis in all of its points we can accept our H_4 hypothesis. The biggest argument for the anticipation of such results is the presence of UMPs in two of our three recession periods. As there are only 15 observations for both the daily and monthly models, the statistical credibility of these models is reduced. However, when modeling the relationship between the unexpected component of the federal funds rate change and stock sector returns using the methodology we implement, there is no reason to stretch these periods artificially. Even with just a few observations, these findings support the ones made by Kontonikas,

MacDonald and Saggi (2013). Their study shows, that including the 2007-2008 financial crisis to their observed period the results of the relationship between the unexpected component of the federal funds rate change and the S&P 500 returns turns from significant and negative to insignificant. As for the H_3 hypothesis, which can be discussed after having shown the results for all of our research periods we conclude the following. The H_3 hypothesis is fully accepted as the expansions sub-period has the most significant models showing the negative relationship between the unexpected component of the federal funds rate change and stock sector returns. Five models showed statistically significant results in the expansion sub-period while only one model showed statistical significance on the 10% or lower level in the full sample period and no models showed statistical significance in the recessions sub-period.

Summarizing the results for all of our research periods we can say that all the models that are statistically significant support the negative relationship between the unexpected component of the federal funds rate change and stock returns and therefore are in line with the results of the majority of research done on this topic (Modigliani, 1971; Mishkin, 1977; Thorbecke, 1997; Conover, Jensen and Johnson, 1999; Basistha and Kurov, 2008). However, we must account for the fact that most of our results are statistically insignificant. This shows, that the relationship between the unexpected component of the federal funds rate change and stock returns, even when negative and significant in some cases, is not completely firm in times of UMPs that are present in the research period chosen for our research. This insignificance is more in line with the results of Kontonikas, MacDonald and Saggi (2013) for their time period that includes the 2007-2008 financial crisis.

4 DISCUSSION AND FUTURE RESEARCH

In this section, we start by discussing the possible limitations of our research and the way they can affect the validity of our results. Next, we move to our conclusion and recommendations following our research as well as providing some takeaways on how similar research could be done in the future.

4.1 Research limitations

Our research design is relatively simple with only one independent variable in our regression models. This can be viewed as a limitation as the inclusion of more relevant variables can improve the statistical significance of the model but also of the independent variables themselves. Another upside to the inclusion of more relevant variables is a potential increase in R^2 . Bernanke, Kuttner (2005) model two formulas in their paper. The first one only includes the raw change in the federal funds target rate as the independent variable while the other model breaks it down into the unexpected and expected component of the raw change. While the first model is not exactly the same as ours the result of the first model of Bernanke, Kuttner (2005) shows insignificant results while the second model shows a statistically significant negative relationship between the unexpected component of the interest rate change and stock returns. The second model has a higher R^2 as well. This study, therefore, supports the argument that adding more relevant independent variables can be beneficial for the research conducted.

Another limitation would be the failure of the assumption that the error term is orthogonal to the unexpected component of the federal funds rate change to hold. Bernanke, Kuttner (2005) describe cases, in which this could happen. One of the reasons that would result in a violation of this condition would be a contemporaneous response of the FED to the stock market. This means that the FED would react to contractions of the stock market by rate cuts or that it would increase rates in reaction to a bullish market. Another scenario for the failure of the orthogonality assumption would be a situation, in which both the stock market and the FED reacted jointly and contemporaneously to new information. An example of such a joint response is the reaction to the 17th September 2001 terrorist attacks when on the first trading day that followed after the attacks the FED announced a cut in the federal funds rate and the stock market dropped on that day in reaction to the attacks. This rate decision is however excluded from our observations. In some cases, the relationship between the stock market, the interest rate decisions and the information both the FED and the market react to is not so transparent. Therefore, it is

hard to successfully eliminate all observations that can be harmful to the model because of the reasons discussed above.

The data structure chosen for our research could also be seen as a limitation. We use the daily change in closing prices on the daily and monthly periods. However, an even shorter time period could result in distinguishing the impact of the policy change from other effects, such as news arriving before or later in the day/month. Gürkaynak et al. (2004) use intra-day data to eliminate as many external factors as possible. Their results are not very different from the ones obtained by daily observations but the intraday ones resulted in having a higher R^2 . The difference between the daily and intraday data might not be significant but if we compare the daily and monthly results there is more room for other factors to influence the price of equities on the monthly level.

The research methods adopted in this paper also do not consider outliers nor do we apply any mechanisms to identify outliers that could alter our results. The removal of outliers, if the methods are chosen correctly can improve the accuracy of the analysis conducted. Therefore, we recognise the absence of such a mechanism as a limitation of our research.

4.2 Conclusions

After recognizing some of the limitations of our research we can discuss the most important results. The research questions and hypotheses are focused on finding answers to how the relationship between the unexpected changes in the federal funds rate and sectoral returns of stocks has evolved in times of unconventional monetary policies. Our research provides interesting results that add to the body of literature that already exists on this topic. We summarize the statistically significant results in table 6.

Table 6: Response of S&P500 returns by sector (significant models), OLS estimates

Independent variable:		UNEXPECTED_COMPONENT			
Time period:		6/1999-2/2023			
Dependent variables	Sub-period	Obs	α	β	Adj \mathcal{R}^2
CONSUMERDISCRETIONARY_DAILY	Full sample period	67	-0,142490	-4,03614**	0,043377
SP500_DAILY	Expansion sub-periods	52	-0,059179	-2,94338*	0,049186
INDUSTRIALS_DAILY	Expansion sub-periods	52	-0,083838	-3,45978**	0,066026
MATERIALS_DAILY	Expansion sub-periods	52	-0,081388	-3,71886**	0,069489
HEALTHCARE_DAILY	Expansion sub-periods	52	0,154836	-3,89026**	0,096100
CONSUMERDISCRETIONARY_DAILY	Expansion sub-periods	52	0,021008	-6,26837**	0,155745

Source: Own Analysis in Gretl processed in Microsoft Excel 2023

From the 60 models estimated in our research for different sub-periods over the whole time period of 1999-2023, we can see only 6 show statistically significant results while all other models show an insignificant relationship between the unexpected changes in the federal funds rate and sectoral returns of stocks. All significant observations confirm the negative relationship between these variables, however, the number of insignificant models shows that the relationship is mostly insignificant in times of UMPs. This supports the findings of Kontonikas, MacDonald and Saggi (2013) who also found the relationship to be insignificant when including times of UMPs in their model. Implications for investors do not show a strong case for either sector. The only sector that shows statistical significance for both the expansion sub-periods and the whole period is the consumer discretionary sector measured on the basis of daily returns. Even this result provides little to no support for long-term investment decisions. The only straightforward implication is for trading, assuming that the trader analyses the size and the direction of the unexpected component of the interest rate change correctly before it happens. Even though our results do not find any concrete implications for investment strategies based on the relationships they examine the results are still interesting along the lines of empirical research conducted on the topic of interest rates and stock returns.

4.3 Implications for further research

Building on previous research as well as our research there are definitely interesting ways, which might be worth looking into in future research. Our research has a lot of limitations, as discussed above. Future research can build on our models and data and also implement new steps to assess the limitations our paper has. The model can be for example extended and can take into consideration shocks in unconventional monetary policies, even though these are harder to measure than interest rate changes. One way of measuring UMPs presented by Rosa (2012) is identifying the unexpected (surprise) component of asset purchases done by the FED by analysing related articles in the Financial Times. This approach, however, is not as clear as the calculation of the unexpected component of interest rate changes. Further researchers can design a methodology that would calculate the unexpected change in UMPs accurately and establish a model that would measure both the unexpected change in interest rates and in UMPs at the same time. Another direction, further research could take is to use a different model. Jareño et al. (2016) and Ferrando et al. (2017) use quantile regressions to estimate interest rate sensitivity. González, Jareño and Skinner (2017) argue that the quantile regression approach allows measuring the impact of interest rate sensitivity also at the tails of the distribution and not only at the centre which makes it a method that provides a more comprehensive characterization of the relationship.

REFERENCES

Alam, M.M., Uddin, M.G.S., 2009. Relationship Between Interest Rate and Stock Price: Empirical Evidence from Developed and Developing Countries. *International Journal of Business and Management*, 4(3). 10.5539/ijbm.v4n3p43.

Assefa, T.A., Esqueda, O.A., Mollick, A.V., 2017. Stock Returns and Interest Rates Around the World: A Panel Data Approach. *Journal of Economics and Business*, 89, pp.20–35. 10.1016/j.jeconbus.2016.10.001.

Basistha, A., Kurov, A., 2008. Macroeconomic Cycles and the Stock Market's Reaction to Monetary Policy. *Journal of Banking & Finance*, 32(12), pp.2606–2616. 10.1016/j.jbankfin.2008.05.012.

Bernakke, B.S., Kuttner, K.N., 2005. What Explains the Stock Market's Reaction to Federal Reserve Policy? *The Journal of Finance (New York)*, 60(3), pp.1221–1257. 10.1111/j.1540-6261.2005.00760.x.

Black, F., Scholes, M., 1973. The Pricing of Options and Corporate Liabilities. *The Journal of political economy*, 81(3), pp.637–654. 10.1086/260062.

Conover, C.M., Jensen, G.R., Johnson, R.R., 1999. Monetary Environments and International Stock Returns. *Journal of Banking & Finance*, 23(9), pp.1357–1381. 10.1016/S0378-4266(99)00007-2.

Conover, C.M., Jensen, G.R., Johnson, R.R., Mercer, J.M., 2005. Is Fed Policy Still Relevant for Investors? *Financial Analysts Journal*, 61(1), pp.70–79. 10.2469/faj.v61.n1.2685.

De Bond, W.F.M., Thaler, R., 1985. Does the Stock Market Overreact? *The Journal of Finance (New York)*, 40(3), pp.793–805. 10.1111/j.1540-6261.1985.tb05004.x.

Eldomiaty, T., Saeed, Y., Hammam, R., AboulSoud, S. L., 2020. The Associations Between Stock Prices, Inflation Rates, Interest Rates Are Still Persistent: Empirical Evidence from Stock Duration Model. *Journal of Economics, Finance and Administrative Science*, 25(49), pp.149–161. 10.1108/JEFAS-10-2018-0105.

Fama, E.F., 1965. The Behavior of Stock-Market Prices. *The Journal of business (Chicago, Ill.)*, 38(1), pp.34–105. 10.1086/294743.

Fama, E.F., French, K.R., 2004. The Capital Asset Pricing Model: Theory and Evidence. *The Journal of Economic Perspectives*, 18(3), pp.25–46. 10.1257/0895330042162430.

Fama, E.F., French, K.R., 2012. Size, Value, and Momentum in International Stock Returns. *Journal of Financial Economics*, 105(3), pp.457–472. 10.1016/j.jfineco.2012.05.011.

Ferrando, L., Ferrer, R., Jareño, F., 2017. Interest Rate Sensitivity of Spanish Industries: A Quantile Regression Approach: Interest Rate Sensitivity of Spanish Industries. *The Manchester school*, 85(2), pp.212–242. 10.1111/manc.12143.

González, M. D. L. O., Jareño, F., & Skinner, F. S. (2017). The Financial Crisis Impact: An Industry-level Analysis of the US Stock Market. *Applied Econometrics and International Development*, 17(2), pp. 61-74.

Gürkaynak, R., Sack, B., Swanson, E., 2004. Do Actions Speak Louder than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *IDEAS Working Paper Series from RePEc*.

Chance, D. M., & Brooks, R. 2011. Introduction to Derivatives and Risk Management. Cengage Learning.

Christian, W., Woltering, R. O., & Sebastian, S. (2017). The Interest Rate Sensitivity of Value and Growth Stocks-Evidence from Listed Real Estate. European Real Estate Society (ERES).

Ioannidis, C., Kontonikas, A., 2006. Monetary Policy and the Stock Market: Some International Evidence. IDEAS Working Paper Series from RePEc.

Jansen, D.W., Tsai, C.-L., 2010. Monetary Policy and Stock Returns: Financing Constraints and Asymmetries in Bull and Bear Markets. *Journal of Empirical Finance*, 17(5), pp.981–990. 10.1016/j.jempfin.2010.08.002.

Jareño, F., Ferrer, R., Miroslavova, S., 2016. US Stock Market Sensitivity to Interest and Inflation Rates: a Quantile Regression Approach. *Applied Economics*, 48(26), pp.2469–2481. 10.1080/00036846.2015.1122735.

Kontonikas, A., MacDonald, R., Saggiu, A., 2013. Stock Market Reaction to Fed Funds Rate Surprises: State Dependence and the Financial Crisis. *Journal of Banking & Finance*, 37(11), pp.4025–4037. 10.1016/j.jbankfin.2013.06.010.

Krause, A., 2001. An Overview of Asset Pricing Models. University of Bath School of Management. UK.

Lee, W., 1997. Market Timing and Short-Term Interest Rates. *Journal of Portfolio Management*, 23(3), pp.35–46. 10.3905/jpm.1997.409604.

Lintner, J., 1965. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics*, 47(1), pp.13–37. 10.2307/1924119.

Lioui, A., Maio, P., 2014. Interest Rate Risk and the Cross Section of Stock Returns. *Journal of Financial and Quantitative Analysis*, 49(2), pp.483–511. 10.1017/S0022109014000131.

Lo, A.W., MacKinlay, A.C., 1988. Stock Market Prices do not Follow Random Walks: Evidence from a Simple Specification Test. *The Review of financial studies*, 1(1), pp.41–66. 10.1093/rfs/1.1.41.

Macbeth, J.D., Merville, L.J., 1979. An Empirical Examination of the Black-Scholes Call Option Pricing Model. *The Journal of Finance (New York)*, 34(5), pp.1173–1186. 10.1111/j.1540-6261.1979.tb00063.x.

Markowitz, H., 1952. Portfolio Selection. *The Journal of Finance (New York)*, 7(1), p.77–91. 10.2307/2975974.

Markowitz, H., 1959. *Portfolio Selection: Efficient Diversification of Investments*. New Haven ;: Yale University Press.

Mishkin, F.S., Gordon, R.J., Hymans, S.H., 1977. What Depressed the Consumer? The Household Balance Sheet and the 1973-75 Recession. *Brookings Papers on Economic Activity*, 1977(1), pp.123–174. 10.2307/2534258.

Modigliani, F., 1971. Monetary Policy and Consumption: Linkages via Interest Rate and Wealth Effects in the FMP Model. *Consumer Spending and Monetary Policy: The Linkages*. Federal Reserve Bank of Boston Conference Series, pp.9-97.

- Poshakwale, S., 1996. Evidence on the Weak-form Efficiency and the Day of the Week Effect in the Indian Stock Market. *Finance India*, 10(3), pp.605–616.
- Roll, R., Ross, S.A., 1980. An Empirical Investigation of the Arbitrage Pricing Theory. *The Journal of Finance* (New York), 35(5), pp.1073–1103. 10.1111/j.1540-6261.1980.tb02197.x.
- Rosa, C., 2012. How 'Unconventional' are Large-scale Asset Purchases? The Impact of Monetary Policy on Asset Prices. IDEAS Working Paper Series from RePEc.
- Ross, S.A., 1971. Portfolio and Capital Market Theory with Arbitrary Preferences and Distributions-The General Validity of the Mean-variance Approach in Large Markets. Working Paper No. 12-72, Rodney L. White Center for Financial Research.
- Ross, S.A., 1976. The Arbitrage Theory of Capital Asset Pricing [online]. *Journal of Economic Theory*, 13(3), pp.341–360. Available at: [http://dx.doi.org/10.1016/0022-0531\(76\)90046-6](http://dx.doi.org/10.1016/0022-0531(76)90046-6).
- Samuelson, P.A., 1965. Proof That Properly Anticipated Prices Fluctuate Randomly. *Industrial management review*, 6(2), p.41–9.
- Sharpe, W.F., 1964. Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance* (New York), 19(3), p.425–442. 10.2307/2977928.
- Shefrin, H., Statman, M., 1994. Behavioral Capital Asset Pricing Theory. *Journal of Financial and Quantitative Analysis*, 29(3), pp.323–349. 10.2307/2331334.
- Shiller, R.J., 1989. *Market Volatility*. Cambridge, Mass. ;: MIT Press.
- Sorensen, E.H., David A. Williamson, 1985. Some Evidence on the Value of Dividend Discount Models. *Financial analysts journal*, 41(6), pp.60–69. 10.2469/faj.v41.n6.60.
- Thorbecke, W., 1997. On Stock Market Returns and Monetary Policy. *The Journal of Finance* (New York), 52(2), pp.635–654. 10.1111/j.1540-6261.1997.tb04816.x.

Appendix

Form NBS/Ethics02 Activities not giving rise to ethics concerns (Simple Form)

NOTTINGHAM TRENT UNIVERSITY Nottingham Business School


Not all dissertations and research projects will involve research activities that give rise to ethics concerns. This form, *NBS/Ethics02*, is the appropriate form to complete if your research activity **does not involve** the collection of unpublished 'primary' data, as described below, **nor does it involve** the use of unpublished data held by public or private bodies *for any purpose other than that intended when collected*. Please complete this form, ask your supervisor or Module Leader to counter-sign it and submit it in accordance with the requirements of your module.

During the course of your research, you may decide to undertake research involving any of the research activities set out below. If you wish to do so, please consult with your Module Leader or supervisor and complete either form *NBS/Ethics03* or *NBS/Ethics04*, as appropriate.

By completing and signing this form, you are declaring that you will not:

- Collect, store and analyse data from, or that relate to, living human beings – unless the data are already in the public domain in some published form and have been obtained from said public domain (subject also to any terms & conditions associated with data-use).
- Collect, store and analyse data from, or that relate to, organisations or agencies of any kind (for example government, public services, voluntary sector organisations or businesses) – unless the data are already published into the public domain by parties authorised to do so.
- Collect, store and analyse data from, or that relate to, people who have recently died (and whose affairs may still be of concern to people or organisations, for example family or former employer) – unless the data are already in the public domain in some published form and have been obtained from said public domain.

Name of student(s)	Student registration number(s)
Arthur Csaba Varga	
Programme of Study	
MSc International Finance	
Module name and code	
MSc International Finance BUS1113	
Working title of research project	
The effects of interest rates on chosen stock market sectors	

Declaration	
I hereby agree that this project will be conducted in strict accordance with this protocol.	
Signed (student/s)	Date
	21.1.2023
I confirm that the student has stated clearly in their research proposal that this project will not involve any primary data collection, nor give rise to issues under either the Data Protection Act, 2018, or the General Data Protection Regulation.	
Signed (supervisor/Module Leader)	Date