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Bachelor Thesis [Economics and Business Economics]

The effect of the Brexit on multinationals and non-multinationals in the United Kingdom

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Abstract

This paper examines the effect of the Brexit referendum on the stock returns of 610 public companies with the headquarter in the UK. The focus is on a distinction between multinationals and non-multinationals, and multinationals that have subsidiaries in the European Union (EU) and those that have not. The effect will be investigated with the use of an event study and regression analysis. The results indicate the Brexit had an overall negative effect. In addition, the effects between multinationals and non-multinationals is overall different, whereby non-multinationals are more negatively affected than multinationals. While, the overall effect between EU multinationals and non-EU multinationals is not different.

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Introduction

It is a very rare phenomenon that a country wants to leave the European Union (EU). In 2009 there was a discussion about Greece to leave the EU, because of the higher government debt than initially reported. Eventually they did not have to leave. The United Kingdom on the other hand, announced a referendum which took place on 23th of June 2016. On this day, people could vote if they wanted to leave the EU or not (BBC, 2016). The outcome had been expected to be tight and in the days before the referendum, bookmakers and pollsters expected that the United Kingdom would stay in the European Union (Becker, Fetzer & Novy, 2017). The results of the referendum were declared on 24th of June 2016 showing most people voted to leave. Thus, Britain will leave the EU, which is called 'Brexit'. This makes the UK the first country to leave the EU.

This paper contributes to existing literature, because it will focus on the distinction between multinationals and non-multinationals and if they had a significantly different reaction to the Brexit based on the stock returns. Most papers focus on the different effects on different areas of expertise the companies are operating in. In addition, the paper will make a distinction in the reaction on the Brexit between multinationals with subsidiaries in the EU and those that have no subsidiaries in the EU.

With leaving the EU, the UK will lose its privilege of being integrated in the EU (Dhingra, Ottaviano, Sampson & Reenen, 2016). These privileges include the free movement of goods, services, people and money. Some additional privileges for companies are free trade and removal of non-tariff barriers (Hix & Høyland, 2011). Therefore, possible disadvantages are a decrease of value in the British pound, lower financial market integration, and a decline in trade. Advantages could be the costs saved of not being in the EU, and new trade deals with non-EU countries (Krause, Noth & Tonzer, 2016; Ramiah, Pham & Moosa, 2017).

In addition, import and export of goods from and to the UK will probably be affected, since 44% of UK exports in 2016 stayed within the EU. This information is derived from the Office for National Statistics (ONS), which is a database about the government and its finance. Import and export will be affected, because of additional value added taxes (VAT) and duties. Today moving goods across the border is still easy and cheap, because only a travel document and a copy of the packing list or commercial invoice are needed (Tielmann &

Schiereck, 2017). With the UK leaving, this will all become more difficult and a longer process. Therefore, this paper will examine if the Brexit had a negative effect on the stock returns of UK public companies listed on the London Stock Exchange, and if multinationals and EU-multinationals are more negatively affected than non-multinationals and non-EU multinationals, respectively. The paper finds contradictory results to this, because non-multinationals are more negatively affected than multinationals, and there is no difference in effect for EU multinationals and non-EU multinationals. Though, a negative effect is found for the stock returns.

The uncertainty the Brexit brings with it will influence the stock prices. The stock prices reflect the expectations of the market participants which can be observed in the markets. So, the response of the market can be seen in the fluctuation of the stock prices (Raddant, 2016). This paper is intended to examine 610 stocks of publicly traded companies in the UK on the London Stock Exchange. There will be looked at the stock returns of these companies to examine the effect of the Brexit using an event study. An event study uses abnormal returns to show the difference in the actual realized returns and the expected returns when the event had not happened. The abnormal returns show that the Brexit has a significant negative effect on the companies investigated. The abnormal returns show only one-day reactions, therefore also the cumulative abnormal returns (CARs) will be used to investigate the effect of the Brexit. The CARs show a negative effect of the Brexit on multiple days by adding up the abnormal returns for multiple days. At last, a regression, with the CARs as dependent variable and independent variables that influence the CARs, will be performed.

The structure of the paper is as follows. Section 2 describes the concepts, descriptive statistics, and discusses previous literature that are relevant for this paper. Section 3 describes the methodology of the used tests. Followed by section 4, which discusses the data needed to conduct the tests. Section 5 shows the results of the tests and in section 6 the conclusion of the paper will be described. In the last section, section 7, the discussion and recommendations for further research can be found.

Theoretical Framework

Brexit means that the UK will leave the EU. Going forward the EU and UK are negotiating about the exit conditions, inclusive of the privileges the UK can keep and what the UK should provide in return. The results of these negotiations should be known by the end of March 2019 when the Brexit becomes final. Since the UK is the first country to leave the EU, there is a lot of uncertainty about the consequences. In addition, it is a current development, so not everything is known about it. Though, some research is already done on this topic. Dhingra, Ottaviano, Sampson & Reenen (2016) for example, conclude that Brexit will cost the UK economy, because the trade will decrease as result of the reduced integration with the EU. In accordance with this, Kierzenkowski, Pain, Rusticelli, & Zwart (2016) concluded that before Brexit was reality, the uncertainty about the outcome already influenced the growth of the UK and an exit would probably have a negative shock to the UK economy. This because the EU is the main trade partner of the UK. Therefore, this paper will explore if the real exit will indeed have a negative shock on companies in the UK with the following hypothesis:

Hypothesis 1: The Brexit has a significant negative effect on the stock returns of UK public companies listed on the London Stock Exchange.

To determine this effect, different methods could be used. For example, Bruggen (2016) used a normal Ordinary Least Squares (OLS) regression on returns and a General Autoregressive Conditional Heteroskedasticity (GARCH) model. Tielmann & Schiereck (2016) also use an OLS regression, only on the CARs and Ramiah, Pham & Moosa use an event methodology. This paper will use an event study to determine the abnormal returns and CARs. The sign of the abnormal returns and CARs gives the direction of the effect, if there is one. To test if the Brexit has an effect, a t-test is conducted and two non-parametric tests, namely the sign test and the Wilcoxon ranked sign test. Two non-parametric tests are used, because they adjust for stationarity when the data tend to be skewed. The data gives a different mean and median (table 1), which implies that the data is skewed and therefore has no symmetric distribution, which is necessary for a t-test.

Abnormal Returns	Mean	Median	Std. Dev	Min	Max	N
All	-0.035	-0.029	0.059	-0.455	0.265	610
Multinationals	-0.028	-0.027	0.050	-0.191	0.115	337
Non-Multinationals	-0.043	-0.036	0.068	-0.455	0.265	273
European Multinationals	-0.030	-0.027	0.050	-0.191	0.115	272
Non-European Multinationals	-0.022	-0.024	0.047	-0.163	0.073	65

Table 1: Descriptive statistics for the abnormal returns of the companies per category. The categories are all, which are all the companies in the sample, multinationals, non-multinational firms, multinationals with subsidiaries in the EU, and multinationals with no subsidiaries in the EU. The mean, median, standard deviation (std. dev), minimum (min), maximum (max), and number of observations (N) are given.

An event study uses the stock returns to examine if they are influenced by the Brexit. The event study approach is chosen, because the theory underlying an event study is the Efficient Market Hypothesis (EMH). According to the EMH, the price adjustment should correspond to the latest information that is released. This means that the price adjustment must be immediate and complete (van der Sar, 2015). Before the Brexit, both sides went head to head till the final day, so it was unpredictable if it the UK would leave or stay in the EU. But following the EMH, an efficient market is a market in which prices always fully reflect all information available (Fama, 1970). This would mean that, when the referendum result was announced, the price reaction of the stock markets was immediate and accurate. The declaration of the referendum result was on the 24th of June 2016. The prices on this day should thus reflect the correct prices according to the EMH. In the adjustment of the stock prices of the companies investigated, the effect of Brexit would thus be seen. So, the stock prices, of the companies investigated, can be used to investigate if the Brexit has a significant effect on the stock returns of these companies.

The event study uses the abnormal returns and the CARs of the companies to find if there is a significant effect on the stock returns of the companies investigated. The abnormal

returns are the difference between the actual realized returns and the expected returns according to the market model. In the rest of the thesis, these will be referred to as realized returns and normal returns, respectively. In the market model, the stock return of the UK companies is related to the market return of the FTSE 100 through a coefficient (β) which represents the market risk (Corhay & Rad, 1996).

Some other papers did examine the effect of the Brexit. These papers mainly focus on the sectoral effects of the Brexit or choose a certain sector to investigate the effect of the Brexit. Beginning with Ramiah, Pham & Moosa (2016) who focus on the sectoral effects of Brexit on the British economy and found varying sectoral effect, but most sectors reacted negatively. Also, Tielmann and Schiereck (2016) find an overall negative value effect for logistic companies, because of the impede of import and export of goods following the Brexit referendum. They found that UK based companies have a significantly poorer performance than logistic companies from Continental Europe.

Therefore, this paper will contribute by making a distinction in companies that are a multinational or not. And if this multinational has subsidiaries in the EU or not, because of the integration of the UK in the EU. A company is considered a multinational if the foreign sales as percentage of total sales is at least or higher than ten percent (Meek, Roberts & Gray, 1995), or when the company has subsidiaries in at least six other countries (Sambharya, 1996). In the rest of the paper multinationals with subsidiaries in the EU will be referred to as EU multinationals and multinationals that have no subsidiaries in the EU will be referred to as non-EU multinationals. A multinational is considered a EU multinational if at least one of the subsidiaries is in the EU.

This paper will investigate if there is a different effect for these various categories. According to Lawless & Morgenroth (2016) EU exports to the UK would fall with 30% and the total world trade will fall by 2%. In addition, the UK export to the EU would fall with 22% and the total trade with 9.8%. Therefore, the expectation is that multinationals would be affected more than non-multinational firms, since non-multinational firms have no operations in other countries, but multinationals do and will be affected by the lesser export and import. Therefore, the second hypothesis is as follows:

Hypothesis 2: There is a significantly different effect from the Brexit for multinationals and non-multinational firms in the UK. Multinationals affected more negative than non-multinationals.

Also expected is a different effect for EU multinationals and non-EU multinationals, because only between the UK and EU changes something and not for the companies that already had no business in the EU. So, the third hypothesis is as follows:

Hypothesis 3: There is a significantly different effect from the Brexit for EU multinationals and non-EU multinationals in the UK. EU multinationals affected more negative than non-EU multinationals.

Both hypotheses 2 and 3 are tested by a pairwise t-test, which tests if there is a difference of effect on the various categories. At last, an OLS regression for the CARs will be conducted, which determines if there is a different effect for multinationals and non-multinationals, and EU-multinationals and non-EU multinationals, and also includes other variables that influence the CARs.

Methodology

In this paper, an event study will be used. When conducting an event study, the event of interest need to be identified and the period that will be influenced by it, called the event period (MacKinlay, 1997). The event of interest is the Brexit and the particularly date of interest is the 24th of June 2016, since this is the day that the results of the referendum were nationally declared. The event period usually is more than one day, e.g. 21 trading days (van der Sar, 2015). Therefore, the event period is from the 10th of June 2016 till the 8th of July 2016. For this period, the abnormal returns should be calculated to find the effect of the Brexit on the 24th of June 2016, and the effect for multiple days through the CARs.

The abnormal return is the difference of the returns in the event period and the normal returns. The normal returns are the returns that are expected if the event didn't take place (MacKinlay, 1997), therefore the normal returns are taken over a control period. The

control period is a period in which the event is not present and should be as close as possible to the event period. The period of the normal returns can be set to e.g. 100 or 250 trading days (van der Sar, 2015). This paper will choose for the 250 trading days to weigh out any other influence of other events in the control period. Therefore, the control period is from the 26th of June 2015 till the 9th of June 2016.

To calculate the abnormal returns, the following formula is used (van der Sar, 2015):

$$ar_{it} = R_{it} - R^*_{it} \quad (1)$$

i denotes the stock concerned.
t is the period relative to the event period.
ar_{it}: abnormal return.
R_{it}: return on stock i over period t.
R^*_{it}: normal return on stock i over period t.

The abnormal return represents the extent to which the realized return of stock i during period t deviates from its expected outcome under normal circumstances, without the event (van der Sar, 2015).

The returns of the stocks are calculated with the following formula:

$$R_{it} = (P_t - P_{t-1})/P_{t-1} \quad (2)$$

P_t: stock price of day t.
P_{t-1}: stock price of the day before t.

The normal returns on the stocks of the companies are calculated by the market model with the following formula (Corhay & Rad, 1996):

$$R^*_{it} = \alpha_i + \beta_i(R_{mkt}) + \epsilon \quad (3)$$

R_{it}^{*} : normal stock return of the companies investigated.

R_{mkt}: market return of the index.

β_i: stock's market risk.

α_i: alpha.

Where β_i and α_i are calculated by the following formulas (Scholes & Williams, 1977):

$$\beta_i = \sigma_{iM}/\sigma_M^2 \quad (4)$$

$$\alpha_i = \mu_i - \beta_i \mu_M \quad (5)$$

σ_{iM}: covariance of the stock and market return.

σ_M: variance of the market return.

μ_i: mean of the stock return.

μ_M: mean of the market return.

To calculate the abnormal returns formulas (1) and (3) are merged, which gives the following formula:

$$ar_{it} = R_{it} - (\alpha_i + \beta_i(R_{mkt})) \quad (6)$$

R_{it} is the return that is realized. The $\alpha_i + \beta_i(R_{mkt})$ the normal return, the return that is expected based on the market model, which is based on the market return. Hereby α and β are still calculated as formula (4) and (5), respectively.

To measure the effect of the event, the average abnormal return (AR_t) and cumulative abnormal returns (CAR_{KL}) are used. The corresponding formulas are (van der Sar, 2015):

$$AR_t = \frac{1}{N}\sum_{i=1}^{N} ar_{it} \quad (7)$$

$$CAR_{KL} = \sum_{t=K}^{L} AR_t \quad (8)$$

Some different CAR's will be considered for the event period, namely CAR(-10, +10),

CAR(-1, 0), CAR(-1, +1) and CAR(-1, +10). All of them still have the event date included, the difference only is the amount of other days, around the event date, they also consider. The CAR(-10, +10) takes 10 days before and after the event date into account, CAR(-1,0) takes 1 day before the event date into account, CAR(-1, +1) considers 1 day before and after the event date, and CAR(-1, +10) considers 1 day before and 10 days after the event date.

The test statistics from the t-tests are calculated with the following formula (Campbell, Lo & MacKinlay, 1997):

$$T = \frac{\mathrm{a}r_{it}}{\sigma * \sqrt{N}} \quad (9)$$

$\mathrm{a}r_{it}$: abnormal return.
σ: standard deviation.
N: amount of days.

The returns and normal returns are significantly different if the T-statistic is higher than 1.96 or lower than -1.96. So, if this is true, the Brexit influenced the stock returns.

To test if the abnormal returns and cumulative abnormal returns are significantly different from zero, several tests can be applied. In this case, the time series t-test (Brown and Warner, 1980), general Sign Test (Cowan, 1992) and Wilcoxon Signed Rank Test (Akeyede, Usman and Chiawa, 2014) will be applied.

The t-test examines if the returns and normal returns systematically differ from each other. In other words, it tests if the abnormal returns are significantly different from zero (van der Sar, 2015). This test is not only executed with the abnormal returns, but also with the cumulative abnormal returns to test the is there is a significant effect on multiple days around the event date. The Sign Test and Wilcoxon Signed Rank Test are additional tests to test if the returns and normal returns of the stocks of the companies investigated are significant different. The difference only is that these tests are nonparametric tests and therefore do not assume that the data has a fixed probability distribution. Therefore, they can be used if the data tend to be skewed. In addition, this test uses the median instead of the mean. Since, the mean and median of the abnormal returns and cumulative abnormal returns are not the

same, more value should be attached to the sign test and Wilcoxon signed rank test, because these take the skewness into account. Therefore, more value should be attached to the sign test and Wilcoxon signed rank test. The t-test are performed with Excel and the sign test and Wilcoxon signed rank test are performed with STATA. Both use the abnormal returns and CARs per category. The categories are all companies, multinationals, non-multinational firms, EU multinationals, and non-EU multinationals. For the t-test, sign test, and Wilcoxon signed rank test, a significance level of 5% is used. If these tests give a p-value lower than 5%, the abnormal returns or CARs are significantly different from zero and thus the Brexit affected the stock returns

The tests mentioned are separated test for all the categories. To test for difference between the categories, a pairwise t-test is used. The pairwise t-test is used to test for significant difference between multinationals and non-multinational firms, and between EU multinationals and non-EU multinationals. To conduct the pairwise t-test, first Levene's test is used to know if the pairwise t-test with equal or unequal variance should be used. For the pairwise t-test, also a significance level of 5% is used. If these tests give a p-value lower than 5%, the effect of the Brexit is different for multinationals vs. non-multinationals and/or for EU-multinationals vs. non-EU multinationals.

To find the influence of a multinational and subsidiary in Europe four additional regressions with the CARs for the event windows (-10, +10), (-1, 0), (-1, +1), and (-1, +10) as dependent variables are executed. An addition is made, namely other variables are included which also influence the CARs. The independent variables are size which is the log of the market value (MV), book-to-market ratio (BTMV), performance which is the stock performance/return (Ret), diversification which is the amount of SIC codes a company has (SIC), dividend yield (DY), a dummy variable multinational which takes 1 if the company is a multinational and 0 otherwise (MULT), and a dummy variable Europe which takes 1 if the company has subsidiaries in Europe and 0 otherwise (EU). The independent variables are based on the paper of Tielmann & Shiereck (2017) and Bruggen (2016). The regressions are used to find which variables influence the CARs, and the regressions show the relative size of the influence of these variables. The values of the variables are obtained from DataStream. The data taken is for the event day, the 24th of June 2016. If one of the variables is not known

the company is deleted from the regression. This leaves the regression with 428 companies. The following regressions are conducted:

$$CAR(\mathrm{K},\mathrm{L}) = \beta_1 MV + \beta_2 BTMV + \beta_3 Ret + \beta_4 SIC + \beta_5 DY + \beta_6 MULT + \beta_7 EU \qquad (10)$$

Since the variables showed some big outliers (table 2), more value should be attached to the pairwise t-test than to the regression analysis.

Data

The companies in the sample are obtained from ORBIS by selecting companies in the United Kingdom. In addition, the companies must be publicly listed on the London Stock Exchange, FTSE 100. 649 companies are found that match these criteria. From ORBIS the ISIN Code and the location of the subsidiaries of the companies are obtained. The ISIN Code is searched for, because this code is then used in DataStream to find the additional data necessary for this paper. The location of the subsidiaries is given by the ISO Code of the country. From DataStream, the stock prices and foreign sales as percentage of total sales are obtained. For the companies that mentioned “NA” (Not Available) for the stock prices or do not have stock prices on dates that are needed, are deleted. These are 23 companies that have no stock price mentioned in DataStream, which leaves 626 companies. In addition, the currency of the stock price should be British pound, which leaves 612 companies. Finally, two companies were removed as not all data needed could be calculated. This leaves 610 companies.

The stock prices are needed for the event study, to calculate the abnormal returns and CARs. The foreign sales as percentage of total sales, and the location of the subsidiaries are needed to determine which company is considered a multinational or non-multinational, and which is a EU-multinational or a non-EU multinational. A company is considered a multinational if the foreign sales as percentage of total sales is at least or higher than ten percent (Meek, Roberts & Gray, 1995), or when the company has subsidiaries in at least or more than six other countries (Sambharya, 1996). The foreign sales as percentage of total sales is obtained from DataStream over the years 2016, 2015 and 2014, and the location of the subsidiaries is obtained from ORBIS for the most recent year, 2016. If in one of these years

the foreign sales are equal to or higher than ten percent, the company is considered a multinational. If the foreign sales as percentage of total sales is not known for any of three years mentioned, the amount of countries the company is operating in, is considered. So, if the company has no mentioned foreign sales, but does operate in six or more countries, it is considered a multinational. If the foreign sales are higher than ten percent, but the company is not operating in any other country than the UK, it is not considered a multinational.

Therefore, of these 610 companies, 337 are multinationals and 273 are not. Of the 337 multinationals, 272 have at least one subsidiary in Europe, and 65 multinationals do not have a subsidiary in Europe. This means that 337 companies are classified as multinationals, 273 as non-multinationals. Of these 337 multinationals, 272 are EU-multinationals, and 65 are non-EU multinationals.

The output of ORBIS, with the 610 companies, gives an ISO code for the countries the companies are operating in. The corresponding country names of these ISO Codes is obtained from the Online Browsing Platform (www.iso.org).

In addition, the market value, market-to-book ratio, stock return, amount of SIC codes, and dividend yield are obtained from DataStream. Not all the companies have the variables mentioned, therefore only 359 companies are left for the regression of the CAR. The variables are calculated as follows: the size is represented by the log of the market value. The leverage is the total debt as percentage of total assets of the company. The book-to-market value (BTMV) is the log of 1 divided by the market-to-book value (MTBV), MTBV being the market value divided by the book value. The dividend yield is the dividend per share as percentage of the share price. The return is the realized stock return on the event day. Multinational is 1 if the company is considered a multinational and zero otherwise, and Europe is 1 if the company is considered to have a subsidiary in Europe and zero otherwise. Some descriptive statistics on these variables are displayed in table 2. The descriptive statistic shows some outliers for the variables, since the minimum and maximum deviate greatly from the mean and median. This could make the regression biased.

	Mean	Median	Std. Dev	Min	Max	N
Size	2.636	2.634	1.038	0.041	4.948	359
Leverage	1.284	1.469	0.599	-1.523	2.291	359
BTMV	0.746	0.581	0.645	-1.087	3.846	359
DY	2.515	2.430	1.975	0	9.62	359
Return	-5.476	-4.505	5.664	-29.262	9.091	359

Table 2: *Descriptive statistics for the independent variables of the regression analysis. The independent variables are size, leverage, book-to-market ratio (BTMV), dividend yield (DY), and realized/actual stock returns (Return). (The mean, median, standard deviation (std. dev), minimum (min), maximum (max), and number of observations (N) are given.*

Results

The t-test, sign test, and Wilcoxon test will give the results of the first hypothesis: 'The Brexit has a significant negative effect on the stock returns of UK public companies listed on the London Stock Exchange". The pairwise t-test will give the results of the second hypothesis: "There is a significantly different effect from the Brexit for multinationals and non-multinational firms in the UK. Multinationals affected more negative than non-multinationals", and the third hypothesises: "There is a significantly different effect from the Brexit for EU multinationals and non-EU multinationals in the UK. EU multinationals affected more negative than non-EU multinationals". For these tests the following significance levels are used: * significant at 10% level (1.645), ** significant at 5% level (1.960), and *** significant at 1% level (2.576). *** indicates a strong significance, while * is a weak significance.

The t-test investigates the effect of the Brexit on the stock returns. In addition, the sign test and Wilcoxon test investigate the same, but the sign test and Wilcoxon signed rank test are nonparametric tests and therefore do not assume that data has a probability distribution. Also, these tests, test if the difference in median is equal to zero, unlike the t-test, which tests if the difference in the mean is zero. Hereby, the companies are divided into categories, as can be seen in table 3. The tests examine if there is a difference between the

returns and normal returns, so if the abnormal returns are different from zero. If the abnormal returns are different from zero, it means that the Brexit influenced the stock returns of the companies investigated. The tests are based on the abnormal returns on the event day, the 24th of June 2016. As said, a 5% significance level is used to determine if there is an effect. This means, if the T-statistic is above 1.96 or below -1.96, or if the p-value is below 5%, the Brexit has an effect. In table 2, all T-statistics and p-values correspond to this. Additionally, the effects are negative for all categories, since the means and medians are lower than zero. Therefore, the Brexit had a negative effect on the stock returns.

	T-test	**Sign Test**	**Wilcoxon Test**
	Mean (T-statistic)	**Median (P-value)**	**Median (P-value)**
All	-0.035*** (-12.188)	-0.029*** (0.0000)	-0.029*** (0.0000)
Multinational	-0.028*** (-9.806)	-0.027*** (0.0000)	-0.027*** (0.0000)
EU Multinational	-0.030*** (-10.809)	-0.027*** (0.0000)	-0.027*** (0.0000)
non-EU Multinational	-0.022*** (-3.071)	-0.024*** (0.0001)	-0.024*** (0.0007)
Non-Multinational	-0.043*** (-12.403)	-0.036*** (0.0000)	-0.036*** (0.0000)

Table 3: T-test, sign test, and Wilcoxon test output to test if there is a significant difference between the returns and normal returns of the stocks of the companies investigated by category on the event day, 6/24/2016. The test statistics and means, and p-values and medians are given per category. The companies are divided in categories by all, multinationals, EU multinationals, non-EU multinationals, and non-multinationals. The test statistic and p-value is for the event day, the 24th of June 2016. The mean and median are the overall mean and median for the companies in the sample that correspond to the associated category.

The results for the CARs are displayed in table 4. The t-test shows a negative effect on all categories for the CARs (-10, +10), and (-1, +1), since the t-statistics are below -1.96. For the CARs (-1, 0), and (-1, +10), the Brexit had a negative effect on all categories, except for the non-EU multinationals. For the non-multinationals of CAR (-1, 0) and CAR (-1, +10), there is no significant effect, since the test statistic falls between 1.96 and -1.96.

CAR	**(-10,+10)**	**(-1,0)**	**(-1, +1)**	**(-1, +10)**
	Mean (T-stat)	**Mean (T-stat)**	**Mean (T-stat)**	**Mean (T-stat)**
All	-0.095*** (-7.211)	-0.032*** (-7.882)	-0.066*** (-13.279)	-0.074*** (-7.446)
Multinational	-0.073*** (-5.512)	-0.025*** (-10.522)	-0.057*** (-15.030)	-0.055*** (-5.462)
EU Multinational	-0.074*** (-5.834)	-0.026*** (-6.761)	-0.063*** (-13.205)	-0.064*** (-6.709)
non-EU Multinational	-0.070** (-2.113)	-0.018* (-1.726)	-0.031** (-2.487)	-0.015 (-0.610)
Non-Multinational	-0.121*** (-7.637)	-0.041*** (-8.334)	-0.077*** (-12.806)	-0.097*** (-8.124)

Table 4: The t-test for the Cumulative Abnormal Returns (CARs). The test statistics and means are given per category. The categories are all companies, multinationals, non-multinationals, EU multinationals, and non-EU multinationals. The CAR for multiple event periods is given, namely (-10, +10), (-1, 0), (-1, +1), and (-1, +10).

The sign test and Wilcoxon test show that the CARs (-10, +10), (-1, 0), and (-1, +1) also have p-values below the 5% significance level, and therefore there is an effect of the Brexit on these CARs. Only for the CAR (-1, +10), the category non-EU multinationals have a significance level above 5%, and therefore the Brexit had no effect on the CAR (-1, +10) for non-EU multinationals. For all the other categories of this CAR, there is an effect.

Sign Test	CAR(-10,+10)	CAR(-1,0)	CAR(-1,+1)	CAR(-1,+10)
	Median (P-value)	Median (P-value)	Median (P-value)	Median (P-value)
All	-0.081*** (0.0000)	-0.024*** (0.0000)	-0.051*** (0.0000)	-0.053*** (0.0000)
Multinational	-0.064*** (0.0000)	-0.019*** (0.0000)	-0.048*** (0.0000)	-0.041*** (0.0000)
EU Multinational	-0.065*** (0.0000)	-0.026*** (0.0000)	-0.055*** (0.0000)	-0.045*** (0.0000)
non-EU Multinational	-0.059** (0.0248)	-0.018*** (0.0026)	-0.037*** (0.0004)	-0.025 (0.1360)
Non-Multinational	-0.107*** (0.0000)	-0.041*** (0.0000)	-0.053*** (0.0000)	-0.079*** (0.0000)

Wilcoxon test	CAR(-10, +10)	CAR(-1,0)	CAR(-1,+1)	CAR(-1,+10)
	Median (P-value)	Median (P-value)	Median (P-value)	Median (P-value)
All	-0.081*** (0.0000)	-0.024*** (0.0000)	-0.051*** (0.0000)	-0.053*** (0.0000)
Multinational	-0.064*** (0.0000)	-0.019*** (0.0000)	-0.048*** (0.0000)	-0.041*** (0.0000)
EU Multinational	-0.065*** (0.0000)	-0.026*** (0.0000)	-0.055*** (0.0000)	-0.045*** (0.0000)
non-EU Multinational	-0.059*** (0.0013)	-0.018*** (0.0010)	-0.037*** (0.0019)	-0.025 (0.2132)
Non-Multinational	-0.107*** (0.0000)	-0.041*** (0.0000)	-0.053*** (0.0000)	-0.079*** (0.0000)

Table 5: Output of the Sign Test and Wilcoxon Signed Rank Test as obtained from STATA. These tests are additional tests to test if the returns and normal returns of the stocks of the companies investigated are significant different. The median, p-value of the sign test, and p-value of the Wilcoxon signed rank test are given for the cumulative abnormal returns for multiple event periods. These event periods are (-10, +10), (-1, 0), (-1, +1), and (-1, +10).

The above results are for all categories separated. Now the results of the tests between the categories will follow. To test between categories, the pairwise t-test is used. To know which pairwise t-test to use, the Levene's test is used. For the p-values higher than the 5% significance level, the pairwise t-test with equal variances should be used. If the p-value is lower than 5%, the pairwise t-test with unequal variances should be used. The test is executed for the variance between multinationals and non-multinationals, and between EU-multinationals and non-EU multinationals. The results can be found in table 6. These test is again for the abnormal returns and cumulative abnormal returns. For the variances that are equal the pairwise t-test with equal variances is performed, and for the variances that are unequal the pairwise t-test with unequal variances is performed.

Levene's test	**AR**	**CAR(-10,+10)**	**CAR(-1,0)**	**CAR(-1,+1)**	**CAR(-1,+10)**
	P-value	**P-value**	**P-value**	**P-value**	**P-value**
Multinationals vs. non-multinationals	0.0000***	0.2333	0.0000***	0.0036***	0.0273**
EU-multinationals vs. non-EU multinationals	0.5013	0.0001***	0.0319**	0.5482	0.1198

Table 6: The results of the Levene's test as obtained from STATA. The Levene's test is to determine if the pairwise t-test must be used with equal variance or unequal variance, to test between two categories. These categories are multinationals vs. non-multinationals, and EU-multinationals vs. non-EU multinationals. The Levene's test is executed for the abnormal returns and the CARs.

The pairwise t-test examines if there is a significant difference between the effect on multinationals and non-multinationals, and between EU-multinationals and non-EU multinationals. The results can be found in table 7. There is a significant difference if the p-value is below the 5% significance level. The pairwise t-test for multinationals vs. non-multinationals gives only p-values below the 5% significance level, which means that there is

a different effect for multinationals and non-multinationals based on the AR and all the CARs. This violates the second hypothesis, but can make sense since multinationals are usually bigger than non-multinationals and are less dependent on the UK since there business is also in other countries. Non-multinationals are only operating in the UK and therefore are reliable on the UK economy, which can be negatively affected by the Brexit and therefore the Brexit influences the non-multinationals more negatively than multinationals (Krause, Noth & Tonzer, 2016; Ramiah, Pham & Moosa, 2017). The pairwise t-test for EU-multinationals vs. non-EU multinationals gives a p-value below 5% for the CAR (-1, +1), and CAR (-1, +10), meaning for these CARs there is a different effect between EU-multinationals and non-EU multinationals. For the AR, CAR (-10, +10), and CAR (-1, 0), there is no different effect between EU-multinationals and non-EU multinationals. This also make sense since multinationals trade with a lot of countries and are both as dependent on the UK, therefore the Brexit influences them in the same way.

Pairwise T-test:	**AR**	**CAR(-10,+10)**	**CAR(-1,0)**	**CAR(-1,+1)**	**CAR(-1,+10)**
	P-value	**P-value**	**P-value**	**P-value**	**P-value**
Multinationals vs. non-multinationals	0.0033***	0.0000***	0.0013***	0.0098***	0.0001***
EU-multinationals vs. non-EU multinationals	0.2652	0.8700	0.2875	0.0060***	0.0030***

Table 7: The results of the pairwise t-test as obtained from STATA. The test is executed for the abnormal returns and CARs (-10, +10), (-1, 0), (-1, +1), and (-1, +10). The test is to find if there is a difference between multinationals vs. non-multinationals, and EU-multinationals vs. non-EU multinationals.

At last, the regressions are conducted with the different CARs as dependent variable. The independent variables are size, leverage, book-to-market value (BTMV), dividend yield (DY), return, multinational, and Europe. The regression will be performed once with and once

without industry fixed effects. Industry fixed effects will be determined by the two-digit SIC code, which represents the industry a business is operating in. The results can be found in table 8.

The coefficient gives the direction of the effect of the variable on the CAR. The p-value indicates if the variable influences the CAR. The variable has an effect when the p-value is below the 5% significance level. The regressions, one without industry fixed effect and one with industry fixed effects, give the same conclusions. For all the CARs, only size (market value) and return influence the CARs. All the other variables have a p-value above 5% and therefore have no effect on the CARs, except for the variable multinational for the CAR (-1, +10). This means that a multinational would be more affected than a non-multiannual for the CAR (-1, +10). Following from the regression, there could only be said that the size and return have an effect, and the effect is positive for all of them. A larger firm, i.e. a firm with a higher market value, is more affected. This can be explained by the fact that smaller firms are more volatile to a declining economy and can hold their employees more easily, so a declining economy affects larger companies more (Moscarini & Postel-Vinay, 2012).

The R-squared and adjusted R-squared are the percentages of variation that is explained by the variables in the model. For the regression with the CARs (-10, 10), and (-1, +10), the variables do not explain the model very well, because the (adjusted) R-squared is very low. The other two regressions, on the other hand, do have a high explanatory power, looking at the (adjusted) R-squared.

	CAR(-10,+10)	CAR(-1,0)	CAR(-1,+1)	CAR(-1,+10)
	Coef. (P-value)	Coef. (P-value)	Coef. (P-value)	Coef. (P-value)
Size	0.032*** (0.000)	0.009*** (0.000)	0.921*** (0.000)	0.023*** (0.000)
Leverage	-0.009 (0.353)	-0.003 (0.233)	-0.219 (0.326)	-0.015* (0.071)
BTMV	0.014 (0.122)	0.003 (0.246)	0.243 (0.240)	0.011 (0.140)
DY	-0.006* (0.064)	0.001 (0.101)	0.080 (0.268)	-0.005* (0.084)
Return	0.014*** (0.000)	0.009*** (0.000)	0.926*** (0.000)	0.015*** (0.000)
Multinational	0.029 (0.206)	-0.001 (0.883)	-0.072 (0.891)	0.042** (0.029)
Europe	0.002 (0.926)	0.001 (0.899)	0.167 (0.749)	-0.018 (0.363)
N	359	359	359	359
R-squared	0.386	0.809	0.823	0.502
Adj. R-squared	0.374	0.805	0.819	0.492

	CAR(-10,+10)	CAR(-1,0)	CAR(-1,+1)	CAR(-1,+10)
	Coef. (P-value)	Coef. (P-value)	Coef. (P-value)	Coef. (P-value)
Size	0.025*** (0.001)	0.010*** (0.000)	1.074*** (0.000)	0.015** (0.020)
Leverage	-0.001 (0.937)	-0.002 (0.440)	-0.149 (0.547)	-0.008 (0.344)
BTMV	0.009 (0.405)	0.002 (0.465)	0.202 (0.389)	0.010 (0.259)
DY	-0.007* (0.058)	0.001 (0.136)	0.082 (0.307)	-0.005 (0.105)
Return	0.012*** (0.000)	0.010*** (0.000)	0.946*** (0.000)	0.013*** (0.000)
Multinational	0.037 (0.159)	0.002 (0.769)	0.243 (0.685)	0.048** (0.026)
Europe	-0.011 (0.673)	-0.004 (0.536)	-0.357 (0.538)	-0.008 (0.708)
N	359	359	359	359
R-squared	0.379	0.808	0.822	0.497

Table 8: Regressions with dependent variable CAR for the event window of (-10, +10), (-1, 0), (-1, +1), and (-1, +1). The upper regression without industry fixed effect, on the bottom with industry fixed effects. The coefficients of the independent variables are given. The independent variables are size, leverage, book-to-market ratio (BTMV), the amount of SIC Codes (SIC), dividend yield (DY), and realized/actual stock returns (Return), rounded to a third decimal. In addition, the amount of companies in the sample (N), the R-squared, and adjusted R-squared are given.

Conclusion

The purpose of this paper is to find the effect of the Brexit on the stock returns of publicly traded companies on the London Stock Exchange, in the UK. In addition, this paper makes a distinction between multinationals and non-multinationals, and between EU-multinationals and non-EU multinationals. This lead to three hypotheses to test. First, the Brexit had a significant negative effect on the stock returns of the investigated companies in the UK. Second, the Brexit had a significantly different effect for multinationals compared to non-multinational firms in the UK, multinationals more negatively affected than non-multinationals. Finally, the Brexit had a significantly different effect for EU-multinationals compared to non-EU multinationals in the UK, EU-multinationals more affected than non-EU multinationals. I explain these hypotheses.

The results of the t-test show a negative effect of the Brexit for the abnormal returns and for all the CARs, except for the category of the non-EU multinationals for the CARs (-1,0) and (-1,+10). The sign test and Wilcoxon signed rank test agree with each other, because they give the same conclusions. These tests are also in accordance with the t-test, except for the category of non-EU multinationals for the CAR (-1, 0). Overall, these tests show a negative effect of the Brexit on the stock returns of the UK companies investigated, which is in accordance with the first hypothesis.

The above tests are all tests for the categories separated. The pairwise t-test compares between categories. The pairwise t-test shows a different effect for multinationals and non-multinationals, for the AR and all the CARs. Hereby, non-multinationals are more negatively affected than multinationals, which means the second hypothesis is however rejected. This could be explained by the fact that non-multinationals are more dependent upon the UK and the UK economy is worsened because of the Brexit. Also, the third hypothesis is rejected, since, overall, EU-multinationals and non-EU multinationals are equally affected. Which make sense since both rely as much on the UK as the other. Only for the CARs (-1, +1) and (-1, +10), the difference between EU-multinationals and non-EU multinationals is also different, EU-multinationals more negatively affected than non-EU multinationals. For the AR, CAR (-10, +10), and CAR (-1, 0), there is no different effect between EU-multinationals and non-EU multinationals.

Finally, the regressions of the CARs do not give any information on the difference between multinationals and non-multinationals, and between EU-multinationals and non-EU multinationals on the CARs, since they are not significant. The regressions only tell there is a positive effect of Size and Return on the CARs. The multinational and Europe dummy are not significant for any CAR regression, except multinational for the CAR(-1, +10). This is in contrast with the pairwise t-test, because this test found a significant difference between multinationals and non-multinationals for some of the CARs. If the regression agreed with the pairwise t-test, the multinational and Europe variable would have been significant. On the other hand, the pairwise t-test did find no difference between EU-multinationals and non-EU multinationals for the CARs (-10, +10), and (-1, 0). This correspond to the regression analysis.

Discussion

There are a few shortcomings in this paper that could be improved. First there a few points concerning the control period. The control period is 250 trading days, which could be good, because so other events can be weight out against each other. On the other hand, by having such a large control period, the possibility is that more unnecessary days are included which makes the tests become less powerful. Another control period often used is 100 trading days. This could have included less unnecessary days to the event study. Another point for the control period, the control period could also have been chosen to be before the announcement of the referendum on the 25th of May 2015. This paper chooses the period directly before the event period to prevent stationarity. On the other hand, the announcement of the Brexit referendum itself could also have influenced the stock returns. Therefore, a control period before the 25th of May 2015 could have been chosen.

Finally concerning the control period, there should have been a more thorough search for other events of these companies in the control period. There could have been other events in the control period that influenced the stock returns. If there were other events, this would change the normal return and thereby the abnormal returns, which could give another conclusion.

Secondly, a few points concerning more thorough research. There could have been a

more thorough research about which tests to use. The most basic tests are used in this paper, which could be simplistic. Maybe there are better tests for such a study as in this paper. In addition, the variables for the regression are chosen based on other papers, from which the writers think they could influence the CARs. This paper could also have searched for its own variables and thought about which variables influence the CAR.

At last, another extension to this paper could be to use other models to calculate the abnormal returns. This paper uses the market model-based abnormal returns, but the mean-adjusted method where the normal returns are the average of the realized returns, or the market-adjusted method where the normal returns is regressed on the market returns could also be used. This would show if all these models would give the same conclusion.

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