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Economic uncertainty and stock returns

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Abstract

Motivated by the results of Ilut and Schneider (2014) this paper examines the relation between ambiguity and stock returns using S&P500 data and data from the Survey of Professional forecasters. Other research mainly focusses on the risk return trade-off whereas this study is more focussed on ambiguity. Using the dispersion in individual forecasts for inflation, real GDP growth and inflation to measure ambiguity, I find a negative effect for inflation ambiguity, mixed results for real GDP growth ambiguity and a positive effect for unemployment ambiguity, particularly during high unemployment periods. Additionally, the results imply significant effects of unanticipated inflation, real GDP, and unemployment as well. Robustness checks with different time periods and a different measure for ambiguity indicate not very high robustness of the ambiguity effects.

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1 Introduction

Motivated by the results of Ilut and Schneider (2014) this paper will investigate the implications of ambiguity for stock returns using S&P500 data and data from the Survey of Professional forecasters. Ilut and Schneider (2014) modelled confidence shocks as changes in ambiguity and found that this could account for 70% of the variation in business cycles. This study builds upon that result and aims at gaining insight into the effect of ambiguity on market returns and how forecasts can help explain these returns.

Numerous studies have investigated the relationship between risk and return and the accompanied equity premium puzzle. Risk is often described as the sensitivity of an individual asset's return to the market premium. Ambiguity is a situation in which the probability distribution of possible outcomes is unknown. What is missing in the literature of asset pricing models is the clear distinction between risk and ambiguity. Many studies regarding ambiguity are about the degree of ambiguity aversion instead of quantifying ambiguity (Izhakian, 2020). Brenner and Izhakian (2018) however, found that there is indeed an ambiguity premium which is embedded in the equity premium. There are also experimental studies that investigate the relation between ambiguity and asset pricing like Epstein and Schneider (2008) and Cao et al. (2005). Empirical studies of the effect of ambiguity on asset pricing are however less abundant. Lee et al. (2019) did a cross-sectional analysis on the relation between individual stocks and ambiguity. Another study from Anderson et al. (2009) used the dispersion in corporate profit forecasts as measure for ambiguity and made a clear distinction between risk and uncertainty.

This study investigates the effect of three different ambiguity measures on the market return. There are several ways to measure ambiguity, for example, Andreou et al. (2014) use option trading activity, Bali et al. (2017) capture ambiguity with an economic uncertainty index and Brenner and Izhakian (2018) calculate ambiguity as the volatility of probabilities of returns. Izhakian (2020) even dedicated a whole paper to ambiguity measurements. For this paper I follow a method that was used by Anderson et al. (2009), Antoniou et al. (2015), Ilut and Schneider (2014) and Lee et al. (2019). They measured ambiguity as the dispersion in quarterly forecasts from experts. These experts estimate several variables from which this paper focusses on ambiguity regarding the inflation rate, the real GDP growth rate, and the unemployment rate. The market return is measured by the return on the S&P500 index. This paper also studies the forecasts themselves and how these forecasts can explain market returns. The accuracy of the forecasts is examined and the relation between the forecast errors and the market return is estimated. The analysis is performed for the period 1969 till 2023 and I control for the savings rate, the term structure of interest rates, inflation rate, real GDP growth rate and the unemployment rate. Robustness checks are conducted in two different manners, one considering different time periods and the other is concerned with different measures for ambiguity.

The results imply a negative relation between inflation ambiguity and stock market returns. The effect of the real GDP growth ambiguity is less intuitive and positive in many cases. Unemployment rate ambiguity is proven to be positively correlated with stock market returns because of high unemployment ambiguity in times of high unemployment rates. Unexpected values of inflation, real GDP growth and unemployment are found to be significantly correlated with stock market returns.

The remainder of this paper will look as follows. First I will give an overview of the literature in section 2, then the methodology and hypotheses will be discussed in section 3. Section 4 will present the results and section 5 tests the robustness of the results. The paper will end with a conclusion and a discussion in sections 6 and 7.

2 Literature review

In this chapter, I give an overview of the most relevant literature. First, stock modelling literature will be discussed, then I elaborate on ambiguity and its relation with stock returns

2.1 Modelling stock returns

One of the classic questions in finance is what the main drivers of stock returns are. Many models are evaluated in the literature to capture the returns of individual stocks and portfolios. One of the most simple and well-known models is the CAPM model from Sharpe (1964). Other models were created to explain the equity premium and the main determinants of individual stock returns. For example, the Fama-French three factor model, Fama-French five factor model and the Carhart four factor model. These models are extensions of the CAPM and include firm characteristics and in case of the Carhart model momentum is also included. Apart from firm characteristics there are numerous other variables that can be of influence for market returns.

Literature about the determinants of the general market return or market premium is also abundant. Macro-economic variables like inflation, real economic activity, unemployment, interest rates, money supply are important factors that influence stock returns (Fama, 1981; Hjalmarsson, 2009; Atanasov, 2021). Higher inflation increases the likelihood that the Federal Reserve will tighten their monetary policy because of their mandate to maintain a stable inflation of two percent on average over time. Expansionary monetary policy leads to a higher money supply and is positively correlated with stock returns (Fama, 1981). Expansionary monetary policy stimulates the economy and real economic activity is positively correlated with stock returns as well (Fama, 1981). Tighter monetary policy lowers the money supply and increases interest rates which affects the stock returns negatively. Higher inflation devalues the real profits that firms will make in the future and lowers the value of firms.

Changes in the unemployment rate are also correlated with changes in stock returns. The Federal Reserve has the mandate to maintain maximum employment and may act on changes in the unemployment rate. When the unemployment rate increases, the Federal Reserve is more likely to loosen their monetary policy to stimulate the economy, which has positive effects on stock returns. Also, investors behave more risk averse when unemployment rates increase which leads to a higher market premium (Atanasov, 2021).

Interest rates are also among the important determinants of stock returns. Discounted net present values of the earnings are highly dependent on the interest rates with which they are discounted. Higher interest rates lead to lower valuations because of the lower value of future cash flows. The term spread captures both long- and short-term rates and can tell something about the state of the economy. Upward sloping yield curves may indicate an expansionary state of the economy because the short-term rates are low and long-term rates are high. However, the effect of the term spread on stock returns is not very straightforward in the literature. The relation between short term interest rates and stock return is negative and consistent among many developed markets (Hjalmarsson, 2009). The term spread, measured as the long-term rate minus the short-term rate, is positively correlated with stock returns in most developed markets (Hjalmarsson, 2009). The latter effect is however less consistent than the effect of the short-term rates. A higher term spread stimulates the economy and increases expected GDP growth (Ang et al., 2006). Longer term interest rates are of less impact on stock returns (Zhou, 1996).

The market return also depends on the level of risk aversion and the compensation investors require for the risk that is involved (Damodaran, 2021). These levels of risk aversion and required compensation differ per individual but what is important for the effect of these factors on the market return is the aggregate level of risk aversion and the average required compensation for market risk. Many variables affect the level of risk aversion and required compensation. The preference for immediate consumption impacts the height of the market premium. When on average people have a high preference for current consumption they will save and invest less. The market premium is lower in countries with higher savings rates (Rieger et al., 2012). People who save more have a lower preference for current consumption and need a lower compensation for delaying their consumption. In other words, a higher savings rate is associated with a lower market premium. A possible reason for people to prefer current consumption over saving or investing could be myopic loss aversion (Benartzi & Thaler, 1995). Myopic loss aversion entails that people are short sighted and treat each decision as one single independent choice. This makes them avoid losses in the short run and ignore the possibility of profits over the long run.

2.2 Ambiguity and the relation with stock returns

Ambiguity is a phenomenon that plays an important role in finance. Ambiguity has to do with uncertainty and is similar to risk except that with ambiguity the probability distribution of the possible outcomes is unknown. Theory about risk and how people make decisions under risk is abundant, for example the expected utility theory of Von Neuman and Morgenstern (1947) or prospect theory from Kahneman and Tversky (1979). However, people behave differently under risk than under ambiguity. Ambiguity causes more uncertainty than risk because the probability distribution of the outcomes is not available. A stylized example of ambiguity is Ellsberg's urn (Ellsberg, 1961) which proves that people are ambiguity averse and prefer choices with known probability distributions over choices for which the probabilities are absent. Epstein and Schneider (2008) constructed a model to assess the implications of ambiguity and information quality for asset pricing. Their findings indicate that investors require a higher return when the future information quality is expected to be more uncertain and low information quality leads to excess volatility. Ilut & Schneider (2014) examined the implications of ambiguity for business cycles and found that confidence shocks and total factor production explain 70% of the variation in business cycles. These confidence shocks are used as a measure for ambiguity. Additionally, Cao et al. (2005) demonstrated that model uncertainty leads to less participation in the market and increases the equity premium.

Brenner and Izhakian (2018) studied the relation between risk, ambiguity and expected returns, defining ambiguity as the volatility of probabilities of returns. Risk can be measured as the volatility of returns and therefore ambiguity can be measured as the volatility of probabilities of returns. The equity premium actually consists of two parts, the risk premium, and the ambiguity premium. The height of the ambiguity premium depends on the attitude of investors towards ambiguity and the expected probability of a positive returns. Investors' ambiguity aversion increases when the expected probability of a gain increases and in case of a higher probability of a loss investors become more ambiguity loving (Brenner & Izhakian, 2018). The presence of the ambiguity premium was also proven by Bali et al. (2017) with the use of an ambiguity measure that was based on an economic uncertainty index. Andreou et al. (2014) demonstrated a negative relation between uncertainty regarding future stock prices and market returns, measuring uncertainty as the dispersion in volume weighted option strike prices. Measuring ambiguity as the dispersion in beliefs about future economic variables as was done by Ilut and Schneider (2014) also proves a negative relation between ambiguity and stock returns. Stocks that are more sensitive to ambiguity perform worse than stocks that are less sensitive to ambiguity (Anderson, 2009; Lee et al., 2019). Economic uncertainty has also negative effects on capital flows towards equity funds. Households are less likely to invest in the equity market when market conditions are more ambiguous. Fewer capital inflow in economic ambiguous times thus lead to lower stock returns (Antoniou et al., 2015).

3 Methodology

3.1 Data

For my analysis I will be using data from the S&P500 and the U.S. government bond rates which are available in Eikon. The time frame of interest is 1969Q1-2023Q4 using quarterly data, spanning a period of 55 years which gives 220 observations per variable. To quantify ambiguity, I will use data from the Survey of Professional Forecasters (SPF) which is provided by the Federal Reserve Bank of Philadelphia. The SPF is a quarterly survey in which professional forecasters predict multiple economic variables, among others future real GDP growth, inflation, and the unemployment rates[1]. The data from this survey is available from 1968Q4 till 2024Q1. The Bureau of Economic Analysis (BEA) provides the data considering the inflation and the real GDP growth. The Bureau of Labor Statistics (BLS) provides the data of the unemployment rate. Both the BLS and the BEA are agencies of the government of the United States.

3.2 Variables

For my analysis I will use the quarterly market return as the dependent variable. Daily data is too noisy and yearly data has too little observations. To measure the market return I use the return of the S&P500 index. These returns are calculated as the natural logarithm of the quarterly

[1] More variables were added to the survey throughout the years.

change in the index price, $\ln(S_t/S_{t-1})$. A visual representation of these returns over time is shown in Figure 1. The Survey of Professional Forecasters is a quarterly survey, hence the choice for quarterly stock returns. For the explanatory variables I will use the unemployment rate, inflation rate, GDP growth rate, term structure of interest rates, savings rate and three measures for ambiguity. I will also create models that exclude the realized values for inflation, real GDP growth and unemployment but include the forecasted values of these variables. Additionally, I test the explanatory power of the actual values for inflation, real GDP growth and unemployment instead of the forecasted values. Finally, I also test the effects of the forecast errors, or unanticipated values for inflation, real GDP growth and unemployment, on market returns.

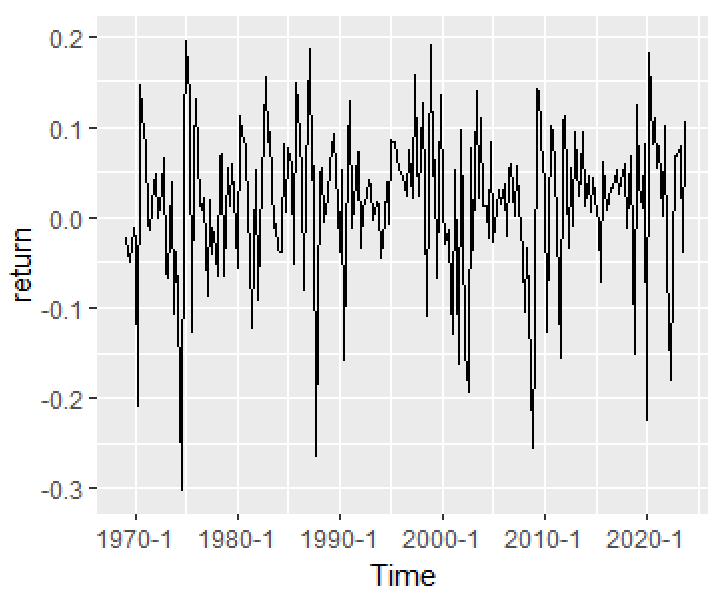


FIGURE 1: QUARTERLY RETURNS OF THE S&P500 INDEX FOR THE PERIOD 1968Q4-2023Q4

The unemployment rate is calculated by the BLS as the fraction of the labour force that is unemployed. The real GDP growth rate is calculated as the growth rate of GDP adjusted for inflation. The savings rate is the fraction of disposable income that is left after consumption and taxes paid. To measure inflation the consumer price index (CPI) would be a logical choice, however, the Survey of Professional Forecasters included this variable in 1981. In order to maintain the time frame 1968-2023, I use the GDP price index (PGDP) as a measure for inflation. This variable was already included since the start of the survey in 1968. The PGDP measures the increase in prices of goods produced domestically. Domestically in this case refers to the United States. The price change of imports is however excluded from the PGDP.

The term structure of interest rates is the yield curve of equally rated bonds for different maturities. To include a measure for the term structure I will include a spread between short term bond rates and long-term bond rates in my regression. As was pointed out by Zhou (1996) there is no theoretical support for which maturities one should use to calculate the spread. The maturities for the short term and long term are chosen almost arbitrarily, so for short term rates I will use the three-month T-bill rate and for the long-term rate I will use the 10-year T-bill rate.

To quantify the degree of ambiguity I follow the method that was earlier used by Ilut and Schneider (2014), Antoniou et al. (2015) and Lee et al. (2019) where they measure the dispersion in forecasts elicited from the Survey of Professional Forecasters. The dispersion is measured as the difference between the 25th decile and the 75th decile. If the experts disagree and the dispersion in forecasts is high, the confidence in these forecasts is low which implies that ambiguity is high. In other words, high dispersion means high ambiguity. The dispersion measures are available for forecasts about unemployment rates, GDP price index and real GDP growth, among others. This gives the opportunity to include three variables that measure ambiguity. I will also include the realized values of these variables, the realized change in GDP price index, the real GDP growth and unemployment rate.

3.3 Analyses

To fit the data, I will use a regular OLS regression with multiple factors, three measures for ambiguity and additional explanatory variables. The regression will then look as follows:

$$R_{mt} = \alpha_t + \beta_1 TERM_t + \beta_2 UNEM_t + \beta_3 INFLATION_t + \beta_4 RGDP_t + \beta_5 S_t + \beta_6 UNEMamb_{t-1} + \beta_7 INFLATIONamb_{t-1} + \beta_8 RGDPamb_{t-1} + \varepsilon_t$$

R_{mt} is the quarterly market return, α_{it} is the intercept, TERM is the measure for the term structure of interest rates at time t, $UNEM_t$ is the unemployment rate at time t, $RGDP_t$ stands for the real GDP growth and S_t the savings rate. UNEMamb, INFLATIONamb and RGDPamb are the ambiguity measures regarding the unemployment rate, GDP price index and real GDP growth, respectively. The last term is the error term. The ambiguity measures are based on forecasts for the upcoming quarter, therefore I use a lag of one quarter for the ambiguity variables. The returns, term spread, unemployment rate, inflation rate, real GDP growth rate and the savings rate are measured in percentage points.

3.4 Hypotheses

H_0: $\beta_6 \neq 0$, $\beta_7 \neq 0$, $\beta_8 \neq 0$ to test whether ambiguity has a significant effect on the market return. The expectation is that these three betas are significantly different from zero and that they will be lower than zero because of an expected negative effect of ambiguity on the market return. This expected negative relation between ambiguity and the market return is based on earlier studies from Andreou et al. (2014) and Lee et al. (2019).

H_1: $\beta_1 > 0$ to test the effect of the term structure on the market return. When the yield curve is upward sloping the long-term interest rates are higher than the short-term interest rates which implies that the economy is expanding. For my analysis, I calculate the spread as the long-term interest minus the short-term interest rate, so the spread is positive in case of an upward sloping yield curve. In short, an upward sloping yield curve results in a positive value for the variable term spread in the regression and implies an expanding economy. The expectation is that a positive spread has a positive impact on the market return because of more economic activity and thus β_1 is expected to be larger than zero.

H_2: $\beta_2 > 0$ to test the effect of the unemployment rate on the market return. According to Gonzalo and Taamouti (2017) an increase in unemployment is followed by an expansionary monetary policy which is positive for the market return.

H_3: $\beta_3 < 0$ to test the effect of inflation on the market return. Fama (1981) found a negative relation between inflation and stock returns hence the expected negative value for β_3.

H_4: $\beta_4 > 0$ to test the effect of real GDP growth on the market return. More economic activity is associated with higher stock returns as was described in Fama (1981), therefor I expect the β_4 to be positive.

H_5: $\beta_5 < 0$ to test the relation between the savings rate and the market return. A higher savings rate is associated with a lower market premium and thus a lower market return (Rieger et al., 2012). People who save more have a lower preference for current consumption and need less compensation for postponing their consumption, hence the lower market premium.

3.5 Robustness checks

To test the robustness of the results of the earlier regression I perform two different types of robustness checks. One type considering different time periods and the other considering different measures for ambiguity.

The first robustness checks will test the effects of the ambiguity measures during alternated time periods. I will first exclude the covid pandemic from the full time period, because of the severe impact of the pandemic on multiple macro-economic variables. Ambiguity during this period was extremely high which may impact the results, therefor I perform the regressions again but with a slightly altered time period, 1969Q1 – 2019Q3. The second robustness check examines the effects during two time periods, the first period being 1969Q1 – 1994Q2 and the second period being 1994Q3 – 2019Q3, also excluding the covid period.

The third robustness check will examine the effect of a slightly different measure for ambiguity. The availability of the individual forecast data gives the possibility to calculate the min-max range of forecasted inflation, real GDP growth and unemployment. This measure of dispersion in forecast can also be used as an alternative measure for ambiguity. The number of forecasters that participate in the survey differs per quarter but is not sufficiently large to calculate a meaningful 95% confidence interval, hence the choice to only use the min-max range for this robustness check.

4 Results

4.1 Descriptive statistics

Table 1 below shows descriptive statistics of the dataset. All variables are measured quarterly and there are no missing values in the dataset, every variable has 220 observations. The mean return of the S&P500 per quarter is 1.74% which is equal to a yearly return of 7.21% (continuously compounded). The returns are negatively skewed, indicating a tail on the left. Usually stock returns are negatively skewed, most returns are positive but large losses do occur. However, the probability for large losses is small. Although some extreme cases or ‘left-tail events’ occur with low probabilities, they play an important role in asset pricing (Neuberger & Payne, 2020). The real

GDP growth varies the most when looking at the min-max range, followed by unemployment and then inflation. The min-max ranges of the ambiguity measures are ranked in the same manner. On average, ambiguity regarding the real GDP growth rate is the highest, indicating that real GDP growth is more uncertain than inflation and unemployment. This may have to do with the stickiness of prices and stickiness of the labour market. Prices tend to react slowly to economic changes which makes it 'easier' to predict inflation (Schumpeter & Keynes, 1936). Based on the averages, the experts of the SPF predict the macroeconomic variables quite well. The difference between the mean forecasted values and the realized values of inflation, real GDP growth and unemployment are relatively small. Section 4.7 will go into more detail about the forecast errors.

TABEL 1. DESCRIPTIVE STATISTICS OF THE DEPENDENT AND INDEPENDENT VARIABLES

Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Median	Max	Kurtosis	Skewness
Return	220	1.740	8.348	-30.268	2.704	19.546	4.540	-0.919
Unem. ambiguity	220	0.269	0.328	0.100	0.200	4.697	152.451	11.360
Inflation ambiguity	220	0.886	0.496	0.000	0.788	3.209	6.610	1.496
RGDP ambiguity	220	1.509	1.488	0.372	1.205	19.330	95.012	8.136
Real GDP growth	220	0.677	1.088	-7.884	0.729	7.751	27.258	-1.081
Inflation	220	0.865	0.610	-0.352	0.668	3.080	4.197	1.197
Unemployment rate	220	6.079	1.720	3.400	5.750	13.000	3.543	0.781
Savings rate	220	8.004	3.448	1.800	7.250	24.367	4.380	0.761
Term spread	220	1.459	1.323	-2.657	1.548	3.640	2.750	-0.534
Forecasted RGDP	220	0.654	0.428	-0.951	0.638	2.374	5.457	-0.300
Forecasted inflation	220	0.839	0.482	0.183	0.666	2.398	4.060	1.335
Forecasted unem.	220	6.128	1.707	3.522	5.800	13.290	3.741	0.837

Note: This table was made based on the full time sample 1969Q1 – 2023Q4. Unem. is short for the unemployment rate. RGDP stands for the real GDP growth rate. The forecasted values are the mean forecasts of all the experts of the SPF per quarter[2]. All variables are measured in percentage points, apart from the ambiguity measures. The ambiguity measures are the dispersions between the 25th and 75th decile of individual forecasts

[2] See https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/individual-forecasts for the individual forecasts of the experts

4.2 The correlation matrix

The correlation matrix (see appendix 1)[3] shows the Pearson correlation coefficients and the corresponding p-values. The matrix indicates that ambiguity regarding the unemployment rate and ambiguity about the real GDP growth have a correlation coefficient of 0.89. These two ambiguity measures are thus highly correlated. In other words, when future growth of real economic activity is uncertain, experts are also uncertain about the future unemployment rate. Furthermore, the forecasted inflation, real GDP growth and unemployment rate are correlated with the realized values. These will be discussed in the section about the forecast errors. Apart from that there are no more highly correlated variables included in the dataset.

4.3 Ambiguity over time

In this section the ambiguity measures will be discussed in more detail. For each variable I created two graphs. One graph displaying the mean forecast of the experts per quarter including the spread. The spread is indicated by the blue lines and represent the 25th and 75th decile of the individual forecasts. This is the same spread that is used to quantify ambiguity. The black line is the mean forecast. Because the blue and black lines were very close to each other the dispersion between them was not very readable. Therefor I scaled the distance between the mean and the 25th and 75th deciles. I multiplied the difference with 5 such that the dispersion over time would be more readable. Therefore, the blue lines are for illustration purpose only. The scaling was applied in the same manner for all three variables. The other graphs display the ambiguity over time. Ambiguity is measured as the difference between the 25th and the 75th decile of individual forecasts per quarter.

The first variable that will be discussed is the unemployment rate. The correlation between the realized unemployment and the forecasted unemployment is very high (0.89) indicating that the experts can quite well predict the unemployment rate. Figure 9 also shows that there is not much spread between the individual forecasts because the blue lines are quite close to each other.[4]

[3] I choose to create a flat correlation matrix because of the amount of variables that are included. In this case, a flat correlation matrix improves the readability of the matrix.

[4] See Appendix 4

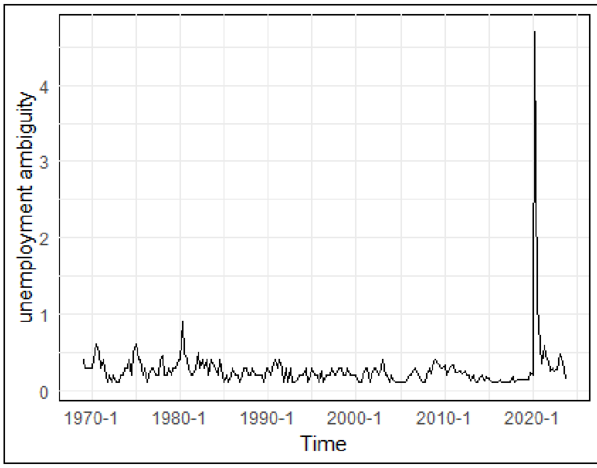
There are also no periods in which the spread increases or decreases apart from the period shortly after 2020. Figure 2 displays the dispersion between the 25th and the 75th decile or the difference between the blue lines of figure 2 over time.

The next variable that will be discussed is the inflation rate. The dispersion in forecasted inflation is higher in times of high forecasted inflation and lower in times of low forecasted inflation. What can be observed in figure 10 is that the dispersion in individual forecasts is generally higher than for the unemployment rate. Also, figure 2 panel B indicates a more volatile period and a less volatile period. During the first half of the time period there is more uncertainty than in the second half of the time period. This seems to coincide with the overall higher inflation rate during the first half of the period compared to the second half of the period[5].

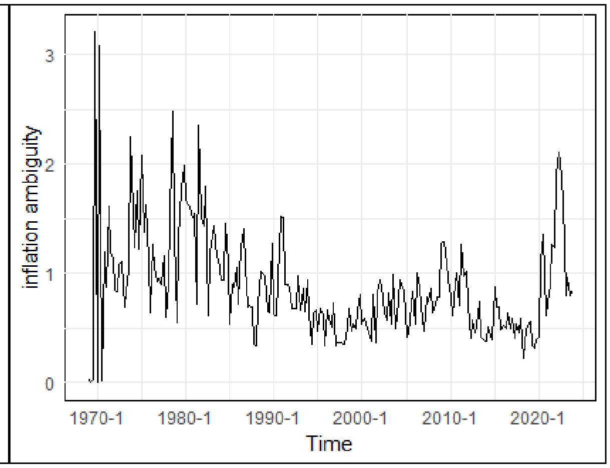
The last variable that will be discussed is the real GDP growth rate. In figure 4 there seems to be a distinction between the first half of the period and the second half of the period as well, where in the first period the uncertainty about the real GDP growth rate is generally higher than in the second half of the period. Especially the periods in which the real GDP growth is very low or even negative there is much uncertainty.

[5] See Appendix 2, figure 9 for the development of inflation over time

PANEL A: UNEMPLOYMENT AMBIGUITY



PANEL B: INFLATION AMBIGUITY



PANEL C: REAL GDP GROWTH AMBIGUITY

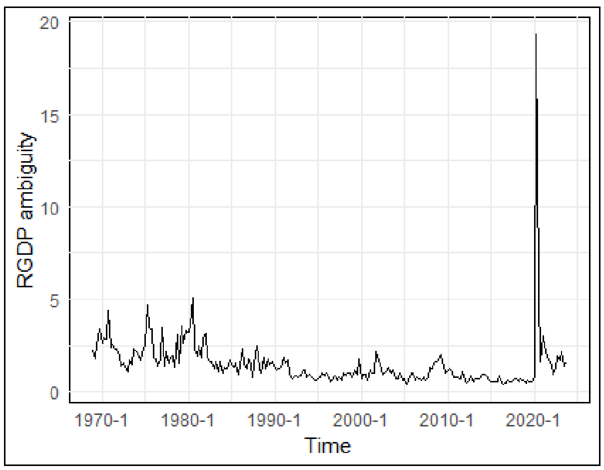


FIGURE 2: AMBIGUITY OVER TIME

4.4 First OLS estimations

For the first analysis I delve deeper into the relations between the independent variables and the market return. I first create a simple OLS model with the market return as the dependent variable and the inflation rate, unemployment rate and real GDP growth rate as the independent variables. For model 2, 3 and 4 other independent variables were added. All variables were tested for stationarity and in case of non-stationarity first differences were taken.[6]

Another problem that occurred was the high correlation between certain variables. As indicated by the correlation matrix the ambiguity measures for the real GDP growth and the unemployment

[6] For more details see appendix 3

rate were highly correlated. Therefor I do not include both variables in one model. However, to not exclude one of the variables completely I estimate separate models.

Table 2 shows that for model 1a all three variables have a significant effect on the market return. Inflation has a negative effect on the market return with a significance level of 0.05. The GDP price index growth is used a proxy for inflation and inflation is usually negatively correlated with stock returns. Real GDP growth shows a positive effect on the market return as well as the unemployment rate. The effect of real GDP growth is significant on the 0.10 level and the effect of unemployment is significant on the 0.01 level. These effects are in line with the hypothesised relations, an increase in real economic activity is associated with higher stock returns as was described in Fama (1981). Higher unemployment rates are likely followed by expansionary monetary policy which has a positive effect on stock returns (Gonzalo & Taamouti, 2017). Model 1b is similar to model 1a but contains the forecasts for inflation, real GDP growth and unemployment instead of the realized values of these variables. What can be noticed is that the forecasted values explain the market returns worse than the realized values because of the lower adjusted R-squared (0.024 vs. 0.056). The effect of the forecasted unemployment rate is the only effect that is significant. This makes sense because the forecasted unemployment rate and the realized unemployment rate are almost perfectly correlated.

The models 2a and 2b also include the change (first differences) in the savings rate and a measure for the term structure of interest rates, the term spread. These models show similar effects compared to the first models for inflation, real GDP growth and the unemployment rate. However, the coefficients for inflation, real GDP growth and the unemployment rate have increased, and the significance of the inflation effect increased. The term spread shows a significant negative effect on the stock market return. At first, this effect is not in line with the hypothesised positive coefficient for the term spread. A positive term spread indicates an expansionary state of the economy which should lead to higher stock market returns because of more economic activity. The savings rate does not show a significant effect on the market return, but the adjusted R-squared is higher than that of model 1a. Model 2b with the forecasted values shows lower explanatory power than model 2a. The adjusted R-squared of model 2b is even lower than that of model 1b.

Model 3a builds further on model 2a and includes two ambiguity measures, the first difference of inflation ambiguity and the ambiguity measure for the real GDP growth. The adjusted R-squared is higher than that of model 1a and 2a and the AIC value lower. The effects of the unemployment rate, inflation and real GDP growth are similar to the first two models. The sign for the savings rate has reversed and the effect of the term spread is not significant anymore. However, model 3a indicates a significant effect of ambiguity on the stock market return. A positive change in inflation ambiguity affects the stock market return negatively. In other words, when inflation ambiguity increases, this leads to lower stock market returns. The negative sign for inflation ambiguity makes economic sense. When future inflation is uncertain people are less eager to invest; they behave more cautiously when the future is more uncertain (Ilut & Schneider, 2014). The logical consequence of more cautious behaviour is a lower stock market return. The other ambiguity measure, RGDP ambiguity, also shows a significant effect on the market return, but this effect is positive. This effect seems odd given that it implies a higher market return when future real economic activity is more uncertain.

Model 3b shows similar effects as model 3a but now the RGDP ambiguity measure is left out and replaced for the ambiguity measure for unemployment. The adjusted R-squared of model 3b is higher than that of model 3a and the AIC value is lower. The effect of ambiguity about the unemployment rate is significant and positive. More uncertainty about the unemployment rate thus leads to higher market returns. The correlation between unemployment ambiguity and the realized unemployment rate is positive with a Pearson correlation coefficient of 0.35. This positive corelation suggests that ambiguity about the unemployment rate is usually high when the unemployment rate is also high. Although this correlation is not very high, it could be an explanation for the positive relation between unemployment ambiguity and market return, given that unemployment and market return are positively correlated as well.

In the models 4a and 4b the forecasted values and the ambiguity measures are included. The forecasted values are the expectations about the future, so the expectations experts have at time t. Both models 4a and 4b show significant negative effects of inflation ambiguity on the market return. RGDP ambiguity and unemployment ambiguity appear to be positively correlated with the market return, however only the effect of unemployment ambiguity is significant. The effect of the forecasted inflation on the market return is positive, just as in model 1b and 2b. Important to note here is that the forecasted inflation is measured as the first difference in forecasted inflation. When the first difference is negative, the forecasted inflation has decreased relative to the prior forecast. Because the coefficient is positive, the effect becomes positive as well which makes economic sense. When experts predict a lower inflation than in prior forecast this translates to a higher market return. The forecasted unemployment rate is positively and significantly correlated with the market return. This effect is also the same effect that was observed for the unemployment rate in earlier models. The observed effect of the unemployment rate is the same as the hypothesised effect. The idea is that the Federal Reserve tends to implement expansionary monetary policy measures when unemployment rates increase because of their mandate to maintain maximum employment (Gonzalo & Taamouti, 2017). This has a positive effect on the stock market return. The adjusted R-squares of model 4a and 4b indicate that the forecasts did not improve the models in comparison to the models that included the realized values for inflation, real GDP growth and unemployment. Thus far, the best models based on AIC value and the adjusted R-squared are models 3a and 3b, the models that include the ambiguity measures and the realized values of inflation, real GDP growth, and unemployment.

TABLE 2. SUMMARY OF THE OLS REGRESSIONS

Results

	Dependent variable:							
	Market return							
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Inflation ambiguity					-1.791*	-1.735*	-2.115**	-2.125**
					(0.965)	(0.960)	(1.012)	(1.001)
RGDP ambiguity					1.098**		0.628	
					(0.480)		(0.509)	
Unem. ambiguity						5.594**		4.840**
						(2.191)		(2.297)
Inflation	-2.105**		-2.929***		-3.333***	-2.685***		
	(0.899)		(1.039)		(1.044)	(1.025)		
RGDP growth	0.875*		1.101*		1.277**	1.423**		
	(0.507)		(0.620)		(0.622)	(0.630)		
Unem. rate	0.962***		1.335***		0.935**	0.846**		
	(0.320)		(0.390)		(0.421)	(0.427)		
Forecasted inflation		3.235		2.982			5.098	4.991
		(4.646)		(4.713)			(4.770)	(4.730)
Forecasted RGDP		0.762		0.869			0.350	4.991
		(1.311)		(1.416)			(1.472)	(4.730)
Forecasted unem.		0.922***		0.968**			0.717*	0.555
		(0.334)		(0.374)			(0.434)	(0.424)
Savings rate			0.034	-0.135	-0.278	-0.287	-0.298	-0.492
			(0.404)	(0.341)	(0.420)	(0.416)	(0.373)	(0.383)
Term spread			-0.939*	-0.107	-0.641	-0.523	0.169	0.314
			(0.552)	(0.510)	(0.561)	(0.568)	(0.569)	(0.549)
Constant	-2.878	-4.411**	-3.214	-4.611**	-2.651	-2.792	-4.075*	-3.409
	(2.202)	(2.201)	(2.213)	(2.300)	(2.194)	(2.181)	(2.338)	(2.348)
AIC	1551.3	1558.6	1552.3	1562.4	1548.1	1546.8	1560.9	1557.9
Observations	220	220	220	220	220	220	220	220
R^2	0.069	0.038	0.082	0.039	0.115	0.120	0.062	0.075
Adjusted R^2	0.056	0.024	0.060	0.016	0.086	0.091	0.031	0.044

Notes: *p**p***p<0.01. The OLS regressions are estimated for the period 1969Q1-2023Q4. All variables are measured in percentage points apart from the ambiguity measures. “Unem.” is short for unemployment. The forecasted variables are the mean forecasts of the experts per quarter. “Forecasted RGDP” stands for the forecasted growth rate of the real GDP.

The effect of inflation is consistently significant and negative as expected. Also in line with the expectations is the consistent and significant effect of RGDP growth on the market return. The ambiguity measure for inflation shows significant negative effects in both versions of model 3 and 4. As mentioned earlier, the negative signs make economic sense. The other two ambiguity measures, for RGDP growth and for the unemployment rate, show significant and positive effects.

Lastly, the change in the savings rate is not significant in any of the models, however, apart from model 2a the sign for the coefficient is consistently negative. This negative sign is in line with the hypothesised relationship between the savings rate and market returns. The variable 'savings rate' is the first difference of the actual savings rate and when this value is positive this indicates a positive change to the savings rate. A higher savings rate is associated with lower market premium and lower market returns (Rieger et al., 2012). The term spread is only significant in model 2a but shows consistent negative signs for the coefficients.

4.5 ARCH models

In this section the second analysis will be discussed. The first models in Table 2 were regular OLS regressions. For the second analysis I address the heteroscedasticity that occurred in the first analysis. The quarterly market returns' variance varies over time which violates the OLS assumptions of homoscedasticity. Therefore, the models in Table 2 may not be very accurate. An autoregressive conditional heteroscedasticity (ARCH) model can be a solid solution to this problem. The ARCH model estimates the variance of the error term using a lag of the error term. The equation:

$$h_t = \alpha_0 + \alpha_1 e_{t-1}^2$$

The h_t indicates the variance of the error term which is a function of the previous period's error term. I took the residuals from the estimated models and used these residuals to calculate the conditional volatility using the ARCH(1) model. This conditional volatility is added to the models to overcome the problem of heteroscedasticity.

TABLE 3. THE SUMMARY TABLE FOR THE ARCH MODELS

Results

	Dependent variable:							
	Market return							
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Inflation ambiguity					-1.796*	-1.738*	-2.113**	-2.114**
					(0.966)	(0.961)	(1.015)	(1.005)
RGDP ambiguity					1.122**		0.625	
					(0.483)		(0.516)	
Unem. ambiguity						5.715**		4.757**
						(2.206)		(2.339)
Inflation	-2.185**		-3.161***		-3.341***	-2.679***		
	(0.883)		(1.032)		(1.046)	(1.026)		
RGDP growth	1.064**		1.299**		1.298**	1.447**		
	(0.501)		(0.619)		(0.624)	(0.632)		
Unemployment rate	0.682**		1.246***		0.913**	0.822*		
	(0.328)		(0.388)		(0.424)	(0.431)		
Forecasted inflation		3.189		3.041			5.113	4.981
		(4.662)		(4.699)			(4.805)	(4.741)
Forecasted RGDP		0.763		1.330			0.360	0.030
		(1.314)		(1.445)			(1.511)	(1.498)
Forecasted unem.		0.916***		0.913**			0.717	0.561
		(0.336)		(0.375)			(0.435)	(0.425)
Savings rate			0.008	-0.218	-0.283	-0.291	-0.299	-0.495
			(0.400)	(0.344)	(0.421)	(0.416)	(0.376)	(0.385)
Term spread			-1.051*	-0.160	-0.642	-0.523	0.167	0.296
			(0.548)	(0.510)	(0.562)	(0.569)	(0.574)	(0.557)
Arch volatility	-0.021***	2.735	0.093**	0.009	20.039	21.676	0.0002	0.001
	(0.007)	(13.644)	(0.039)	(0.006)	(38.651)	(39.230)	(0.005)	(0.007)
Constant	6.589*	-346.023	-14.029***	-5.831**	-2,210.425	-2,323.853	-4.132	-3.602
	(3.795)	(1,704.273)	(5.003)	(2.432)	(4,258.250)	(4,200.662)	(2.930)	(2.538)
AIC	1544.1	1560.5	1548.4	1562	1549.8	1548.5	1562.9	1559.8
Observations	220	220	220	220	220	220	220	220
R^2	0.107	0.038	0.106	0.049	0.116	0.122	0.062	0.075
Adjusted R^2	0.091	0.020	0.081	0.022	0.083	0.088	0.027	0.040

Notes: *p**p***p<0.01. These are the regressions with the ARCH models. Arch volatility indicates the conditional volatility. The other variable names are the same as the ones used in Table 2.

The first thing that can be noticed in table 3 for the ARCH models is that the effects of real GDP growth, inflation, and the unemployment rate are similar to the models in Table 2. The change in the savings rate is still not significant but most signs are negative as hypothesised. The term spread is only significant in model 2a and negative which is contradicting with theory. However, the effect loses significance in all the other models. The inflation ambiguity measure is still significant and negative like in the first OLS regressions. The effects of the other ambiguity measures for unemployment and real GDP growth remain the same and still show significant effects. For the mean forecasted variables there does not seem to change much.

4.6 Ambiguity across longer time horizons

In the first analyses the ambiguity measure captured the uncertainty regarding the next quarter. However, the experts also provide forecasts for the second, third and fourth quarter following the quarter in which the survey takes place. Table 5 below presents the results of the regressions with ambiguity measures for the next quarter up until the fourth next quarter. At first, the results show that the most significant effects appear in the regressions with the ambiguity measures that use a one quarter horizon. The adjusted R-squared also indicates that these regressions explain the market return best compared to the regressions which used longer horizons for ambiguity. Between the three ambiguity measures there are some differences. The significant effect of the unemployment ambiguity seems to hold over several time horizons, only being insignificant for the four-quarter period. The coefficient for the t+1 horizon is the highest and for the t+4 horizon is the smallest. For RGDP ambiguity the positive effect remains also for longer time horizons. The effect seems to be the strongest for the two- and three-quarter horizons. For inflation ambiguity only the one quarter horizon measure has a negative and significant effect on the market return. Overall, the ambiguity measures with a one quarter horizon seem to be the most relevant for the effect on the market return. However, ambiguity regarding the unemployment rate and the real GDP growth rate are relevant for longer time horizons as well.

TABLE 5. REGRESSION RESULTS WITH AMBIGUITY MEASURES THAT DIFFER IN FORECASTING HORIZON

Results

	Dependent variable:							
	Market return							
Time horizon	T+1		T+2		T+3		T+4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unem. ambiguity	5.594**		4.828**		4.918**		2.049	
	(2.191)		(2.033)		(2.264)		(2.162)	
RGDP ambiguity		1.098**		1.962**		1.923*		-0.244
		(0.480)		(0.944)		(1.066)		(1.088)
Inflation ambiguity	-1.735*	-1.791*	-0.215	-0.910	0.770	0.788	0.492	-0.285
	(0.960)	(0.965)	(1.669)	(1.694)	(1.720)	(1.727)	(1.740)	(1.799)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	1546.8	1548.1	1550.4	1551.8	1551.3	1552.8	1512.1	1487
Observations	220	220	220	220	220	220	215	212
R^2	0.120	0.115	0.106	0.100	0.102	0.096	0.070	0.064
Adjusted R^2	0.091	0.086	0.076	0.070	0.073	0.066	0.039	0.032

Note: *p**p***p<0.01. The time horizon for the ambiguity measures is indicated by T+1 for the next quarter following the quarter in which the survey took place, T+2 for the second quarter, etc. The control variables were the same in all regressions and represent the inflation rate, real GDP growth rate, unemployment rate and the savings rate, all at time t. There were some missing variables in for the fourth quarter forecasts hence the slightly lower number of observations for regressions 7 and 8.

4.7 Unanticipated inflation, real GDP growth and unemployment

The first analyses showed that the models with the forecasts as explanatory variables were not very good. In this section I compare the forecasted values with the realized values to investigate whether the expectations of the experts about the future were accurate or not. The correlation (Pearson correlation) between the forecasted inflation and the realized values is relatively high (0.81) indicating that the forecasted values are quite well in line with the realized values. The same goes for the unemployment rate, the correlation between the forecasted unemployment rate and the realized values is 0.89, indicating a high correlation. For the real GDP growth the correlation is much lower. The correlation between the forecasted real GDP growth and the realized GDP growth rates is 0.45, which indicates that experts on average forecast Inflation and the unemployment rate better than the real GDP growth rate. The graphs in Appendix 2 show the forecasted values and the realized values. What can be noted is that indeed for unemployment the two lines for the realized values and the forecasted values are almost identical. The graph of the forecast error for unemployment is close to zero most of the time. As can be seen, the forecast error for unemployment is very close to zero for a major part of the time. The forecast error for the real GDP growth fluctuates the most which is logical because of the relatively low correlation between the forecasted real GDP growth and the realized real GDP growth. Furthermore, the plotted forecast errors in figure 3 indicate no systematic over- or underestimations. The graphs also do not show a trend for in- or decreasing forecast errors. The only thing that stands out is the relatively large peaks around 2020 which is likely due to the pandemic which caused a sudden drop in economic activity and caused a lot of uncertainty.

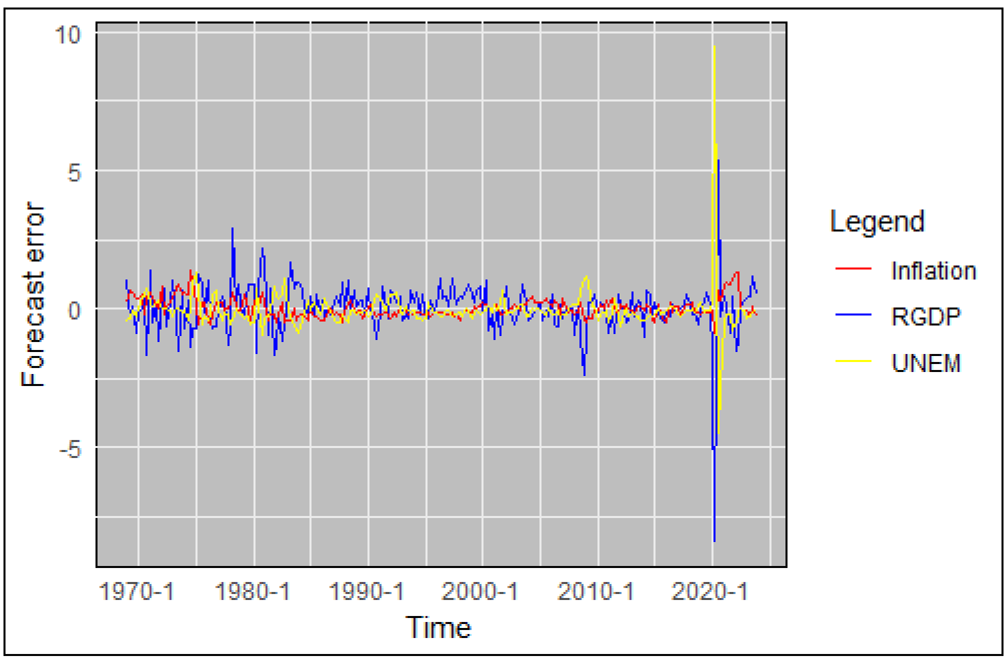


FIGURE 3: FORECAST ERRORS OF THE EXPERTS FOR THE VARIABLES INFLATION, REAL GDP GROWTH AND THE UNEMPLOYMENT RATE

Notes: The forecast error is calculated as the realized value minus the mean forecasted value per quarter. If the line is above zero it indicates an underestimation, if the line is below zero it indicates an overestimation. Inflation, RGDP and UNEM indicate the forecast error for the inflation rate, the real GDP growth rate, and the unemployment rate respectively.

In addition to the correlations, I also calculated if the mean forecast error significantly differs from zero. For all three variables the difference between the forecasts and the realized values on average do not significantly differ from zero. For each variable, a t-test was performed to test whether the mean forecast error significantly differed from zero. The null hypothesis was that the mean equals zero and all p-values of the t-tests were higher than 0.05. The p-values were 0.7645 for unemployment, 0.7719 for the real GDP growth and 0.2223 for inflation. This does not necessarily indicate that the experts predicted the inflation, real GDP growth and unemployment rate correctly, but is does indicate that they did not systematically over- or underestimated these variables.

The experts do not always predict the inflation, unemployment, and real GDP growth rate very accurately. Or, stated otherwise, the experts and other market participants face surprises from time to time. For this analysis, I will use the forecast errors as explanatory variables. The idea is that the market return reacts to surprises in important macroeconomic variables as inflation, unemployment, and real GDP growth. This was also proven earlier by Chen et al. (1986). Their analysis indicated that unanticipated inflation had a negative effect on the market return. This effect can also be observed in table 6 below. The effect of the unexpected inflation is significantly negative in all four regressions. The effect of the unexpected real GDP growth seems to be even stronger which could be because of the lower predictability of the real GDP growth rate. The sings of the unexpected inflation, real GDP growth and unemployment are again in line with the hypothesised relations and the effects that were observed in the earlier regressions. The effects of the ambiguity measures are mostly significant. The signs are the same as in the earlier regressions.

TABLE 6. THE REGRESSIONS WITH UNANTICIPATED VALUES.

Results

	Dependent variable:			
	Market return			
	(1)	(2)	(3)	(4)
Inflation ambiguity			-1.584	-1.661*
			(0.966)	(0.978)
RGDP ambiguity				0.900*
				(0.486)
Unem. ambiguity			6.699***	
			(2.264)	
Unexpected inflation	-3.164*	-3.209*	-3.412**	-3.393*
	(1.630)	(1.707)	(1.692)	(1.726)
Unexpected RGDP	2.572***	2.472***	2.367***	2.227***
	(0.844)	(0.852)	(0.834)	(0.853)
Unexpected unem.	2.565**	3.055***	1.381	2.011
	(1.043)	(1.157)	(1.296)	(1.325)
Savings rate		-0.436	-0.563	-0.518
		(0.448)	(0.440)	(0.445)
Term spread		0.219	0.390	0.353
		(0.431)	(0.427)	(0.435)
Constant	1.888***	1.582*	-0.545	-0.009
	(0.547)	(0.844)	(1.102)	(1.212)
AIC	1550.1	1552.7	1545.1	1550.4
Observations	220	220	220	220
R^2	0.074	0.080	0.127	0.106
Adjusted R^2	0.061	0.058	0.098	0.076

Note: *p**p***p<0.01. The unanticipated inflation, real GDP growth, and unemployment are the forecast errors of the experts. The forecast errors are calculated as the realized value minus the mean forecasted value of the respective variable.

4.8 Replacing expectations with actual values

The previous section showed that the experts of the SPF do not always predict very accurately. Especially the inflation rate and the growth rate of the real GDP differ sometimes from the actual values. In this section I assume that experts have rational expectations about the future. If the experts would have rational expectations about the future their predictions would be equal to the actual values. Therefore, for this analysis I use the actual values of inflation, unemployment, and real GDP growth from the next quarter to explain the market return of the current quarter. In table 7 the results of these regressions are presented. The first thing to notice is the significant negative effect of inflation ambiguity on the market return which is similar to the previously observed effects in the other models. However, the effects of the unemployment ambiguity and the RGDP ambiguity are not significant anymore. Future inflation, real GDP growth and unemployment are correlated with the market return in the same way as in earlier models, apart from some changes in significance. Especially the effect of future real GDP growth is highly significant in all models. On top of that, another difference to the first analyses that can be observed is the significant effect of the savings rate in regressions 3 and 4. The negative sign is as hypothesis since the expectation was that higher savings rates are associated with lower market participation and lower market returns (Rieger et al., 2012). Based on the AIC values and the adjusted R-squares, the regressions in table 7 are a better fit for the data than the previous regressions.

TABLE 7. REGRESSIONS WITH FUTURE REALIZED VALUES.

Results

	Dependent variable:			
	Market return			
	(1)	(2)	(3)	(4)
Inflation ambiguity			-2.272**	-2.253**
			(0.948)	(0.944)
RGDP ambiguity			0.360	
			(0.497)	
Unem. ambiguity				2.369
				(2.152)
Future inflation	-1.098	-1.696*	-1.986*	-1.791*
	(0.879)	(1.013)	(1.054)	(1.002)
Future RGDP	2.480***	2.822***	2.744***	2.638***
	(0.496)	(0.537)	(0.593)	(0.595)
Future unem.	0.342	0.614	0.538	0.484
	(0.314)	(0.374)	(0.392)	(0.393)
Savings rate		-0.521	-0.629*	-0.691*
		(0.335)	(0.362)	(0.365)
Term spread		-0.584	-0.576	-0.497
		(0.540)	(0.551)	(0.557)
Constant	-1.059	-1.589	-1.371	-1.358
	(2.150)	(2.168)	(2.167)	(2.154)
AIC	1541.3	1542.3	1540.1	1539.4
Observations	220	220	220	220
R^2	0.110	0.122	0.147	0.150
Adjusted R^2	0.098	0.102	0.119	0.121

Note: *p**p***p<0.01. The future inflation, RGDP and unemployment are the actual values of the respective variables at time t+1.

5 Robustness checks

5.1 Adjusted time periods

The first robustness check will be very similar to the earlier regressions but with a slightly adjusted time period. The time period for the first robustness check will be excluding the covid pandemic period. The covid pandemic started in December 2019, so the time sample for this analysis is 1969Q1 – 2019Q3 which gives 203 observations per variable instead of the 220 observations of the complete time sample. The reason to adjust the time period by excluding the covid period is that the variables of interest show some extreme values during the covid period, particularly the ambiguity measures. Table 8 below shows the results of the regressions with the adjusted time sample. The negative sign for the effect of inflation ambiguity on the market return remains consistent, however the significance is less consistent compared to the previous regressions. The effect of RGDP ambiguity was relatively consistent in previous regressions. For this analysis the effect is not significant anymore. The effect of the unemployment ambiguity is in line with the previous regressions.

TABLE 8. REGRESSIONS FOR THE PERIOD 1969Q1 – 2019Q3

Results

	Dependent variable:					
	Market return					
	(1)	(2)	(3)	(4)	(5)	(6)
RGDP ambiguity	0.299			-0.245	0.743	
	(0.912)			(0.708)	(0.914)	
Inflation ambiguity	-2.112**	-2.078**	-1.454	-1.493	-1.643*	-1.557
	(0.970)	(0.962)	(0.975)	(0.977)	(0.977)	(0.971)
Unem. ambiguity		8.000	5.456			10.722*
		(5.798)	(5.106)			(6.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
AIC	1422	1420.2	1424.6	1425.7	1427.7	1425.1
Observations	203	203	203	203	203	203
R^2	0.107	0.116	0.096	0.091	0.082	0.094
Adjusted R^2	0.075	0.084	0.063	0.058	0.049	0.061

Notes: *p**p***p<0.01. Regressions 1 and 2 control for the future realized values of inflation, real GDP growth and unemployment. Regressions 3 and 4 control for the forecast errors. Regressions 1, 2, 3 and 4 also control for the savings rate and the term spread. Regressions 5 and 6 control for the inflation, real GDP growth, unemployment, savings rate, and term spread at time t.

The second robustness check entails splitting the time period in two. As was pointed out earlier there seemed to be two different periods regarding the dispersion in inflation forecasts and the dispersion in real GDP growth rate forecasts (figure 4 and 6). That makes this robustness check even more relevant. The time samples will be 1969Q1 – 1994Q2 and 1994Q3 – 2019Q3, again leaving out the covid period. For this analysis I only used regressions in which the ambiguity measures are included since those are of the main interest. Table 9 below shows some interesting differences between the two time periods. To start off with the ambiguity measure for inflation, in the first period two of the four regressions show significant negative effects like in the previous regressions. In the second period however, the effect is not significant anymore and the sign of the effect has even turned positive. During the first period the uncertainty about the inflation rate was generally higher than in the second period which may cause the different effects in the two time periods. Real GDP growth ambiguity had positive coefficients in earlier regressions from which some were significant but not all. Here the sign of the effect is not consistently positive and

TABLE 9. REGRESSIONS WITH THE SPLIT TIME PERIOD

Results

	Dependent variable:							
	Market return							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time period	**1969Q1 – 1994Q2**				**1994Q3 – 2019Q3**			
Inflation ambiguity	-2.246**	-2.129**	-1.585	-1.683	1.670	1.396	0.409	0.748
	(1.025)	(1.018)	(1.023)	(1.026)	(3.382)	(3.410)	(3.132)	(3.131)
RGDP ambiguity	1.165			0.471	-0.897			1.108
	(1.070)			(1.000)	(2.405)			(2.575)
Unem. ambiguity		10.290	7.532			2.571	9.976	
		(6.787)	(6.657)			(11.465)	(9.358)	
Unexpected inflation			-3.348	-3.346			-2.814	-3.337
			(2.404)	(2.418)			(3.433)	(3.408)
Unexpected RGDP			0.927	0.942			5.711***	5.556***
			(1.152)	(1.162)			(1.445)	(1.482)
Unexpected unem.			4.211*	4.716*			-5.624**	-5.954*
			(2.428)	(2.409)			(2.821)	(3.304)
Future inflation	-3.619*	-3.337*			3.577	3.857		
	(2.013)	(1.876)			(3.619)	(3.600)		
Future RGDP	1.797*	1.897**			4.173***	4.197***		
	(0.935)	(0.927)			(1.338)	(1.336)		
Future unem.	1.246**	1.029			0.828	0.718		
	(0.615)	(0.636)			(0.638)	(0.720)		
Savings rate	1.189	0.978	0.488	0.610	-2.268**	-2.336**	-2.068**	-1.944**
	(1.024)	(1.032)	(1.045)	(1.044)	(0.876)	(0.901)	(0.839)	(0.833)
Term spread	-0.344	-0.245	0.870	0.783	-0.835	-0.846	-0.072	-0.026
	(0.893)	(0.891)	(0.654)	(0.674)	(0.953)	(0.962)	(0.647)	(0.682)
Constant	-5.361	-5.141	-1.841	-0.495	-4.952	-5.740	-0.353	0.519
	(4.464)	(4.400)	(2.459)	(2.567)	(4.143)	(3.854)	(2.048)	(2.334)
AIC	719.6	718.4	721.3	722.4	703.2	703.3	683.8	684.9
Observations	102	102	102	102	101	101	101	101
R^2	0.181	0.190	0.167	0.158	0.176	0.176	0.320	0.313
Adjusted R^2	0.120	0.130	0.105	0.095	0.114	0.114	0.269	0.261

Note: *p**p***p<0.01. Regression 1 to 4 are the same as regressions 5 to 6, they only differ in time period.

also not significant anymore. Unemployment ambiguity was mostly significant in previous analyses but not anymore with the split time periods. The effect is however still consistently positive. Table 9 also shows a significant negative effect of the savings rate on the market return which is not observed earlier in the analyses.

5.2 Alternative ambiguity measure

The first robustness check was a more general check, with this robustness check I specifically test the robustness of the ambiguity effects. For the second robustness check I use an alternative measure for ambiguity. Thus far, ambiguity was measured as the dispersion between the 25th and 75th decile of individual forecasts. The alternative measure for ambiguity that is used for this analysis is the min-max range of the individual forecasts. The individual inflation forecasts were made by means of an index with different base years. The forecasts for the real GDP were made in chain weighted dollars. To standardize the min-max range, I calculated the min-max range relative to the mean forecasted value. For the ambiguity measure of inflation first differences were used because of non-stationarity in the data.

The results in table 10 below demonstrates that for inflation ambiguity and RGDP ambiguity there no significant effects. Only unemployment ambiguity shows significant effects which are similar to earlier observed effects.

TABLE 10. REGRESSIONS WITH MIN-MAX RANGE FOR AMBIGUITY

Results

	Dependent variable:					
	Market return					
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation ambiguity	-0.172	-0.191	0.114	0.087	0.057	-0.005
	(0.347)	(0.348)	(0.361)	(0.357)	(0.355)	(0.355)
RGDP ambiguity	0.137		0.187		0.249	
	(0.232)		(0.212)		(0.234)	
Unem. ambiguity		0.398		1.316**		0.953*
		(0.530)		(0.533)		(0.541)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
AIC	1545.7	1545.4	1555.8	1550.4	1555.1	1553.1
Observations	220	220	220	220	220	220
R^2	0.125	0.126	0.083	0.106	0.087	0.095
Adjusted R^2	0.096	0.097	0.053	0.076	0.056	0.065

Notes: *p**p***p<0.01. Regressions 1 and 2 control for the future realized values of inflation, real GDP growth and unemployment. Regressions 3 and 4 control for the forecast errors. Regressions 1, 2, 3 and 4 also control for the savings rate and the term spread. Regressions 5 and 6 control for the inflation, real GDP growth, unemployment, savings rate, and term spread at time t.

5.3 Investor sentiment

As a last robustness check, I also control for the investor sentiment. Investor sentiment is not observable and has to be estimated (Zhou, 2017). To estimate the investor sentiment I use the same data and method as was also used in Brown and Cliff (2004). Sentiment is calculated as the difference between the percentage of investors that believe the stock market will go up (bullish) and the percentage of investors that believe that the stock market will go down (bearish). In other words, sentiment is measured as the bull-bear spread. The American Association of Individual Investors (AAII) does the survey on a weekly basis. The data was aggregated to quarterly data by taking the averages per quarter. For the regression analyses the first differences were used because of non-stationarity in the sentiment data. The data of the AAII sentiment survey is available from July 1987 till now.[7] On average investors are more bullish than bearish with an

[7] See https://www.aaii.com/files/surveys/sentiment.xls for the historical sentiment data

average bull-bear spread of 6.6% over the life of the survey. Note that the participants in the sentiment survey are individual investors and not necessarily experts like in the SPF.

TABLE 11. REGRESSIONS RESULTS INCLUDING SENTIMENT

Results

	Dependent variable:					
	Market return					
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation ambiguity	-3.803^{*}	-3.651^{*}	-5.187^{**}	-5.229^{**}	-5.164^{**}	-5.275^{**}
	(2.200)	(2.199)	(2.220)	(2.216)	(2.026)	(2.026)
RGDP ambiguity	-0.595		0.461		-0.234	
	(0.494)		(0.414)		(0.407)	
Unem. ambiguity		-3.057		2.089		-0.479
		(2.107)		(1.706)		(1.664)
Sentiment	0.247^{***}	0.246^{***}	0.266^{***}	0.266^{***}	0.265^{***}	0.265^{***}
	(0.047)	(0.047)	(0.048)	(0.048)	(0.043)	(0.043)
Term spread	-2.094^{***}	-2.224^{***}	-0.418	-0.402	-1.174^{*}	-1.129^{*}
	(0.670)	(0.687)	(0.488)	(0.489)	(0.598)	(0.606)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
AIC	970.4	969.7	974.3	974.1	951.5	951.8
Observations	144	144	144	144	144	144
R^2	0.306	0.309	0.287	0.288	0.391	0.390
Adjusted R^2	0.265	0.268	0.244	0.246	0.355	0.354

Note: *p**p***p<0.01. The control variables in the first two regressions were the inflation rate, real GDP growth rate and the unemployment rate. In regressions 3 and 4 the forecast errors of the aforementioned variables were used as controls and for regressions 5 and 6 the future values of the inflation rate, real GDP growth rate and unemployment rate were used. Sentiment is measured as the bull-bear spread in percentage points.

Table 11 above provides the results of the regressions with the sentiment data included. The period that was used for the analysis is from 1987 Q4 till 2023 Q4. At first, inflation ambiguity remains a variable that has a significant negative effect on the stock market return. The other two ambiguity measures are not significant and on top of that the signs of the effects show ambiguous results. The results indicate that sentiment has a strong effect on the market return. The effects of sentiment in all regressions are highly significant and positive which implies that the bull-bear spread is positively correlated with the stock market return which is in line with the results from

Brown and Cliff (2004) who used a similar measure for sentiment. Another interesting result in table 11 is the more consistent and significant effect of the term spread on the stock market return. This result is contradicting with the hypothesised relationship between the term structure and the stock market return. A possible explanation for this could be that a higher term spread can be caused by an increase in the long-term interest rates. Higher long term interest rates lead to a decrease in the net present value of future cash flows, and this results in lower valuations for listed companies and hence lower returns. To test this possible explanation I tested the correlations between the long-term interest rate (ten-year U.S. T-bill) and the term spread. The correlation between the long-term interest rate and the term spread is very low, but slightly positive at 0.04. However, the change (first difference) in the long-term interest rate and the change in the term spread is much higher and positive as well (0.40). This positive correlation implies that an increase in the long-term interest rate coincides with an increase in the term spread, which supports the possible explanation for the negative relation between the term spread and the stock market return. The last thing that can be noted from table 9 is the relatively high adjusted R-squared of the models compared to all the regressions that were done earlier. This implies that the investor sentiment really adds explanatory power to the models. Based on the AIC values the models with the actual values for inflation, real GDP growth and unemployment are the best fit compared to the other regressions models. The adjusted R-squares of models 5 and 6 confirm this.

6 Conclusion

This paper examines the effect of ambiguity on stock market return and how forecasts of experts can be used to explain market returns. Using the dispersion in individual forecasts and the returns of the S&P500 index I find mixed results for three different ambiguity measures.

The results imply a negative relation between inflation ambiguity and the return on the S&P500 index, however, this relation seems to be mostly present during the period 1969-1994. The inflation rate itself and the unexpected inflation, measured as the forecast errors of the experts, have negative effects on the market return as well. The negative effect of inflation ambiguity is economically meaningful because of the importance of the inflation rate for stock returns. The inflation rate is also of impact on monetary policy which in turn is also an important determinant of stock returns. A clear relation between real GDP growth ambiguity and market returns has not been proven in this paper which is opposing to the evidence provided in the literature. The results show mostly positive estimated relations but some negative as well. The negative correlation between RGDP ambiguity and the real GDP growth rate gives reason to expect that the relation between RGDP ambiguity and market returns is negative as well, however the results do not prove this relation. The relation between unemployment ambiguity and market returns is positive and quite robust. This relation may not be intuitive but the positive correlation between unemployment ambiguity and the unemployment rate could be an explanation for this result. The results imply a positive relation between the unemployment rate and stock returns. When unemployment rates are high the experts experience more uncertainty about future unemployment rates but at the same time the high unemployment rate affects the stock market positively. High unemployment rates are likely to be followed by expansionary monetary policy by the FED because of their mandate to achieve maximum employment. Expansionary monetary policy is found to be positively correlated with stock returns (Fama, 1981).

The forecasts of the experts were also used to calculate the forecast errors and the relation between these errors and the market return. The results implied that mainly real GDP growth is relatively difficult to forecast compared to real GDP growth and unemployment. Overall, the forecasts errors did not hint at systematic over- or underestimation of these variables. The forecast errors, or unexpected inflation, real GDP growth and unemployment, were however of enough size to significantly affect the stock returns in most cases. The results implied a negative relation between unexpected inflation and stock returns and a positive relation between unexpected real GDP growth and stock returns. For unexpected unemployment, the relation with the market return was less consistent but positive as well. When inflation is higher (lower) than expected, this leads to lower (higher) stock returns and when the real GDP growth rate is higher (lower) than expected, this leads to higher (lower) stock returns.

7 Discussion

This study extents the literature in the sense that it examines not only the relation of returns with real GDP growth ambiguity but also with inflation ambiguity and unemployment ambiguity. The results highlight the importance of monetary policy for stock returns but also more in general. High rates of inflation and unemployment are correlated with higher ambiguity. It is therefore important to maintain stable inflation and maximum employment to minimize economic uncertainty and achieve financial stability. However, this study does not control for measures of monetary policy. Including, for example, money supply as an independent variable could give more insight in the relation between stock returns and monetary policy, but also in the relation of money supply with inflation, real GDP growth and unemployment.

The ambiguity measures used in this paper are used by other economists as well but there are many more options to measure ambiguity. At first, one could consider a dispersion measure of forecasts other than the variables used in this paper. For example, the dispersion in corporate profit forecasts, the dispersion in industrial production forecasts or the dispersion in forecasts for the three-month treasury bill. Secondly, option trading activity can be used to measure ambiguity. However, this would drastically change the scope of the paper since such a measure would be concerned with uncertainty regarding future stock prices instead of economic uncertainty.

Inflation in this paper is measured as the GDP price index which excludes imports. The effects that are observed in this paper for inflation are in line with the literature, but it should be noted that the inflation measure does not fully represent the actual inflation. The market return is represented by the S&P500 returns which only contains American listed firms, although it is considered a good proxy for the market return it does not contain foreign companies, let alone non-listed companies. Furthermore, this study is focussed on the U.S. market, but the European Central Bank also publishes a quarterly survey of professional forecasters like the SPF of the Federal Reserve Bank of Philadelphia. Furter research could investigate the relation between economic uncertainty and stock returns in the Eurozone. Other research could examine the relation between economic uncertainty and economic activity.

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9 Appendices

9.1 Appendix 1: correlation matrix

row	column	cor	p
Unem. ambiguity	RGDP ambiguity	0.892032606	0
Unem. ambiguity	Inflation ambiguity	0.166892482	0.013185374
RGDP ambiguity	Inflation ambiguity	0.320814212	1.17136E-06
Unem. ambiguity	Inflation	0.030074348	0.657307309
RGDP ambiguity	Inflation	0.239484031	0.000338133
Inflation ambiguity	Inflation	0.544676688	0
Unem. ambiguity	Real GDP growth	-0.476934936	6.75016E-14
RGDP ambiguity	Real GDP growth	-0.411010024	2.23706E-10
Inflation ambiguity	Real GDP growth	-0.090877284	0.179262312
Inflation	Real GDP growth	0.016599849	0.806588219
Unem. ambiguity	Unemployment rate	0.351120813	8.81499E-08
RGDP ambiguity	Unemployment rate	0.343463028	1.73981E-07
Inflation ambiguity	Unemployment rate	0.238040252	0.000368137
Inflation	Unemployment rate	0.029634316	0.662009829
Real GDP growth	Unemployment rate	-0.10122274	0.134479237
Unem. ambiguity	Forecasted inflation	0.092322427	0.172417217
RGDP ambiguity	Forecasted inflation	0.315696743	1.76489E-06
Inflation ambiguity	Forecasted inflation	0.528123276	0
Inflation	Forecasted inflation	0.81441191	0
Real GDP growth	Forecasted inflation	-0.068866858	0.309225099
Unemployment rate	Forecasted inflation	0.23317207	0.000488494
Unem. ambiguity	Forecasted unem.	0.033607681	0.620047637
RGDP ambiguity	Forecasted unem.	0.052644688	0.437195593
Inflation ambiguity	Forecasted unem.	0.202433153	0.002554922
Inflation	Forecasted unem.	0.085315293	0.207481483
Real GDP growth	Forecasted unem.	0.252103869	0.000157316
Unemployment rate	Forecasted unem.	0.887866016	0
Forecasted inflation	Forecasted unem.	0.217804659	0.001148853
Unem. ambiguity	Forecasted RGDP	-0.091909243	0.174354183
RGDP ambiguity	Forecasted RGDP	-0.134040059	0.047057801
Inflation ambiguity	Forecasted RGDP	-0.17532498	0.009163556
Inflation	Forecasted RGDP	-0.1017147	0.132586105
Real GDP growth	Forecasted RGDP	0.451529388	1.89182E-12
Unemployment rate	Forecasted RGDP	0.000934029	0.989009514
Forecasted inflation	Forecasted RGDP	-0.284836111	1.78726E-05
Forecasted unem.	Forecasted RGDP	0.110260788	0.102870861
Unem. ambiguity	Savings rate	0.454011007	1.38289E-12

RGDP ambiguity	Savings rate	0.621481197	0
Inflation ambiguity	Savings rate	0.371735643	1.28953E-08
Inflation	Savings rate	0.515517217	2.22045E-16
Real GDP growth	Savings rate	-0.085344685	0.207324402
Unemployment rate	Savings rate	0.405794106	3.95371E-10
Forecasted inflation	Savings rate	0.574996781	0
Forecasted unem.	Savings rate	0.296282224	7.81022E-06
Forecasted RGDP	Savings rate	0.053118811	0.433072614
Unem. ambiguity	Term spread	-0.104431464	0.122498565
RGDP ambiguity	Term spread	-0.15267421	0.023517679
Inflation ambiguity	Term spread	-0.16505619	0.014243332
Inflation	Term spread	-0.391940277	1.71201E-09
Real GDP growth	Term spread	0.112234881	0.096818057
Unemployment rate	Term spread	0.489365922	1.19904E-14
Forecasted inflation	Term spread	-0.317693568	1.50537E-06
Forecasted unem.	Term spread	0.468509122	2.10498E-13
Forecasted RGDP	Term spread	0.29560027	8.21335E-06
Savings rate	Term spread	-0.079770544	0.23866635
Unem. ambiguity	Return	0.159190028	0.018137166
RGDP ambiguity	Return	0.114405949	0.090491604
Inflation ambiguity	Return	-0.114161232	0.091187751
Inflation	Return	-0.146058966	0.03033484
Real GDP growth	Return	0.091425811	0.176640895
Unemployment rate	Return	0.182014756	0.006789733
Forecasted inflation	Return	-0.049959905	0.460961652
Forecasted unem.	Return	0.153025924	0.023195545
Forecasted RGDP	Return	-0.020368066	0.763858803
Savings rate	Return	0.055226939	0.415012937
Term spread	Return	0.085402841	0.207013843

9.2 Appendix 2: correlation between forecasts and realized values

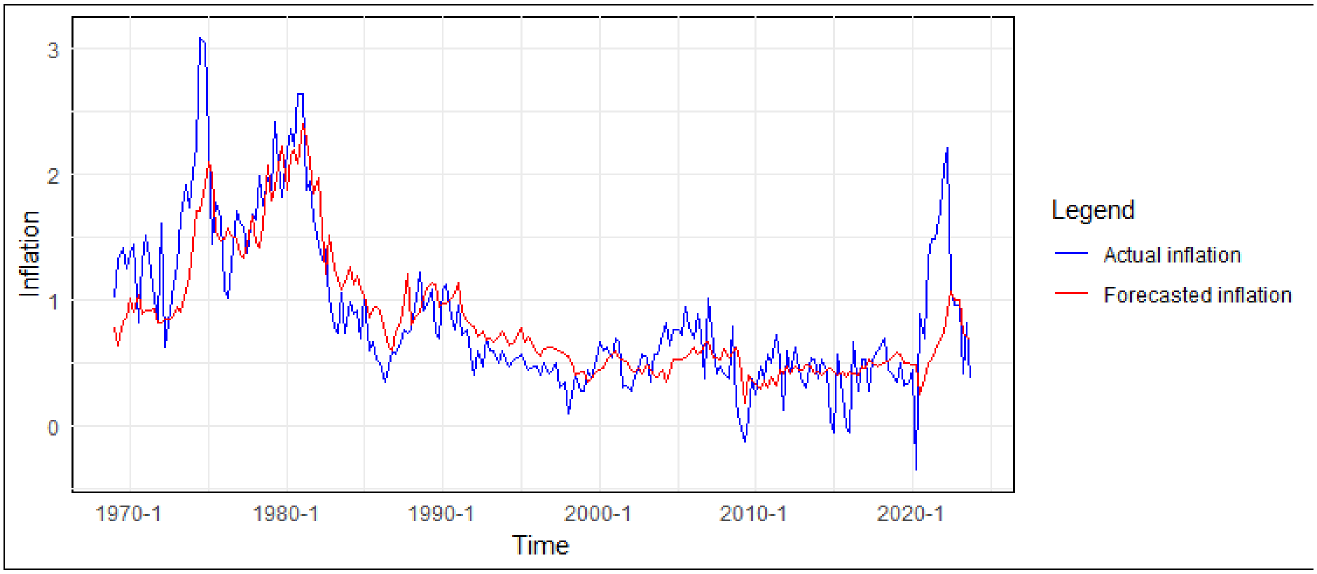

FIGURE 6. THE ACTUAL INFLATION AND FORECASTED INFLATION OVER TIME.

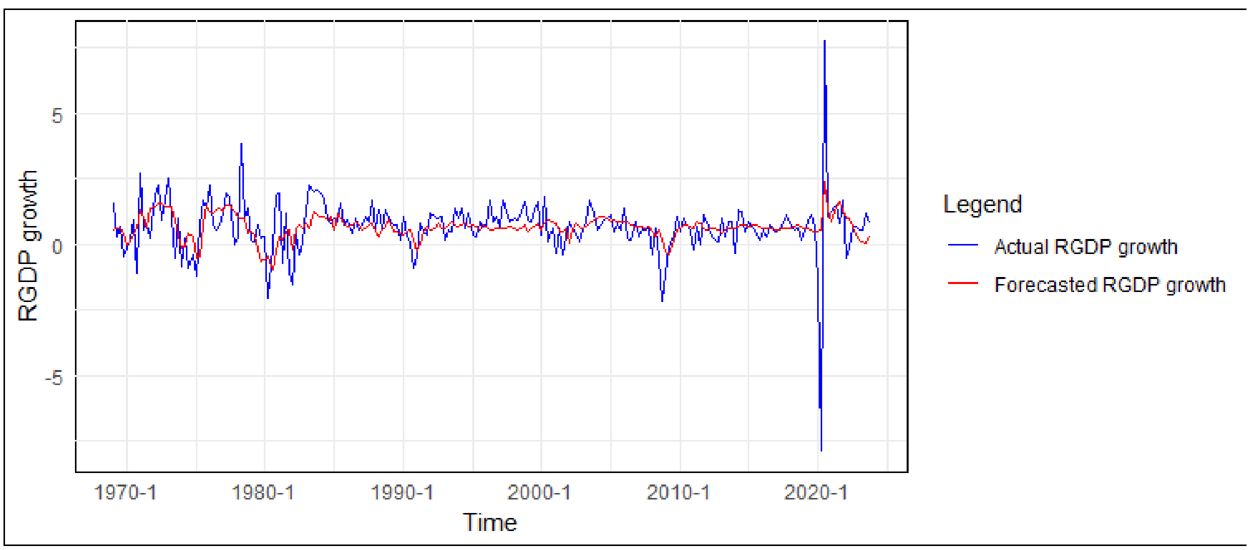

FIGURE 7. THE ACTUAL REAL GDP GROWTH AND THE FORECASTED REAL GDP GROWTH OVER TIME.

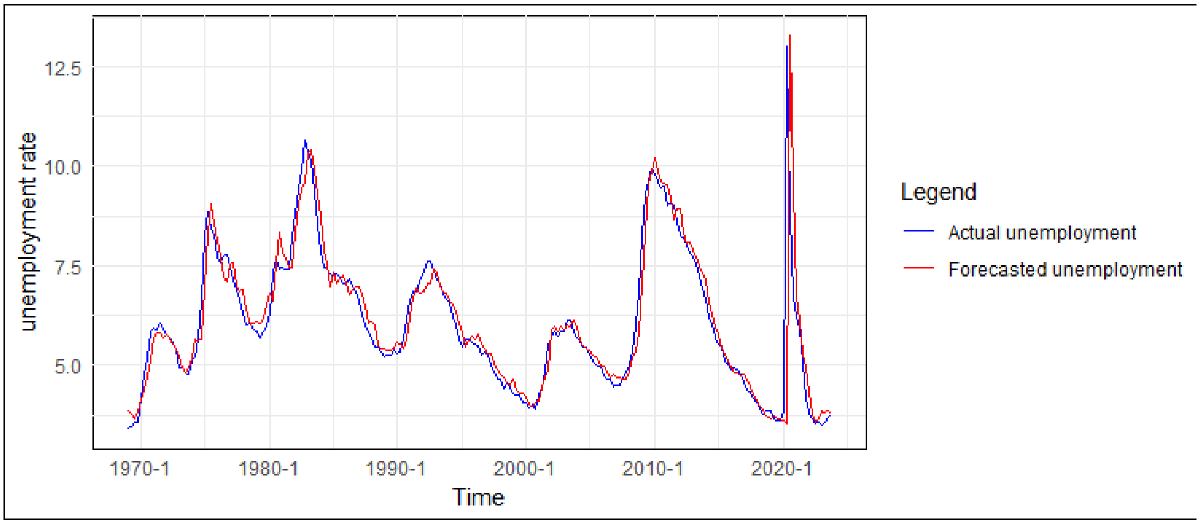

FIGURE 8. THE ACTUAL UNEMPLOYMENT RATE AND THE FORECASTED UNEMPLOYMENT RATE OVER TIME.

9.3 Appendix 3: stationarity tests

Before estimating the model I performed an augmented Dickey-Fuller (ADF) test on both the dependent and independent variables to test for stationarity in the variables. The ADF test resulted in insignificant p-values for the ambiguity measure for inflation (0.1199), the mean forecasted inflation (0.2964) and the savings rate (0.1366), indicating that these variables are non-stationary. Since stationarity is an OLS assumption this problem had to be solved. After taking the first differences of these variables the ADF tests showed significant p-values (α=0.05), indicating that the first differences are stationary. I replaced the original variables that were non-stationary for the first differences to estimate the OLS regressions.

9.4 Appendix 4: ambiguity measures

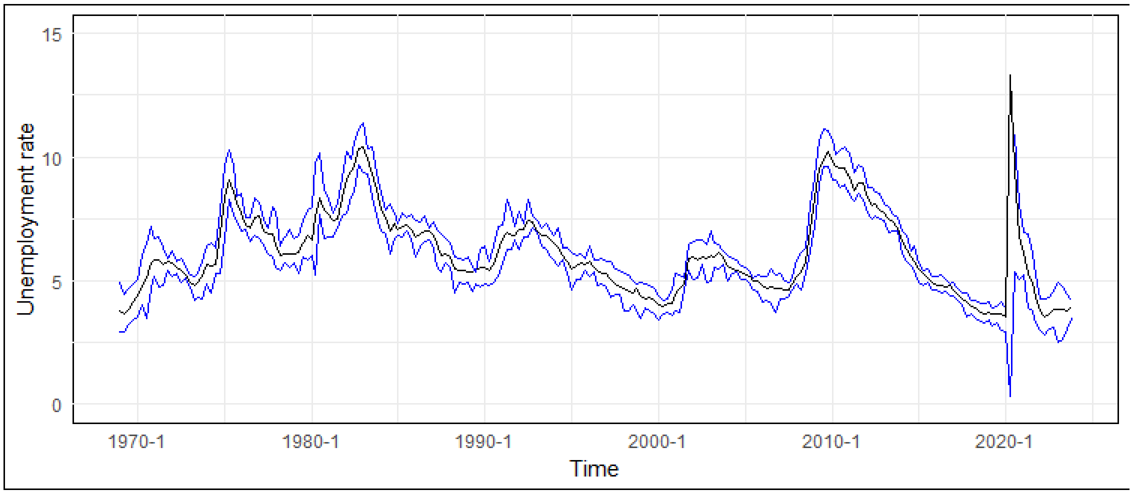

FIGURE 9. THE MEAN FORECASTED UNEMPLOYMENT RATE OVER TIME INCLUDING THE 25TH AND 75TH DECILE

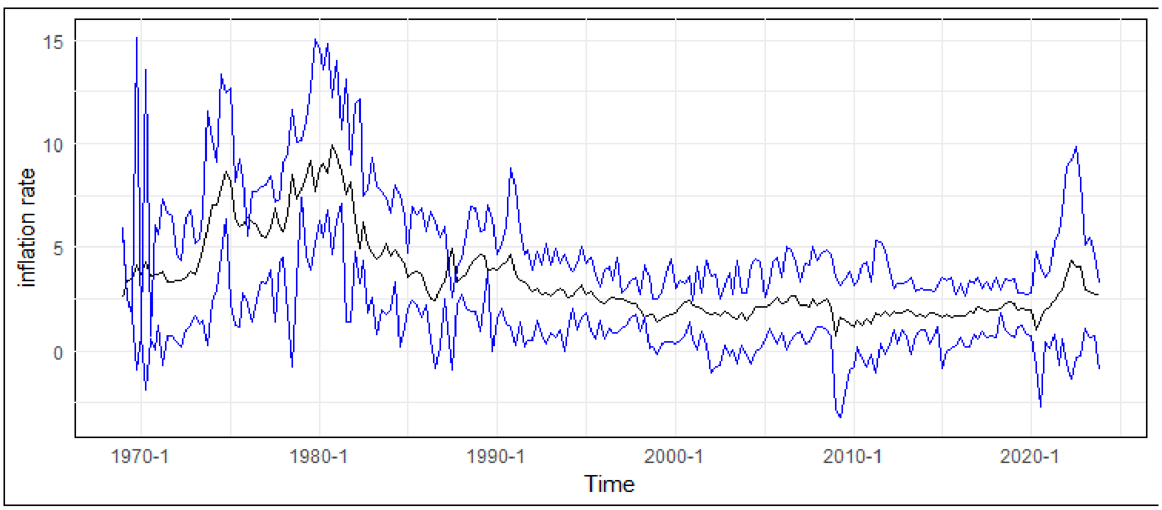

FIGURE 10. THE MEAN FORECASTED INFLATION RATE OVER TIME INCLUDING THE 25TH AND 75TH DECILE

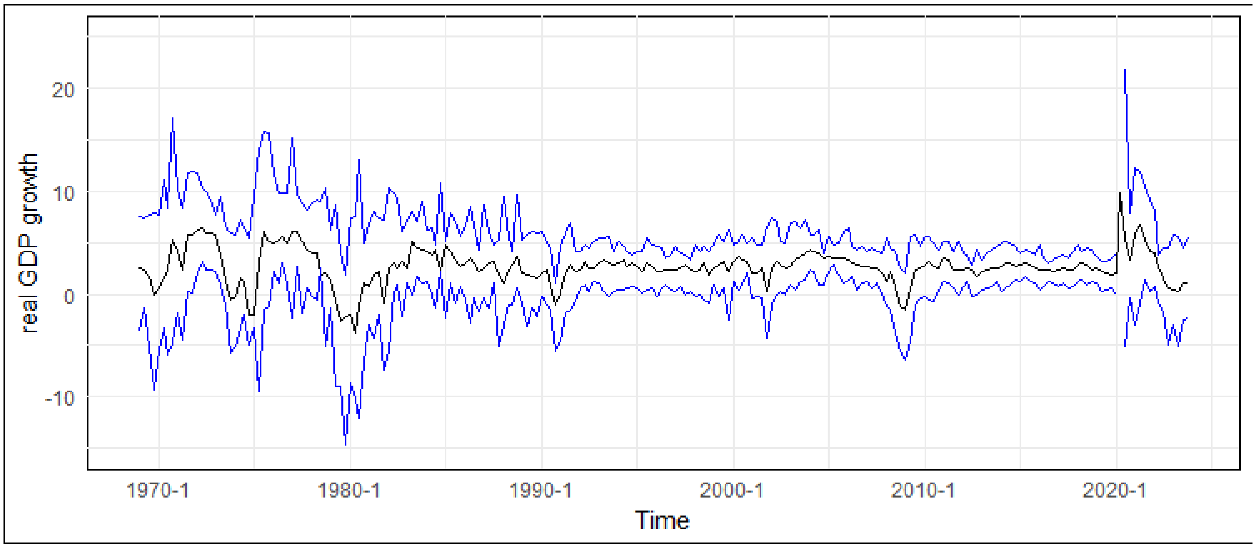

FIGURE 11. THE MEAN FORECASTED REAL GDP GROWTH RATE OVER TIME INCLUDING THE 25TH AND 75TH DECILE