Brexit announcement effects on the UK stock market

A PARCH model approach

Abstract

A widely discussed topic nowadays, what is going to happen if a Brexit actually happens to the British economy, and more specifically to the British stock market? This paper attempts to find significance in the disturbances caused by the Brexit announcement starting from May 2015 till the referendum date June 2016. A very extensive literature review is done on the systematic factors affecting the stock market return. Data starting from 1995 is used to find this effect. A Power GARCH approach is used to model the data, in combination with a dummy variable to catch the effect of the Brexit announcement. In the end no significant results were found that indicate an effect of the Brexit dummy.

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1 Introduction

In May 2015 during the Queen's speech it was made public that the people of Great Britain would get a referendum about whether or not Great Britain would stay or leave the European Union on 23th of June 2016 (Gross and Winning, 2015). The motive for this referendum was a promise from the British prime-minister David Cameron to the anti-European Union party, to arrange a referendum. The anti-EU party insisted on this referendum because they stated that the disappointment in the European Union was at an all-time high (Payne, 2016).

A so-called 'Brexit' is what this anti-EU party pledged for. Their reasoning is that the European Union is only damaging for the United Kingdom and the United Kingdom would be better off without the European Union. But what are the actual consequences if Great Britain leaves the European Union? Because such a thing never has happened before, 'experts' can only speculate on what could happen. It has been a well-discussed topic for the past months. For example, in an article written by Arnold and Noonan (2016) in the Financial Times the concerns about banks possibly leaving the United Kingdom are discussed. This possibility arises because the banks are no longer able to run their European businesses from the United Kingdom.

In another article, also in the Financial Times, written by Jackson and Bullock (2016), the effect of the uncertainty about the Brexit on firms that want to 'go to the market' (listings, initial public offerings) is set forth. It is written that a lot of firms do not want to go public because of the current financial economic state. It is thus clear that the announcement of the Brexit was cause for a lot of disturbances on the financial market, mainly due to its uncertainty. This paper tries to find what the effect of the announcement that there is a possibility that Great Britain leaves the European Union (or the Brexit announcement) is, and more specifically what the effects are on the UK stock market.

A lot has been speculated on what could happen if a Brexit goes through. Because it is such a new subject, not a lot have been written about it yet. Though, still some small research has already been done on the possible effects. It is shown that Germany would suffer most from a Brexit, followed by France and the United Kingdom itself (Bouoiyour and Selmi, 2016). Other than this small research, only working papers with speculations have been written on what would happen if the referendum results in a win for the party to leave the European Union. One of our biggest fears should be, according to Capriglione (2016), that the win will be seen as an incentive to hold more referenda.

In this paper it is attempted to determine the impact of the uncertainty concerning Brexit on the stock market return of the UK stock market. Since the Brexit referendum was first announced in the Queen's speech on 25th May 2015 and the referendum was going to be held on 23th June 2016, this period will be used as the event period.

The intuition behind looking at the stock market return of a country is that according to the Efficient Market Hypothesis (Fama, 1970), stock market returns are a reflection of all available information about the stock market. And thus changes in the stock market returns are explained by a new inflow of information that is either favorable or unfavorable. Since more and more companies are choosing to go public, the stock market return is a great indication of how well an economy of a country is doing. Increases in stock prices are an indicator that the stocks of a firm are high in demand. This increase in demand among investors is based on positive growth expectations about the firm. This positive growth of firms in a country will be translated into a positive economic growth in this country. Such a growth will be captured by the country's stock market index that will be in higher demand.

Thus an increase in the stock market return of a country is an indicator for economic growth and a positive investment environment. This stock market return, however, is affected by systematic factors. The literature about what systematic factors could affect the stock market return is really extensive. For example, Chen, Roll and Ross (1986) find five macroeconomic factors that have an effect on the stock market return of a country. Fama and French (1993) found three market factors that predict the stock market return. Among the others, there was a factor that represents risk. They showed that an increase in risk, increases the stock market return as investors see it as fair to be rewarded more the more risk they take.

Concerning the literature, this paper has been very extensive to search for different factors that affect stock market return. This is done to be able to assign the effect to the Brexit effect as complete as possible.

This paper contributes to the existing literature as it is a clear exposition of previous papers written on the topic of the stock market return. This paper attempts to compile the existing literature as good as possible to form a model that is able to analyze the historic stock market return. As an extension of the existing literature a new variable in the form of the relative exchange rate is proposed. Furthermore, although some small research has already been done on the consequences of the Brexit announcement, no paper has done so as extensive as this paper. It has never occurred that a country is so close in stepping out of the European Union. This makes it such an interesting, but yet delicate subject. Since no one can fully predict what is going to happen if all this goes through. As it is such a current subject, this paper can serve as a basis upon which further, more detailed research can be done.

This paper is structured as follows. In section 2, previous literature that is relevant for this paper is discussed. In section 3, the selection of different variables is set forth. In section 4, the methodology that is used to analyze the data is presented. In section 5, the data is shown as well as the descriptive statistics on the data. In section 6, the results of the analysis of this paper are presented. In section 7, the conclusion of the research is discussed. Finally, in section 8, the limitations of this research are set forth.

2 Literature Review

2.1 A word on 'Brexit'

In a recent paper written by Bouoiyour and Selmi (2016) describes the effects of a potential 'Brexit' on the stock prices of German and French stocks. They investigate how much the attention given to the event impacts UK, French and German equities. Different variables are used to control for the effects of global financial and economic factors. The variables used in this paper are the US equity volatility index (VIX), the West Texas Intermediate (WTI) oil price and the world gold price. To test for the Brexit announcement they use data from Twitter and Googletrends. It is showed that Germany would suffer the most from a Brexit, France comes second and the United Kingdom last.

It is shown, however, that the consequences of a 'Brexit' are more harmful to the United Kingdom compared to Europe as a whole. However, the biggest risk that is faced if Great Britain votes to exit the European Union is the risk that other members of the EU (especially the ones more populistic of nature like Italy and France) may promote these referendums which undeniably would influence the market instability (Capriglione, 2016).

Further research on the subject of Great Britain leaving the European Union is done by Nicholas Bloom (2016). He sets forth, while using an Economic Policy Uncertainty index, that the largest economic policy uncertainty is even higher than the Economic Policy Uncertainty of the financial crisis of 2007.

A similar event that could be used for comparison is the potential exit Greece out of the European Union. It is surprising how little research is done in this area, especially compared to the amount of research found that is already been done on the effects of a possible Brexit. Although researchers are unanimous that the impacts of Great Britain leaving the European Union in any case would be negative, research that is found shows that this is not the case for Greece. Only the Greek banks would have suffered from a Greek bailout, European banks (even if they have any exposure to Greek banks). This is shown by a paper from Mink and De Haan (2013) investigating the effect of news about the possibility of Greece leaving the Euro.

2.2 Factors affecting stock market returns

To make sure to show the effect of a news announcement like Brexit, other macroeconomic variables need to be included in the model to be able to show the effect as clearly as possible. Since this paper focuses on the effects on the FTSE 100 index it is reasonable to look at macroeconomic variables, since it is expected that these affect such an index. The research done in this area is very extensive. There are many papers trying to find what underlying systematic factors affect the stock market return. There has been interest in the value premium of stocks among investors and the underlying factors that cause this value premium. Of course, if one could find all the factors that affect the stock market return, one would be able to predict the stock market return at all times. Such a model would be highly profitable and that is why the research done in this area is so extensive. Although some factors in the economy seem exogenous, all macroeconomic factors are ultimately linked one way or the other to each other which makes each factor endogenous. Only natural events occurring, like earthquakes or tsunamis, truly affect the world economy exogenous (Chen, Roll and Ross, 1986). This means that there could be created a model that implements all the factors affecting the stock market of a country. A lot of research has been done in this area, which will be set forth in the following paragraphs.

According to the Efficient Market Hypothesis (EMH) (Fama, 1970) stock market returns are a reflection of all available information in the market. Changes in the stock market return are thus, according to the theory, due to changes in information about the stock market return and its underlying factors. It is thus expected that the new available information concerning the possibility of Great Britain leaving the European Union has an effect on the stock market return. Since the stock market return reflects all available information, the new information concerning the Brexit should be translated into changes in the stock market return.

Fama and French (1993) were first to assign an increase in risk to an increase in stock market return. They found that the book-to-market ratio is an indication for stock market risk. Fama and French stated that if the risk on stocks increases, investors want a higher premium on their returns. Investors want to be rewarded for the risk they take in investing in a riskier stock. Investors select portfolios based on risk, by selecting how much exposure to systematic factors they want. Swifts in the stock market return are then explained by more information being available about an increase or decrease in risk on the stock. Thus it is reasoned that there is no anomaly with respect to EMH since changes in the stock market return is a reflection of changes in risk of the underlying factors (Van der Sar, 2015).

To start the exposition of papers relating the systematic factors underlying the stock market return, in the paper of Chen, Roll and Ross (1986) a set of macroeconomic variables are compiled that are expected to have an effect on the stock market returns. The set of variables consists of the inflation rate, the treasury-bill rate, the long-term government bonds, industrial production, low-grade bonds, equally weighted equities, value-weighted equities, consumption and oil price. They find that the industrial production, changes in risk premium, twists in the yield curve significantly explain the expected stock market returns. During periods in which these variables were highly volatile it was found that the measures of unanticipated inflation and changes in expected inflation were more weakly significant. In the end they find five systematic factors that have an effect on the stock market return. First there is the unexpected inflation rate, second the expected inflation rate, third the yield curve, fourth a (default) risk premium, and finally they found that changes in the growth rate of industrial production has an effect on the stock market return.

The intuition behind the factor of industrial production used by Chen, Roll and Ross (1986) is that industrial production is an indicator of the activity of firms within a country. An increase in industrial production usually corresponds with an increase in the demand of the goods of the firm. If the demand of a good of a firm increases, the opportunity for the firm to grow increases as well. Increases in the growth rate of a firm gets warm reception on the stock market. As demand of investors in the stocks of a particular firm or country increases, the stock price increases as well and thus the stock market return increases. Therefore, a positive effect between industrial production and stock market return is expected to be seen.

Another prominent variable in their research is the inflation rate (Chen, Roll and Ross, 1986). It is expected that whenever inflation increases this effects the real activity in a negative way. According to financial theory a decrease in real activity affects anticipated growth rates of firms which cause the stock market returns to decrease. There exists a positive relation between interest rate and inflation (Fama, 1981). This is due to the fact that governments change their monetary policy with changes in inflation. The interest rate can be seen as the opportunity cost of holding money. Following the quantity theory of money, if interest rate increases it becomes more favorable to hold money instead of investing it. This causes a decrease in demand on stocks and this causes in turn a decrease in the stock market price, and thus the return.

Shanken and Weinstein (2006) test the five factors compiled by Chen, Roll and Ross (1986) that are expected to affect stock market returns. These factors are the percentage change in industrial production, the change in expected inflation, the contemporaneous unanticipated inflation, the excess return of low grade corporate bonds over long-term government bonds and the excess return of long-term government bonds over T-bills. They find that there is a significance in the variable of industrial production. However, for the other factors they don't find significant results. This has to do with the fact that, other than Chen, Roll and Ross (1986), they looked at the post-ranking returns instead of the backward-looking returns.

Dividend yield is calculated by dividing the dividend by the stock price. The dividend yield thus shows how much money the investor receives for every euro invested in the company. A high dividend yield ratio indicates low stock prices. Theoretical reasoning behind this is that investors expect these stock prices to be considered too low. Investors expect stock prices to increase in the near future which causes higher demand on these stocks which then causes stock prices to increase. Therefore, a positive relation between stock prices and dividend yield is expected according to the theory (Van der Sar, 2015).

Fama and French (1988) wrote a paper on the forecasting power of dividend yield on stock market returns. They calculated the dividend yield by dividing the dividend of a stock by the price of that stock and showed that the dividend yield explains for 25% the stock prices variances for the returns from two to four years. They showed that when dividend is high the stock return will be high in the future.

One year later Fama and French (1989) wrote a paper about whether or not the same variables predict stocks and bonds. And, more interesting for this paper, they looked if the variation in expected bond and stock prices are related to business conditions. For the business conditions variable, they choose the default spread. The dividend yield is chosen as explanatory variable because previous literature thoroughly investigated if there is enough explanatory power in this. It is showed that the dividend yield is highly correlated with the default spread which means that dividend yield moves in a similar way as the long-term business cycle. For the shorter-term business cycle, the term spread is used as a measure for excess return. It is showed that all of these three variables have enough explanatory power to forecast bond returns, as well as stock returns. They conclude with their finding that bond and stock returns are negatively related to short- and long-term business cycle fluctuations.

Amihud (2002) modeled a newly composed illiquidity equation to the stock market return and found positive indications on the effect of illiquidity on stock market returns. Fear among investors about the market illiquidity has substantially increased after the financial crisis of 2007, as well as after the finding about the fast integration of capital markets. Research about the stock market return nowadays always include the illiquidity factor (see for example Laing and Wei, 2012). The source of this interest in the liquidity of stocks is the fact that if liquidity decreases (illiquidity increases), is cause for transactions to become less efficient. This is mainly due to the increase in transaction costs (Huang and Wang, 2010). An increase in transaction costs can happen if for example the government intervenes with policy. Thus, if stock markets become less liquid, stability and efficiency decreases which causes an increase in risk for investors to join in a transaction. It is already showed that with an increase in risk, investors demand higher premiums which causes stock market returns to increase. It is thus expected that an increase in illiquidity goes together with an increase in the stock market return.

In their paper, Chiang and Chen (2016) look for the proper set of variables in emerging markets. They find a set of variables based on previous literature. They focus on two types of variables. The first type describes the fundamental determinants of the domestic market. The second type of variables describe the external forces. Among variables mentioned before, they include the trading volume and stock market volatility.

Trading volume is used in their model because, to quote Karpoff (1987), “it takes volume to make price move.” Trading volume is a great indicator of the structure of capital markets. As mentioned before, new information causes demand or supply on the equity market (good news causes demand and bad news causes supply). Thus, if there is a new information arrival on the stock market, it is expected that trading volume increases as well. Due to short sale constraints (mainly transaction costs) it is seen that these information arrivals generally cause the trading volumes that are linked with a price increase exceed the trading volumes with an equal price decrease. It is thus expected that an increase in trading volume is associated with an increase in stock market return. Empirical research supports this view (among others, Epps and Epps, 1976; Rogalski, 1978; Harris, 1986).

Another variable used in the model of Chiang and Chen (2016) was the stock market volatility. Among the variables used in this paper, this is the variable most closely related to risk. The more volatile a stock is, the riskier it is to invest in (highly volatile implies the possibility of large increases as well as large decreases). As seen before, a generally accepted theory in finance is that the risk and stock market return are positively correlated with each other. Therefore, following theoretical reasoning, it is expected to see increases in the stock market return as stock market volatility increases.

In a more recent paper, Flannery and Protopapadakis (2002) extend the research done on the macroeconomic variables that effect stock market returns. In this they use a GARCH model to analyse daily equity return data. They use 17 macroeconomic announcement series from 1980 to 1996. If the macro announcement series affects the returns or increases the conditional volatility of the market, the announcement is identified as a potential “risk factor”. So they tested for 17 macroeconomic announcements if it was a potential “risk factor”. They found that the previously widely accepted variables of inflation to affect the stock market return, the CPI and PPI, only affect the returns. Three real factors, balance of trade, employment and unemployment, and housing, only affect the conditional volatility. It is found that monetary aggregate affects both returns and conditional volatility. In this it is new to find that balance of trade, employment and housing have a significant effect. What is surprising is that they find no significant effect from the variable that represents industrial production, despite this factor being widely recognized to have a significant effect.

3 Selection of Variables

The selection of variables is of great importance to be able to link the events concerning the possibility of Great Britain leaving the European Union with effects on the stock market return of Great Britain. The more extensive the amount of variables of economic forces that affect the stock market return is, the better the effect of a potential 'Brexit' can be liked to an abnormal stock market return. However, adding variables that do not influence the British stock market return would cause for the results to be false and the analysis to be based on a spurious regression. A lot has been written on what economic forces affect the stock market return of a country. Based on previous literature, the following selection of variables has been assembled.

According to previous papers there are two types of macroeconomic factors that affect the stock market return of a country. The first category consists of domestic macroeconomic factors like dividend yield or the trading volume of the stock market. The second category concerns global factors (externally) affecting the stock market returns of a country. The variables below are compiled after an extensive literature analysis on papers written on stock market returns. A new variable is suggested which is the exchange rate variable. Except for this variable, all of the below are based on theoretical and empirical papers.

3.1 Stock market return

This will be the independent variable. The return value represents the FTSE 100 stock index. In order to obtain the weekly growth rate of the stock market return, the log return is calculated following the equation composed by Ding, Engle and Granger (1993):

$$R_t = \ln(P_t) - \ln(P_{t-1})$$

In this R_t stands for the stock market return, P_t for the stock price at time t and P_{t-1} the stock price at time t-1.

3.2 Dividend yield

Dividend yield is a variable which is much discussed on and by researchers widely accepted to have an influence on the stock returns. In their paper Campbell and Shiller (1988) find that the higher prices of stocks are related with an expected future dividend that is higher. In their conclusion they say that the log dividend yield moves along with stock prices. As said earlier, it is proven that the explanatory power of dividend yields to forecast the stock market return lies within the expectation that it leads to a higher stock return in the future. It is found that the dividend yield moves along with the stock return (Fama and French, 1988). Thus, according to the theory, there should be a positive relationship between stock market return and dividend yield. In order to obtain the logarithmic return from the dividend yield, the equation proposed in their paper by Campbell and Shiller (1988), and later confirmed by Fama and French (1988), is used. The equation looks as follows:

$$Y_t = {}^{D_t}/_{P_{t-1}}$$

Where Y_t stands for the dividend yield at time t, D_t is the dividend at the corresponding time t and P_{t-1} is the stock price at time t-1.

3.3 Trading volume

The theory that trading volume contains information concerning stock market returns has been studied quite extensively. Early research rationalized on the fact that trading volume should affect stock market returns positively. This rationale starts from a former equilibrium position and then assumes that demand on a security increases (decreases), the market then in the clear at some price above (below) the equilibrium price. Within this process the security is constantly adjusted by transaction, hence increasing (decreasing) the trading volume (Crouch, 1970; Clark, 1973; Westerfield, 1973). Empirical research showed that there is a relationship between the trading volume and price changes (Epps and Epps, 1976). It is suggested using trading volume as a determinant of market information, since it reflects the investor's opinion. They show that there is a positive relation between transaction volume on the stock market and stock market returns. Rogalski (1978) and Harris (1986) find similar results.

More recent research shows that across nine national markets investigated, trading volume contains some information on the stock market returns. Empirical research shows that the stock market returns Granger cause trading volume, and that trading volume (although to a lesser extent) Granger causes stock market return (Chen, Firth and Rui, 2001).

To calculate the monthly growth rate of the trading volume, the log return is calculated as follows:

$$MV_t = \ln(TV_t) - \ln(TV_{t-1})$$

In this MV_t stands for the monthly growth rate of the trading volume at time t, TV_t stands for the trading volume at time t and TV_{t-1} stands for the trading volume at time t-1.

3.4 Stock market volatility

Theoretical models like that of Sharpe (1964) and Black and Scholes (1974) relate stock price changes directly to the concept of variance. Investors expect to earn more when the volatility increases, since risk increases with this as well. It is found that there exists a positive and significant relation between the stock market volatility and the stock market return (French, et al., 1987; Baillie and DeGennaro, 1990; Ghysels, et al., 2005; Bali and Peng, 2006; Ludvigson and Ng, 2007; Bali and Cakici, 2010). In a more previous paper, the difference between realized volatility and absolute return volatility is measured. It is found that, although the realized return volatility is a better predictor of near-future market behaviour, the absolute return volatility is roughly as sensitive as the realized return volatility, but easier to calculate (Zheng, et al., 2014).

Chiang and Chen (2016) come to this same conclusion, and thus absolute return volatility will be used in this analysis. To calculate the absolute return volatility, the following formula is used:

$$\sigma_{AB}(t) = \left|\frac{R_t - \langle R_t \rangle}{\sigma_R}\right|$$

In this $\sigma_{AB}(t)$ is the absolute return volatility, R_t is the return, $\langle R_t \rangle$ is the average value of the return and σ_R is the standard deviation of the return series.

3.5 Illiquidity measure

In his paper, Amihud (2002) describes the significance of stock illiquidity on its return. It is shown that market illiquidity positively affects ex ante abnormal stock returns. An abnormal excess return, is usually interpreted as a "risk premium", Amihud suggests that a premium for stock illiquidity is included in this. Stock illiquidity shows how easily stocks can be sold or bought. This is affected by for example the transaction costs. Amihud came up with an illiquidity measure based on the absolute value of the return and the trading volume of a stock. The paper states that there is a positive relation between illiquidity and stock market return. The Amihud illiquidity measure is further used in research and confirmed that there indeed is a positive relationship between illiquidity and stock market returns. The formula he used, is used in this paper as well and looks as follows:

$$ILLIQ_{iy} = 1/D_{iy} \sum_{t=1}^{D_{iy}} |R_{iy}| / VOLD_{ivyd}$$

In this $ILLIQ_{iy}$ stands for the illiquidity measure, D_{iy} stands for the number of days for which the data is available for stock i in year y, $|R_{iy}| / VOLD_{ivyd}$ is the average ratio of the absolute return to the trading volume of that day. In this R_{iy} stands for the return on stock i of year y and $VOLD_{ivyd}$ is the respective trading volume.

3.6 Industrial Production

As discussed earlier, Chen, Roll and Ross (1986) first introduced this variable in their paper. They find significant results for an industrial production variable. They find that the effect industrial production has on stock market returns is positive. This variable is found to have a significant effect in later research as well. Shanken and Weinstein (2006) show that there is indeed a significant positive relation between industrial production and stock market returns. They reinvestigated the five factors effecting the stock market returns, compiled by Chen, Roll and Ross (1986), and the only variable they found a significant effect for was the industrial production. To calculate the growth rate of the industrial production, the following equation, composed by Chen, Roll and Ross (1986) is used:

$$MP_t = lnIP_t - lnIP_{t-1}$$

Where MP_t stands for the weekly growth rate of the production, $lnIP_t$ stands for the natural logarithm of the industrial production at time t and $lnIP_{t-1}$ stands for the natural logarithm of the industrial production at time t-1.

3.7 Inflation

In his paper, Fama (1981) finds a negative relation between inflation and stock market returns. The intuition behind this is that of the quantity theory of money in which it is predicted that higher anticipated growth rates of real activity are combined with lower inflation rates. In their paper Chen, Roll and Ross (1986) also emphasize on the importance of the effect of inflation on the stock market return. They also find a significant, negative relation between inflation and stock market returns. However, they only found a significant result for one of the four sets of periods they used, so the results were rather weak. The effect of inflation on the stock market returns has been the topic of many papers after that. The weekly growth rate of inflation is obtained by taking the log return and is calculated as follows:

$$WI_t = lnI_t - lnI_{t-1}$$

In which WI_t stands for the weekly growth rate of the inflation at time t, lnI_t stands for the natural logarithm of the inflation at time t and lnI_{t-1} stands for the natural logarithm of the inflation at time t-1.

3.8 Relative Exchange rate

This variable is suggested because of the increasing integration from stock markets. The strength of a domestic currency depends on the strength of foreign currencies. Exchange rate variations have a great influence on the commodity prices of a country and this is directly translated through in the competitive position of a country, and hence will influence the stock market returns. In the short run it is expected that if the exchange rate of a country increases, the foreign investors' interest in the stocks of a country increases as well because an increase in the exchange rate mirrors an economy that is doing well (Chiang and Chen, 2016). In the paper Chiang and Chen find a statistically significant negative sign for the US dollar/Taiwan dollar exchange rate and thus their result can be interpreted as a raise in value of the Taiwan dollar and strengthens the economy, which in turn rises the optimistic market sentiment and promotes the purchasing of stocks. Since this thesis is interested in the effects on the UK stock exchange, the value of the British sterling pound is obtained. It is expected to see a positive effect between the British pound value and the stock market return. The intuition behind this positive effect is that if the currency of a domestic country is increasing, the goods of this country increase in demand. As demand in domestic goods increase, the growth of domestic firms increases as well. Higher growth rates for firms will be translated on the stock market as favorable and increases the demand in the stocks for domestic firms. As demand increases, the stock prices (and thus the stock market returns) increase as well.

3.9 Brexit dummy

The Brexit dummy is the most important variable in this paper because the whole research question is built around it. The methodological intuition behind it is emphasized in the following chapter. The dummy variable will take the value 0 before the announcement that Great Britain is going to have a referendum about whether or not Great Britain leaves the European Union or stays in it. This date is set at the 27th of May 2015 in which it became public that there was going to be a referendum through the Queen's speech. After this date the dummy variable will take the value 1 (Gross and Winning, 2015). From now on the dummy variable for Brexit will be referred to as 'BrexitDum.' Because of the possibility of a Brexit, this increases uncertainty on the stock market, and with it the risk, it is expected that stock market returns increase. Greater risk for investors makes investors want to be compensated, as stated before. However, because such an uncertainty has never happened before in history, it is really hard to predict what is going to happen, which increases the uncertainty to a certain extent.

Table 1: Glossary and definition of variables

Symbol	**Variable**	**Definition or Source**
R	Stock Market Return	Log return of the FTSE100 stock index
Y	Dividend Yield	Log return of the dividend yield
MV	Trading Volume	Log return of monthly trading volume
SMV	Stock Market Volatility	Absolute return volatility
ILLIQ	Amihud Illiquidity Measure	Measurement of illiquidity as proposed by Amihud (2002)
MP	Industrial Production	Log return of monthly industrial production
MI	Inflation	Log return of monthly Consumer Price Index
RER	Relative Exchange Rate	Log return of monthly relative exchange rate

4 Methodology

4.1 OLS estimation

As the literature indicates that it is preferred to look at the variances of financial data, the GARCH model is used for the regressions and is explained in the following section. However, for comparison reasons, a normal Ordinary Least Squares (OLS) regression method will be used as well. The OLS method tries to estimate the different parameters (the independent variables) on a certain dependent variable. For this research, two types of regressions will be used. One with the proposed variable relative exchange rate, and one without this variable, so that the following two regression functions are estimated:

(1) $R = \alpha + \beta_1 Y + \beta_2 MV + \beta_3 SMV + \beta_4 ILLIQ + \beta_5 MP + \beta_6 MI$

(2) $R = \alpha + \beta_1 Y + \beta_2 MV + \beta_3 SMV + \beta_4 ILLIQ + \beta_5 MP + \beta_6 MI + \beta_7 RER$

4.2 GARCH Model

To analyse financial time series data, it is common to use a General Autoregressive Conditional Heteroskedasticity (from now on GARCH) model. This model is derived from the Autoregressive Conditional Heteroskedasticity model. The ARCH model of regression was first introduced by Robert Engle (1982), when he was estimating the variance of United Kingdom inflation. He reasoned that the usual econometric assumption of a constant one-period forecast variance is improbable. Instead a new way of stochastic processing was found called autoregressive conditional heteroscedastic processes. In this the mean is zero, serially uncorrelated, with non-constant variances and constant unconditional variances. It was known that the market volatility has the tendency to cluster in periods of high volatility and of low volatility. After the discovery of the model it became possible to formalize and generalize this tendency (Engle, et al., 2012).

The ARCH/GARCH model approach is used because of its approach to successfully predict volatility changes. The data analysed consists of financial data, which is known for its clustering of volatilities. As asset prices are a reflection of the best predictions of companies' and countries' future probabilities, these changes with new information (by the news for example). The ARCH and GARCH model is then best in measuring the severity of the news. When it concerns economic data, volatility clustering can be best seen as news clustering (Engle, et al., 2012). Since this paper is interested in analysing the effect of news announcements surrounding the possibility of Great Britain leaving the European Union, the GARCH model is, in definition, the best option to use for the analysis.

The ARCH/GARCH model previously mentioned concerns single asset data. Since the analysis done in this paper focuses on using more than one variable to predict the stock market return, a multivariate approach to the GARCH model has to be used. A multivariate approach frequently used by researchers is the power

GARCH model. The power GARCH model is first introduced by Ding, Granger and Engle (1993). After the introduction of the power GARCH model, the model is confirmed on its applicability on stock market data (Hentschel, 1995; Brooks, et al., 2000; McKenzie and Mitchell, 2002; Giot and Laurent, 2004). The advantage of using the PARCH model rather than other variances on the GARCH model is that "rather than imposing a structure on the data, the PARCH model allows a power transformation term inclusive of any positive value and so permits a virtually infinite range of transformations" (McKenzie et al., 2001).

As with the OLS regressions, two different regressions are run for the power GARCH model as well. One includes the variable relative exchange rate, and one excludes this variable. Then the two will be compared to see which of the regressions fits the data best. When considering a power GARCH model, the equation consists of two parts. On the one hand there is the OLS equation, estimated in section 4.1 (equations (1) and (2)). On the other hand, the GARCH model approach estimates a conditional volatility equation. This equation looks as follows:

(3) $h_{i,t}^{\delta_i} = \omega_i + \alpha_i(|\varepsilon_{i,t-1}| - \gamma_i\varepsilon_{i,t-1})^{\delta_i} + b_i h_{i,t-1}^{\delta_i}$

In this $h_{i,t}^{\delta_i}$ is the power GARCH model outcome, $|\varepsilon_{i,t-1}|$ is the absolute value of the residual at time t-1, $\gamma_i\varepsilon_{i,t-1}$ is the residual at time t-1 multiplied by the coefficient γ_i, $b_i h_{i,t-1}^{\delta_i}$ is the GARCH model outcome at time t-1 multiplied by the coefficient b_i.

4.3 Dummy variable

To test for the effect of the announcement of the possibility of Great Britain leaving the European Union a dummy variable is used.

The hypothesis that surrounds the research question of this paper is directly related to the Brexit dummy. The hypothesis concerning the Brexit dummy is formulated as follows:

$$H_0: \beta_9 \neq 0$$

This means that whenever the z-statistic of the dummy variable is significant, a significant effect is found. This allows for a conclusion that the Brexit announcement has a significant effect on the UK stock market (whether this effect is positive or negative).

5 Data

5.1 Information on the data

In this section an elaboration on the source of the data is given. All the data concerning the variables is collected from the Thomson Reuters Datastream. For the stock market return variable the corresponding stock prices. For the stock prices the FTSE 100 index is collected. For the dividend yield variable, the corresponding dividends and stock prices are collected from Datastream as well. In order to be able to see the noise surrounding a Brexit announcement which this thesis focuses on, weekly data is collected from Datastream, because daily data was not available for all of the variables included in the model. Weekly data was not available for the variables concerning inflation, industrial production and the exchange rate. To be able to work with the data, all the data needed to be equal and thus monthly data was conducted from Datastream.

The data concerns time series data starting from the sixth month in 1966 and ends at the sixth month of 2016. For the variables including the FTSE100 index data was not available until the second month of 1978. Data regarding the industrial production doesn't start until the first month of 1968. The data surrounding the trading volume doesn't start until the first month of 1995 and inflation doesn't start until the first month of 1988. So to sum up, from the first month of 1995 the data is complete. The conclusions made in this analysis are thus only based on data from the first month of 1995. For the inflation rate measure, the most widely used indicator for inflation is used as the Consumer Price Index (CPI from now on).

As already mentioned in the introduction, the time period concerning the event that includes the announcement effect of Brexit stretches from May 2015 to June 2016. In May 2015 it was made public in the Queen's speech that there was going to be a referendum. And in June 2016 (more precisely 23th June 2016) the referendum was going to be held. Since there is no data available after the 4th month of 2016, the event date of this research stretches from the 5th month of 2015 to the 4th month of 2016.

5.2 Descriptive statistics

In this section an overview is given on the descriptive statistics of the variables used for this thesis. The variables used in the model are stock market returns, dividend yield, trading volume, stock market volatility, Amihud illiquidity measure, industrial production, the inflation rate and the exchange rate.

The emphasis on the different variables mentioned above can be found in *Table 2*. In *Table 2* descriptive statistics can be found of the stock market return (R), the dividend yield (Y), the monthly growth rate of the trading volume (MV), the stock market volatility (SMV), the Amihud illiquidity measure (ILLIQ), the monthly growth rate of industrial (MP), the monthly growth rate of the inflation (MI) and the monthly growth rate of the relative exchange rate of the British Pound Sterling (RER).

After taking a closer look at the descriptive statistics it is seen that all of the means are positive, except for the dividend yield (Y) and the relative exchange rate (RER). This indicates that for most of the variables they have seen a positive average growth. However, for the dividend yield and relative exchange rate this sign is negative. The median for both these variables is below zero as well, this may indicate that a lot of negative values can be expected from these variables.

The highest maxima and minima observed are from the stock market volatility (SMV) and the illiquidity measure (ILLIQ). This probably has something to do with the way they are calculated. For the stock market volatility the average stock market return is subtracted from the stock market return at time t. This is divided by the standard deviation of the stock market return. As seen in the descriptive statistics the standard deviation is really small, so this means that the stock market volatility is going to relatively high. For the illiquidity measure the stock market return is divided by the trading volume. Looking at the averages, the stock market return is higher than the trading volume (denoted as MV). This means that the illiquidity measure (ILLIQ) is going to be relatively high.

When looking at the descriptive statistics the skewness and kurtosis are elaborated. The skewness shows the asymmetry of the distribution around its mean and the kurtosis is an indicator of the sharpness of the peak of the distribution curve. The skewness in the descriptive statistics shows that for the dividend yield (Y) and inflation rate (MI) that it is slightly right-skewed. For the variables illiquidity (ILLIQ), industrial production (MP) and relative exchange rate (RER) the data is slightly left-skewed. Whereas for the variables stock market return (R) and trading volume (MV) the data has a left-skewed distribution. And the for the variable stock market volatility (SMV) the data consists of a right-skewed distribution. The kurtosis shows high values which means that the distribution of the values has fat tails and are flat-shaped.

Table 2: Descriptive Statistics

	R	**Y**	**MV**	**SMV**	**ILLIQ**	**MP**	**MI**	**RER**
Mean	0.005628	-0.001866	0.002597	0.731943	0.251962	0.000661	0.002147	-0.00521
Median	0.007571	-0.006645	0.008160	0.592448	0.832067	0.000985	0.002567	-3.12E-05
Max.	0.130294	0.364555	0.101638	6.744931	5.929895	0.094221	0.033959	0.057366
Min.	-0.315953	-0.401441	-0.239793	0.000891	-5.711102	-0.081883	-0.009395	-0.086757
Std. Dev.	0.047677	0.059192	0.046116	0.680508	1.222646	0.013592	0.004239	0.016310
Skewness	-1.291295	0.151949	-1.707107	2.985921	-0.039353	-0.186320	0.991208	-0.587972
Kurtosis	8.990056	9.044779	6.156504	20.75969	5.512696	13.51256	12.39957	5.944049
Jarque-Bera	815.5521	914.2662	159.1929	6728.830	67.67491	2669.496	1307.328	182.5799
Prob.	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	2.588726	-1.117918	0.667395	336.6940	64.75431	0.382476	0.729881	-0.227023
Sum Sq. Dev.	1.04337	2.095217	0.544439	212.5590	382.6850	0.106782	0.006093	0.115717
Obs.	460	599	257	460	257	579	340	436

The Jarque-Bera test statistics are for each variable below the 5% significance level. This means that the null hypothesis of normality is rejected. This means that there is non-normality in the time series data.

What is surprising is the similarity between the stock market return (R) and the trading volume (MV). The similarity could mean that there exists correlation between the two variables for which needs to be corrected later on.

6 Results

First it is tested if the variables are not equal to zero. The coefficient restrictions Wald test is calculated. It is found that none of the variables is equal to zero.

Then for each variable it is calculated whether or not the variable has a unit root or not. This process is done to be able to correct for non-stationarity. It is found that the variable MI has a unit root and this is corrected for by taking the first difference, this first difference variable is from now on referred to as MI1.

To test for correlation between the variables, a table with the corresponding correlations is made (see *Table 3* in the appendix). It is seen that the variable MV is highly correlated with the independent variable R. Since the variable MV is already incorporated in the illiquidity measure, it is assumed that the variable can be left out. The variable ILLIQ is then used as an instrumental variable for the dependent variable MV.

After the standard tests, the section looks as follows. First an OLS model is created without the variable ER implemented in the model. After this an OLS model is created is created with the variable ER and the two models are then compared with each other to see whether or not it makes sense to include the variable in the model or not. Then the Power GARCH models are run in the same way. In the end all the models are compared to see what model is best. After the best model is found, the Brexit dummy is added to the model to see if there is a significant effect on the UK stock market return after the announcement that Great Britain is having a referendum to leave the European Union.

6.1 OLS model without variable RER

First it is necessary to test to see if the model suffers from serial correlation. To test for serial correlation the Breusch-Godfrey test statistic is conducted. The Breusch-Godfrey test statistic for the model is below the 5% significance level (0.0000) which means that the null hypothesis that there is no serial correlation is rejected. A correlogram is created in order to see where the serial correlation comes from. After looking at the correlogram it is found that there is partial correlation to the first order. This is corrected with by creating a first order autoregressive model (from now on AR(1) model). The model is significant with a probability 0.000. The Breusch-Godfrey test statistic is increased to 0.3425 which means that the null hypothesis for serial correlation cannot be rejected anymore.

In order to see if the model suffers from Heteroskedasticity, the Breusch-Pagan-Godfrey test for Homoskedasticity is calculated. As mentioned above, according to the theory financial data is most likely to be Heteroskedastic which means that the variance of the error terms is not constant. Since it is planned to use a power GARCH model to test for the effects of the independent variables, it is expected that there is Heteroskedasticity. After calculating the Breusch-Pagan-Godfrey test statistic for Homoskedasticity the F-statistic is below the 5% benchmark. This means that the null-hypothesis for Homoskedasticity is rejected and the model suffers from Heteroskedasticity (as expected).

After it is determined that the model suffers from heteroskedasticity, the OLS regression is run. The outcomes of the model are found in the table below.

Table 4: Eviews outcomes OLS regression model without RER

Dependent Variable: R
Method: ARMA Conditional Least Squares (BFGS / Marquardt steps)
Date: 07/09/16 Time: 11:58
Sample (adjusted): 1995M03 2016M04
Included observations: 254 after adjustments
Convergence achieved after 10 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007343	0.002510	2.925548	0.0038
Y	-0.401956	0.045872	-8.762526	0.0000
SMV	-0.014007	0.002751	-5.092298	0.0000
MP	0.268141	0.217793	1.231173	0.2194
ILLIQ	0.015301	0.001584	9.660234	0.0000
MI1	0.032343	0.402207	0.080413	0.9360
AR(1)	-0.326258	0.060144	-5.424647	0.0000

R-squared	0.591916	Mean dependent var	0.002851
Adjusted R-squared	0.582003	S.D. dependent var	0.046085
S.E. of regression	0.029795	Akaike info criterion	-4.161788
Sum squared resid	0.219271	Schwarz criterion	-4.064302
Log likelihood	535.5471	Hannan-Quinn criter.	-4.122571
F-statistic	59.71123	Durbin-Watson stat	2.052685
Prob(F-statistic)	0.000000		
Inverted AR Roots	-.33		

It is seen that there are significant results for the coefficients regarding the dividend yield, the stock market volatility and the illiquidity measurement. However, the sign for both the dividend yield and the stock market volatility is negative, while theory and empirics show that these signs should be positive. The dividend yield is seen as an indicator of stock price growth according to investors, and thus the effect of a higher dividend yield should correspond with a higher stock market price and thus return. The stock market volatility is seen as an indicator for risk and higher stock market volatility, is seen as an increase in the risk. Following risk aversion, investors want higher returns as the risk of a stock increases and thus the relation should be positive. For the illiquidity measure it is found that the sign significantly corresponds to what theory predicts.

The R-squared in the model is relatively high. This means that the variables of the model are good in predicting the dependent variable stock market return (R). When looking at the F-statistic of the model it is seen that the model is highly significant.

6.2 OLS model with variable RER

Again the Breusch-Godfrey test statistic for serial correlation is calculated. It is found that the F-statistic is below the 5% significance level (0.0000). This means that the null hypothesis that there is no serial correlation is rejected and it is found that there is serial correlation. After looking at the correlogram is is found that again there is first order partial correlation. The first order autoregressive model is created (AR(1) model). The Breusch-Godfrey F-test statistic then is above the 5% significance level (0.3135) which means that the null hypothesis that there is no serial correlation cannot be rejected.

To test for Heteroskedasticity, the Breusch-Pagan-Godfrey test is calculated. Again it is expected that the null-hypothesis for Homoskedasticity is rejected since it is expected (based on the theory) that the variances of the error terms are non-constant because it concerns financial data and in financial data the volatilities are clustered. The Breusch-Pagan-Godfrey test-statistic shows that the null hypothesis is indeed rejected and there is Heteroskedasticity in the model.

Again it is determined that the model suffers from heteroskedaticity, as this will be corrected for in the next two sections, the model as it is now being run. The outcomes of the model are found in the table below.

Table 5: Eviews outcomes OLS regression model with RER

Dependent Variable: R
Method: ARMA Conditional Least Squares (BFGS / Marquardt steps)
Date: 07/09/16 Time: 15:05
Sample (adjusted): 1995M03 2016M04
Included observations: 254 after adjustments
Convergence achieved after 13 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007128	0.002517	2.831734	0.0050
Y	-0.406364	0.046020	-8.830211	0.0000
SMV	-0.013748	0.002762	-4.977292	0.0000
MP	0.240316	0.221875	1.083114	0.2798
ILLIQ	0.015328	0.001584	9.674327	0.0000
MI1	0.024880	0.403353	0.061683	0.9509
RER	0.086778	0.119736	0.724739	0.4693
AR(1)	-0.333125	0.060548	-5.501840	0.0000

R-squared	0.592779	Mean dependent var	0.002851
Adjusted R-squared	0.581192	S.D. dependent var	0.046085
S.E. of regression	0.029824	Akaike info criterion	-4.156032
Sum squared resid	0.218807	Schwarz criterion	-4.044620
Log likelihood	535.8161	Hannan-Quinn criter.	-4.111212
F-statistic	51.15644	Durbin-Watson stat	2.057933
Prob(F-statistic)	0.000000		

Inverted AR Roots	-.33

As seen in the table above, similar results are found concerning the coefficients Y (dividend yield), SMV (stock market volatility) and ILLIQ (the Amihud illiquidity measure). Both the dividend yield and the stock market volatility do not correspond with the existing literature on their signs. Again the illiquidity measure shows a sign that corresponds with the theory as well as empirics. It is seen that the addition of the variable ER (the relative exchange rate) shows no significance. This means that the variable does not have an effect on the dependent variable stock market return.

When looking at the R-squared, an increase is seen from the model in section 6.1 in comparison with the model in section 6.2. This means that the latter model is better in predicting the dependent variable R (stock market return).

6.3 Power GARCH model without variable RER

In order to estimate the order of the Power GARCH model, the first step is to estimate the order of the Autoregressive (AR) model. A normal OLS function is generated to be able to test for serial correlation and for Heteroskedasticity. As this model uses the same OLS function that has been used in section 6.1, results were equal to the ones found in section 6.1. Thus again, an AR(1) model is created, and the model suffers from heteroskedasticity (which was expected). A Power GARCH model is able to correct for this heteroskedasticity. Therefore, the Power GARCH (PARCH) model is created. The Eviews outcomes are listed below.

Table 6: Eviews outcomes PARCH regression model without RER

Dependent Variable: R
Method: ML ARCH - Normal distribution
Date: 07/09/16 Time: 11:50
Sample (adjusted): 1995M03 2016M04
Included observations: 254 after adjustments
Convergence achieved after 108 iterations
Presample variance: backcast (parameter = 0.7)
@SQRT(GARCH)^C(12) = C(8) + C(9)*(ABS(RESID(-1)) - C(10)*RESID(-1))^C(12) + C(11)*@SQRT(GARCH(-1))^C(12)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004868	0.002510	1.939449	0.0524
Y	-0.419702	0.038854	-10.80208	0.0000
SMV	-0.010982	0.002013	-5.455854	0.0000
MP	0.380839	0.204910	1.858567	0.0631
ILLIQ	0.016057	0.001104	14.54600	0.0000
MI1	0.031569	0.408814	0.077221	0.9384
AR(1)	-0.325114	0.075467	-4.308028	0.0000
	Variance Equation			
C(8)	0.000736	0.003037	0.242247	0.8086
C(9)	0.107945	0.057029	1.892805	0.0584
C(10)	-0.264854	0.199760	-1.325861	0.1849
C(11)	0.854962	0.088324	9.679800	0.0000
C(12)	1.245378	1.160982	1.072693	0.2834

R-squared	0.589213	Mean dependent var	0.002851
Adjusted R-squared	0.579235	S.D. dependent var	0.046085
S.E. of regression	0.029893	Akaike info criterion	-4.181838
Sum squared resid	0.220723	Schwarz criterion	-4.014719
Log likelihood	543.0934	Hannan-Quinn criter.	-4.114608
Durbin-Watson stat	2.077949		
Inverted AR Roots	-.33		

It is found that the dividend yield shows a significant negative effect on the dependent variable. This is contrary to what the theory suggests. The stock market volatility also shows a negative significant effect.

Theory on this variable suggests that this effect is positive. The monthly growth rate for the industrial production shows a positive effect on the stock market return, however this effect is not significant at a 5% significance level. The coefficient is significant when taking a 10% significance level. This variable is in accordance with the theory that industrial production positively effects the stock market return. The Amihud illiquidity measure shows a significant positive effect. Amihud (2002) found the same positive relation. The inflation rate was according to the theory a bit of a dubious variable (Chen, Roll and Ross (1986) only found a significant effect in one of the periods they tested for). This variable is far from significant and has a positive effect on the stock market effect in the model, where theory suggests that is should be negative.

When looking at the R-squared and the adjusted R-squared the explanatory power of the model can be found. As shown in the table above the model shows relatively high values for the R-squared and the adjusted R-squared. This means that the model is able to explain the data well.

6.4 Power GARCH model with variable RER

Again the order of the autoregressive model has to be determined. An OLS regression function with the new variable ER is conducted form Eviews. Again the tests regarding the OLS regression concern the tests for serial correlation and Heteroskedasticity. As it is exactly the same model as used in section 6.2, the same correction had to be made to correct for the serial correlation (an AR(1) model). Also the model created in section 6.2 suffered from heteroskedasticity. A PARCH model approach is able to correct for this and thus the PARCH model is conducted. The outcomes of the Eviews regression are listed below.

Table 7: Eviews outcomes PARCH regression model without RER

Dependent Variable: R
Method: ML ARCH - Normal distribution
Date: 06/28/16 Time: 16:40
Sample (adjusted): 1995M03 2016M04
Included observations: 254 after adjustments
Failure to improve Likelihood after 66 iterations
Presample variance: backcast (parameter = 0.7)
@SQRT(GARCH)^C(13) = C(9) + C(10)*(ABS(RESID(-1)) - C(11)*RESID(
-1))^C(13) + C(12)*@SQRT(GARCH(-1))^C(13)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004574	0.002509	1.822982	0.0683
Y	-0.416636	0.038698	-10.76642	0.0000
SMV	-0.010973	0.002048	-5.358317	0.0000
MP	0.358304	0.207272	1.728666	0.0839
ILLIQ	0.016523	0.001126	14.67111	0.0000
MI1	0.026217	0.412954	0.063488	0.9494
RER	0.080488	0.144639	0.556473	0.5779
AR(1)	-0.322373	0.072338	-4.456477	0.0000
		Variance Equation		
C(9)	0.002350	0.007429	0.316353	0.7517
C(10)	0.093110	0.054416	1.711063	0.0871
C(11)	-0.406263	0.258646	-1.570728	0.1162
C(12)	0.872547	0.081255	10.73837	0.0000
C(13)	0.900946	0.883554	1.019685	0.3079

R-squared	0.589810	Mean dependent var	0.002851
Adjusted R-squared	0.578138	S.D. dependent var	0.046085
S.E. of regression	0.029932	Akaike info criterion	-4.175129
Sum squared resid	0.220402	Schwarz criterion	-3.994084
Log likelihood	543.2414	Hannan-Quinn criter.	-4.102297
Durbin-Watson stat	2.084536		
Inverted AR Roots	-.32		

The Eviews outcomes show that again the dividend yield coefficient is significantly negative. The variable for dividend yield (Y) again shows a negative significant effect on the stock market return. The variable SMV that measures the stock market volatility again is significant as well. But again contrary to what theory suggests, shows a negative effect on the stock market return. MP shows a positive effect again on the independent variable R, however this effect is again not significant at a 5% level. The variable is significant at a 10% level. The probability of the z-statistic increased a bit compared to the previous model. The Amihud illiquidity measure shows a significant effect again and is positive. This is again in accordance to the theory. The variable for the relative exchange rate RER doesn't show a significant effect on the independent variable R. The coefficient however does show a positive effect, which is in accordance with what was expected. But since the z-statistic is not significant, no conclusions can be based on this.

When looking at the R-squared and the adjusted R-squared of the model that includes the relative exchange rate (RER), it is seen that both of the values drop (however slightly) compared to the model that excludes the RER. This means that the second model explains the data not as well as the first model.

After looking at the regression and the model significance the following things can be noticed. The RER variable is not significant. The Adjusted R-squared increases (however very slightly) which means that the data fits the model worse. The probabilities of the other variables increase a bit as well.

Taking these things into consideration it is decided to leave out the RER variable and continue without it.

6.5 Model including DumBrexit

After it is seen that the model that included the new proposed coefficient RER had outcomes that were worse compared to that of the model that excluded the coefficient RER, the latter is chosen to test the significance of the DumBrexit variable with. Although the OLS regressions showed higher R-squared and Adjusted R-squared statistics, the PARCH model is preferred since it corrects for heteroscedasticity. This section shows the results of the Eviews tables after including the Brexit dummy in the model which excludes the variable RER.

Table 8: Eviews outcomes PARCH regression model including Brexit dummy

Dependent Variable: R
Method: ML ARCH - Normal distribution
Date: 06/28/16 Time: 16:45
Sample (adjusted): 1995M03 2016M04
Included observations: 254 after adjustments
Convergence achieved after 47 iterations
Presample variance: backcast (parameter = 0.7)
@SQRT(GARCH)^C(13) = C(9) + C(10)*(ABS(RESID(-1)) - C(11)*RESID(
-1))^C(13) + C(12)*@SQRT(GARCH(-1))^C(13)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004348	0.002605	1.669420	0.0950
Y	-0.415144	0.038747	-10.71421	0.0000
SMV	-0.010744	0.002015	-5.331801	0.0000
MP	0.366911	0.206700	1.775094	0.0759
ILLIQ	0.016380	0.001224	13.38039	0.0000
MI1	0.011918	0.413712	0.028808	0.9770
DUMBREXIT	0.009945	0.008417	1.181611	0.2374
AR(1)	-0.329164	0.074148	-4.439319	0.0000
Variance Equation				
C(9)	0.000283	0.001382	0.204599	0.8379
C(10)	0.114652	0.061710	1.857920	0.0632
C(11)	-0.233336	0.179566	-1.299445	0.1938
C(12)	0.842395	0.093549	9.004896	0.0000
C(13)	1.521166	1.373849	1.107230	0.2682

R-squared	0.590805	Mean dependent var	0.002851
Adjusted R-squared	0.579161	S.D. dependent var	0.046085
S.E. of regression	0.029896	Akaike info criterion	-4.181417
Sum squared resid	0.219868	Schwarz criterion	-4.000372
Log likelihood	544.0399	Hannan-Quinn criter.	-4.108585
Durbin-Watson stat	2.072564		
Inverted AR Roots	-.33		

It is seen from the table above that the coefficients Y, SMV and ILLIQ are significant at a 5% level again. These probabilities have not changed compared to the previous models. The direction of the variables is also the same as what was previously found. The coefficient MP is again significant at a 10% level, which is what was found previously.

Again the model shows a relatively high R-squared and a relatively high adjusted R-squared. This means that the explanatory power of the model, like the previous models, is good. Compared to the model that excluded the coefficient RER, the R-squared increased and the adjusted R-squared slightly decreased.

The coefficient on which this thesis is based upon, DUMBREXIT, does not show to have a significant effect on the stock market return. This means that it is not possible to say whether or not the announcement that Great Britain may leave the European Union has had a significant influence on the stock market return of the British FSTE100 index.

7 Conclusion

The goal of this paper is to investigate if there is a significant effect of the announcement that Great Britain might leave the European Union, or in this paper called the Brexit announcement effect. The effect was attempted to find by regression a Brexit dummy with variables affecting the stock market return on the index of the British stock market return. The variables affecting the stock market return were found by an extensive literature review, and ultimately came down to the following: dividend yield, industrial production, inflation, trading volume, stock market volatility and the Amihud illiquidity measure. Also a new variable was proposed in the form of the relative exchange rate. No significant results were found on this so eventually it was left out of the regression.

As the topic surrounding the stock market return is still an ongoing research to this day, this model has been created to the best of knowledge from the literature that is available at this point. The dividend yield and stock market volatility both show to have a negative effect on the stock market return, where literature clearly indicates otherwise. Only for the Amihud illiquidity the results match the corresponding literature. The sign of the coefficient of industrial production corresponds with the literature, only to a lesser degree. It is thus found that the model used for this research is not ideal.

Regarding the Brexit dummy, although the coefficient is not significant the sign of the effect on the stock market return is positive. This sign corresponds with a combination of the EMH that stock returns are a reflection of all available information on the one hand. On the other hand, there is the theory on risk aversion that people demand higher value premiums with an increase in the risk on the stock. Due to the announcement of the potential Brexit, uncertainty on the UK stock market increased. With uncertainty risk increases on the stock market, as it is harder to predict what is going to happen with the market index of the UK stock market. Investors that trade with these riskier stocks want, according to (among others) Fama and French (1993), a higher value premium and thus it is seen that the returns on these riskier stocks increase.

Although higher returns can be realized on the UK equity market as it is now, the current state of uncertainty is damaging for economic growth. For firms, in order to grow, it is preferred to have a stable, reliable financial market. As it is now, firms will postpone ‘going to the market.’ In the article in the Financial Times, mentioned before, initial public offerings are now on a hold, as it is still uncertain what the impact will be of the Brexit. Thus, whether or not Great Britain leaves the European Union, it is better to act fast and create certainty on the effects of the Brexit (whether these are positive or negative) than to postpone decisions and create a risky financial environment.

8 Recommendations and Limitations

The limitations of this research is that first of all no significant results were found. The biggest shortcoming of this paper is that the variables that according to the literature significantly affect stock market return, do not so here. A recommendation for future study on this area can be the use of a different data set, or a different group of variables. However, the latter seems less likely as the literature review in this paper is rather extensive.

Furthermore, as an extension of this research, the effects of Great Britain leaving the European Union can be measured, rather than the announcement effect of the Brexit. As it is known now that Great Britain has voted to leave the European Union, the effects of this exit would be an interesting research. It would not be surprising if literature on this will appear on a short notice.

For the data in this paper, only monthly data was collected because weekly or, even better, daily data was not available for all variables. Would one be able to find such a type of dataset; this would be a real improvement of the research.

To measure the effects that Brexit has on the UK stock market return, a dummy variable is used. As this variable only takes the values one or zero, there are a lot of advantages in this. However, one could also use a more attention-based variable like is done in the paper of Bouoiyour and Selmi (2016) in which Googletrends data is used on the frequency of the search on Google to the word 'Brexit'.

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APPENDIX

Table 3: Correlation Matrix

	R	Y	MV	SMV	ILLIQ	MP	MI	ER	DUM*
R	1.000000	-0.511461	0.993347	-0.439966	0.608118	0.096920	0.027783	-0.049971	-0.059164
Y	-0.511461	1.000000	-0.503019	0.254829	-0.285445	-0.174845	-0.046527	0.083761	0.029694
MV	0.993347	-0.503019	1.000000	-0.433224	0.595952	0.096344	0.047007	-0.046182	-0.058808
SMV	-0.439966	0.254829	-0.433224	1.000000	-0.268906	-0.080623	-0.001606	-0.043182	-0.011274
ILLIQ	0.608118	-0.285445	0.595952	-0.268906	1.000000	0.013923	0.044496	-0.069881	-0.195496
MP	0.096920	-0.174845	0.096344	-0.080623	0.013923	1.000000	0.036122	0.150868	0.036389
MI	0.027783	-0.046527	0.047007	-0.001606	0.044496	0.036122	1.000000	0.021257	-0.086178
ER	-0.049971	0.083761	-0.046182	-0.043182	-0.069881	0.150868	0.021257	1.000000	-0.077047
DUM*	-0.059164	0.029694	-0.058808	-0.011274	-0.195496	0.036389	-0.086178	-0.077047	1.000000

* DUM stands for the Brexit dummy