Bachelor Thesis:

Analyzing the stock returns reaction of listed British banks on the announcement of Brexit

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Abstract

The following study aims to investigate the impact of the UK's vote to leave the European Union on the British banking industry. The determinant of this impact is the stock returns behavior. The overall effect is measured with the help of an event study tool and the market model is used to define abnormal returns. As it was expected, the results of the event study show the negative influence the British banking industry experienced due to the referendum result. In order to test whether the bank size makes a difference in reaction on the unexpected political events, particularly on the example of Brexit, a linear regression model was constructed. As a result, the tested variable is significant and provides a solid reason to assume the existence of the tested difference.

Key words: Brexit, banks, stock returns, event study.

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1. Introduction

In the modern world of fierce competition, the political positions are often subject to instability. There are some parts of the world where countries may experience the dramatic changes in their political structures every single day. As a result, the abundance of such changes prevents the particular areas from economic development. However, highly economically developed countries can occasionally shock the whole world with their unexpected political adjustments.

The motivation for the underlying research is based on one of the most unexpected voting outcomes of the current century. At the end of June 2016, Brexit referendum took place. It was aimed at deciding whether the United Kingdom should leave the European Union or remain as a member. Although most of the European politicians and business representatives were highly concerned about the potential result of the referendum and were anticipating the Brits to choose to stay in the EU, no one could seriously expect the final outcome. On the 24th of June, the results of the referendum were officially announced. The voting-based decision of Great Britain was to leave the EU. The results were extremely surprising for the whole world and led to a very disappointing market reaction. The pound declined to a level that was not reached since 1985 and was followed by a fall of the UK-focused index FTSE 250 by more than 8% in one day. The underlying paper centers its attention on this particular day.

The overall British market reaction on the announcement of the referendum result is publicly available and widely discussed nowadays. However, the following study focuses on the British banking industry in particular, aiming to measure the overall impact the referendum had on it. Besides, the paper will try to identify the components of this impact and measure their significance in the current case.

Essentially, the theoretical support of the research will be provided by the prior literature to create a general notion in the mind of a reader of the way such events ought to be investigated. It will be followed by the description of the data and methodology that the whole analysis is based on. Finally, with the help of obtained results, it will become possible to draw the final conclusions about the British banking industry's reaction to one of the most unexpected outcomes of the latest political processes.

2. Theoretical Framework

The stock performance has been broadly researched and analyzed mostly for the purpose of the returns prediction. A lot of different influences on stock performance have been tested such as market and political news. The results of most of the investigations show that there is "a large amount of evidence that stock prices are predictable" (Chan & Wesley, 2003, p.224). Chan bases the potential prediction on two categories: "The first is major public announcements, which are identifiable from headlines and extreme concurrent events. The second source is large price movements unaccompanied by any identifiable news" (Chan & Wesley, 2003, p.224). As a result, the research showed a significant difference between positive and negative public news influence. It was proved that negative news causes a relatively bigger drift in stock performance than positive news.

The second conclusion states that stocks that have no influence by the news during the event month tend to reverse in the following month.

2.1. News influence on stock pricing

The information that is publicly available on the market is claimed to be fully reflected by the efficient market price (Fama, 1970). To provide a backup for his research, Fama introduced acceptable conditions for capital market efficiency. The first one is the transaction cost absence in trading securities. The second condition implies that every market participant can get all the available market information without incurring any costs. The final condition is that 'all agree on the implication of current information for the current price and distributions of future prices of each security' (Fama, 1970). Even though it is almost impossible to satisfy these conditions in the real market, in spite of some deviations, they are enough to provide solid evidence of information reflection on the price of the security.

However, EMH is only a hypothesis and cannot be used as a real research support since it does not provide a solid proof of the information influence on prices. Nonetheless, Fama (1970) tried to inquire into this issue by conducting three versions of the Efficient Market Model testing: weak, semi-strong and strong. Although there is limited evidence against the EMH in the strong test case, weak and semi-strong tests' results support the hypothesis.

The more recent research conducted on the subject of news influence on the stock prices is the one by Heston and Sinha (2016). They conducted an immense research that involved 900000 public news pieces to investigate their influence on the stock prices. As a result of an investigation, the previous literature and analyses were supported by affirming that daily published news affect the stock prices for only 1-2 days that still provides an opportunity for predictions. Besides, the positive news was estimated to have a positive influence on the stocks, while the negative news has the negative influence.

As a matter of fact, EMH is still just a widespread assumption, but a significant number of existing research papers that provide some evidence, in this case, cannot be ignored. The news was proved to have a significant influence on stock pricing anyways. Occasionally, they can influence the stock market even before becoming publicly available. Some of it can also produce the so-called post-news reaction or they can end up causing multiple stock movements. This research is aimed at checking whether the obtained results can support the previously found evidence.

2.2. Major world events

One of the first research papers that aimed to investigate the stock market reaction on the world events was written by Victor Niederhoffer (1971). In his paper, he states: "The most unequivocal pattern of influence reported below is that large changes are substantially more likely following world events than on randomly selected days." (Niederhoffer, 1971, p.193). Moreover, it was mentioned that the significant abnormal returns can be disclosed on the first two days following the major world event. Around 20 headlines were gathered annually in the period of 1950-1966 with help of which it became possible to construct nineteen different event categories. While being supported by history and theory, these events were claimed to have a significant influence on stock pricing.

The reaction of the stock market performance of bad news, in particular, was described by Merrill (1966, p. 112): "The market has some very bad moments immediately following the tragic news. Selling drives prices down to a surprising degree. However, when a day has passed, the market recovers from its panic, and sometimes works upward to a higher level."

There are also studies that analyze the impact of economic events in particular on the stock price performance. For instance, Dangol (2008) based his study on the unanticipated political events. According to his findings, good news tends to result in positive abnormal stock returns, while negative political announcements are likely to experience the reverse effect. A sample of the paper consists of 11 commercial banks stocks which are traded on Nepal Stock Exchange during the period of 5 years (2001-2006) resulting in 81 observations. An important part of the paper is the separation of the events between negative and positive, in order to estimate the effect of each group on the stock performance. The market model was, and still is, considered to be the most precise one for the expected normal returns calculation in the event study with daily data. The results of the study showed the usual significance and positivity of the abnormal returns in the pre-event window, while the estimation day of t = -1 also yielded a positive abnormal performance on average, but it was insignificant. Moreover, right after the event, strong significance and negativity of the abnormal performance was observed and did not change during the following four days. The consistency of these findings might be later supported by the results of the thesis. Overall, the major findings of the paper were the short-term abnormal returns in the day following the event date and the consistency of the sign of the news and its effect (i.e. good news results in positive abnormal returns and vice versa).

Another relevant paper was written by Mahmood, Irfan, Iqbal and Kamran (2014). They based their research on the sample of 50 significant political events happening from 1998 until 2013. The results showed negative abnormal returns observed a couple of days before and after the political event in his research.

2.3 Previous studies

Brexit is a relatively recent event, therefore it has not been studied or analyzed to all extents yet. The stock market reaction is one of the subjects that was not deeply researched so far. However, two relevant research papers were found that can play a fundamental role for the thesis development.

The first research was performed by Ramiah, Pham and Moosa (2016). In their paper, they examine the impact of the referendum on various sectors of the British economy. The investigation

period was chosen to be one month long (June-July, 2016). The authors conducted an event study, the findings of which indicate the mixed effect depending on the investigated sector.

As it was already mentioned in the previously discussed literature, the essential step in finding the abnormal returns is the expected normal returns calculation. The researchers chose to apply CAPM model for the sake of this analysis. The CAR values were calculated for the 10 following days after the event. Zero values of ARs or CARs are assumed to indicate one of the following results: (i) no influence of Brexit on cost or revenue (ii) the industry is protected against the abnormal returns (iii) the cost can be burdened on the customers of an industry (iv) there is a decline in revenue experienced by the industry, which is compensated by a cost decline implemented as a government subsidy or vice versa. The paper concludes that there is an impact of Brexit on stock returns. The sectors that were affected, had significantly negative results on average, showing that the news can be categorized as bad for the UK economy.

The results of the paper pointed out the banking sector to be affected most severely by the Brexit referendum with negative abnormal returns. In conclusion, the predictions about changes in systemic risk in the short-run made by Bank of England were verified by the results of the research.

Another relevant paper was written by Burdekin, Hughson and Gu (2017) and it focuses on measuring the Brexit influence on equity markets around the world. The sample was constructed out of 64 stock exchanges in a 5-month period (January - June 2016). The authors decided not to focus on a particular industry, but to analyze the reaction of equity markets as a whole. The data was collected from over 40 countries in Asia, Europe and North and South Americas.

The normal expected returns were constructed using the market model. On the day of the referendum result announcement (24 June), the first negative abnormal returns could be already observed. Subsequently, they were followed by another set of negative abnormal performance on the third and the fourth day after the event date. Despite the fact that Brexit was considered to be worldwide ‘bad’ news, not all countries observed have shown negative ARs. The largest negative values of ARs were found within the European Union, which seems to be normal for the authors. The highest negative impact of the news was experienced by the PIIGS countries with an estimated average value of -6.64%. On the other side of the sample, BRICS countries take place, Russia and

Brazil in particular. The estimates of the abnormal returns of these two countries are positive and are 5.3% and 5.5% respectively. Finally, the UK experienced the average AR of -4.2%.
The ARs calculation was followed by a cross-sectional analysis that led to a conclusion of more economically open countries to suffer less from Brexit announcement than others. In general, the results of the research indicate the negativity of the Brexit effect on stock markets around the world, showing the biggest impact on the Eurozone countries.

What makes these two papers different from the underlying research? Firstly, the main focus of the thesis is on the banking sector reaction. Secondly, the investigated area is the UK in particular. Basically, two previously discussed papers will be combined into one specific research, providing more insights into the UK banking industry and the influence the referendum had on it.

2.4 Hypotheses development

Consistent with the theoretical background, two hypotheses of the thesis are formulated as follows:

H1: The announcement of Brexit referendum result had a negative impact on the stock prices of the listed British banks.

The research of Burdekin, Hughson and Gu (2017) showed a negative reaction of the British equity market to the referendum result. The idea behind this hypothesis is to test the returns' behavior of the British banking sector in particular. In order for the hypothesis to be tested, an event study will be applied. Even though the hypothesis is strongly expected not to be rejected, the output of the event study might be very useful in terms of its explanatory power.

H2: The size of a bank is positively correlated with the abnormality of returns.

Testing of this hypothesis involves a cross-sectional analysis. As soon as the values of cumulative abnormal returns are obtained, a regression analysis with a number of appropriately chosen variables will be conducted.

In order to construct a cross-sectional regression, the relevant independent variable was selected. All the data was obtained from Datastream database. The chosen variable is described below:

- *Size* - the variable that is calculated as the natural logarithm of the total assets a bank holds. By now, there is already enough evidence gathered that verifies the

existence of the correlation between the firm size and its returns on stock. For instance, in his paper, Van Dijk (2011) has collected a lot of support for this assumption from previous literature such as Banz (1981), Keim (1983), Brown & Warner (1985), etc. Each paper is testing the correlation in different markets, time periods and duration. The common idea that unites all of these papers is that they all conclude about the existence of such relationship and claim that it cannot be ignored. Therefore, one of the aims of the underlying research is to test this relationship on the example of Brexit and conclude whether the previous findings also make a difference while measuring the stock returns reaction on the unexpected political events. Concerning the stock returns, which are presented in the percentage terms, an increase in the size variable would be expected to lead to a decrease in the abnormal returns' absolute value. However, the anticipated impact of Brexit on stock returns is negative. Thus, one would expect the 'Size' variable to have a positive correlation with the CAR due to the fact that the overall post-referendum effect is negative.

3. Data and methodology

3.1. Sample selection

The research is based on 15 banks that are publicly listed and headquartered in the United Kingdom. Another important criterion for the sample construction was that banks had to be traded on the London Stock Exchange in United Kingdom Pounds. The list of observed banks can be found in Appendix A. Essentially, the Datastream request provided a sample of 19 banks, but for various reasons, 4 of them had to be eliminated.

For instance, information about the stock returns of CYBG plc was missing. It is a holding company that was founded at the beginning of 2016 and it has acquired three British banks since the foundation (Yorkshire Bank, Clydesdale Bank and B Bank). The last acquisition was performed in May 2016, around one month before the referendum. An assumed reason for obtaining missing values of the returns is that the company became publicly listed after the referendum date.

Another bank that had to be removed from the sample is TBC Bank Group. Even though it is traded in the London Stock Exchange and headquartered in Great Britain, it is originally a Georgian bank and most of its operations are performed there.

The rest of the banks simply became dead by the time of referendum and had no data to use in the underlying event study.

3.2. Event study

3.2.1. Definition and structure

In order to test the first hypothesis, an event study was adopted. To get a precise definition of the term, a textbook of Campbell, Lo and MacKinley (1997) is applied. It is a widely used financial tool that allows testing the existence of an impact a particular event has on an investigated firm, industry, etc. It can be applied to test the influence on a stock from a broad variety of events, starting with mergers and acquisitions and finishing with major political events.

There are several different ways in which an event study can be conducted. An underlying research will follow the method presented by Campbell, Lo and MacKinlay (1997) in their book "The Econometrics of Financial Market".

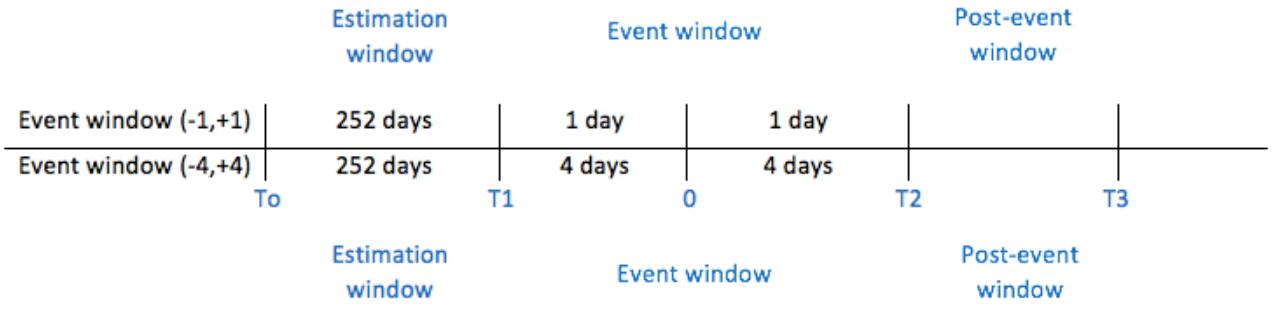
(i) Defining the event

In the first step, the event of interest needs to be defined. Basically, it is a particular date based on which the whole analysis is constructed. In the case of this study, an event is the referendum result announcement dated back on the 24th of June 2016, as the referendum itself took a place on the 23rd. Technically, the results were already available on the day of the referendum but since they were published late, it led the market to react on this event on the next trading day.

(ii) Estimation procedure

The time period of an event study needs to be identified. An example provided in the figure below will help the reader to have a clear notion of a research timeline.

Figure 1: *Event study timeline*



An estimation window (To, T1) is a period of time (before the event) counted in trading days. It is used as a basis for the expected return estimation with the help of which, the abnormality of the returns during the event will become possible to measure. The event window (T1, T2) is the number of trading days during which the abnormal returns are calculated. The event itself occurs at the point (0). If the chosen event window is (-4, +4), that means that the abnormal returns will be estimated starting from 4 days before the event until 4 days after. The biggest event window possible can go up to 41 trading days (-20, +20). What is the right way to define the event window for an event study? There are a lot of previous studies with different event windows suggested. The first event window chosen for an underlying research is the one proposed by MacKinlay (1997), (-1, +1). However, Kanas (2005) and Miyajima & Yafeh (2007) chose to use the windows of (-3, +3) and (-5, +5) respectively in their studies. For some special cases, post-event intervals can highly exceed the pre-event ones, such as the one Cox & Peterson (1994) used in their paper (-4, +20). The decision was made to test several different estimation windows in the underlying study.

As for the estimation window, there are no generally accepted intervals at all. Researches are simply using the ones they think provide the highest precision for their studies. The only thing they have in common is that one should not build an estimation window of less than 126 days (Benninga, 2008). Besides, based on the general knowledge, it is known that an average trading year consists of around 250 days. For the underlying study, the decision was made to have an estimation window of 252 days.

(iii) Index selection

The whole sample of the research is included in FTSE 350 Banks index. The fact that the index also reacts to the investigated event should be considered during the study. Basically, the obtained results of the stock performance will be adjusted by the index reaction. Besides, the return of the index plays a role of the basis for the expected normal returns calculation.

(iv) Defining normal performance

The event on which the whole study is based on takes place of a bias that affects the stock returns. Normal performance implies the returns that would be expected in the scenario, where the event would not occur (Campbell, Lo & MacKinlay, 1997). For every bank in the sample, the following condition holds:

$$\mathbf{AR_{i,t} = R_{i,t} - E\,[\,R_{i,t} \mid X_t\,],}$$

where:

$AR_{i,t}$- abnormal return

$R_{i,t}$- actual return

$E\{R_{i,t}|X_t\}$- expected normal return on the day t from the event window

There are different ways to estimate expected normal returns. As it was suggested by MacKinlay (1997), all the estimation techniques can be divided into two groups - statistical and economic models.

There are two key features of the statistical models: (i) they are independent of economic conditions and (ii) they assume asset returns to have an independent and identical distribution over time. The most commonly known and used representatives of this group are MM (the market model) and the constant-mean-return model.

As for the economic models, they are actually dependent on economic conditions and statistical assumptions are not applied to them by default. The main representatives of this group, on the basis of their usage, are APT (the arbitrage pricing theory) model and CAPM (the capital asset pricing model).

In the underlying research, the decision has been made to use the market model. This choice is based on the investigation conducted by Cable & Holland (1999). Essentially, their study showed the advantage regression-based models have over others. The study also includes the comparison between CAPM and MM in particular. MM was proved to be valid in 9 cases more

than CAPM. As a result, the research showed that the CAPM model is not perfect on the background of MM. Therefore, there is a strong evidence of MM to be the most reliable one for the underlying research and to clearly outperform other models.

3.2.2. AR and CAR

The following formula is used for the abnormal return calculation:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{it}),$$

where:

$AR_{i,t}$- abnormal return

$R_{i,t}$- actual return of the chosen event window

$(\alpha_i + \beta_i R_{it})$ - market model prediction of the normal return

In order to present an overall picture of the stock returns abnormal reaction, the obtained AR values should be aggregated. The aggregation can be performed in two different ways. First one implies the average abnormal return (AAR) calculation for every single day in the event window. It is expressed by the following formula:

$$\overline{AR_\tau} = \frac{1}{N}\sum_{i=1}^{N} \widehat{AR_{i\tau}}$$

However, based on the findings of Brooks (2014), this method might be a subject to imprecision in case of a high variation across the days. The potential solution to this problem is the second method of aggregation that implies combining the values through time. This method leads to obtaining cumulative abnormal returns (CAR) using the following formula:

$$\widehat{CAR_i}(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau=2} \widehat{AR_{i\tau}}$$

where τ_1 and τ_2 are the chosen borders of the event window.

For the research output to be credible, the obtained values of AAR and CAR need to be tested for significance. According to Brooks (2014), it is normally done through performing standard t-tests. An introduced null hypothesis, in this case, is Ho: AAR (CAR) = 0 implying that there is no effect from the event on the stock returns. The formulas for conducting the t-tests are as follows:

$$T_{AAR_t} = \sqrt{N}\frac{AAR_t}{S_{AAR_t}} \qquad T_{CAAR} = \sqrt{N}\frac{CAAR}{S_{CAAR}}$$

Where the S variable implies the standard deviation observed in the whole sample during the event window.

3.3 Cross-section

In order to test the second hypothesis, cross-sectional regression will be applied. It is normally used to examine which factors have a significant influence on the stock returns abnormal performance. Despite the independent variables introduced in the theoretical part, the regression will also include three control variables. They were chosen on the basis of the general impact they have on stock returns of the banking industry. The control variables that were picked for the underlying research are:

- *Domestic Accounts* - the variable indicates how internationally oriented the particular bank is. It is measured in percentage terms and calculated by dividing the number of domestic accounts by a total number of accounts. The stock prices can be significantly affected by a geographical position of a firm (Pynnönen, 2005). Most of the observed banks are also operating outside the UK. Since the event, the study is based on, concerns the domestic land, and the percentage share of these operations might be influential in estimating the abnormal returns. In particular, if the bank is significantly internationally oriented, that means that Brexit will yield a lot of impediments for the bank to keep operating outside the UK. That would drop the stock price leading to an increase in the negative abnormal returns.

- *Price-to-Earnings ratio (P/E)* - it denotes the amount of money that needs to be invested in the stock to receive one pound of company earnings. P/E ratio is an important component in the stock pricing process (Basu, 1977). Therefore, the correlation between the P/E ratio and abnormal returns is worth to be tested.
- *Earnings per share (EPS)* – it is a ratio with the help of which one can measure the net income amount that was gained per share of outstanding stock. EPS ratio is one of the essential determinants in the process of stock returns prediction (Holthausen & Larcker, 1992). This provides enough evidence to suspect the existence of its impact on the abnormal returns.
- *Dividend Yield* - is a proxy for a yearly dividend payout relative to a firm's share price. Dividend yield is one of the main tools in forecasting stock returns (Fama & French, 1987).

As a result, the OLS regression was constructed as follows:

$$CARi = \alpha + \beta 1\text{Size} + \beta 2\text{Domestic\_Accounts} + \beta 3\text{PE} + \beta 4\text{EPS} + \beta 5\text{Dividend\_Yield} + \varepsilon$$

with the help of which it will be possible to measure an impact of each variable on the cumulative abnormal returns.

4. Results

4.1 Event study results

The underlying event study was conducted throughout several different event windows. The best window used in the study will be determined after analyzing the results.

Table 1. *Abnormal returns in (-1, +1) event window*

Date	Mean	t-statistic
AR (+1)	-11.55%	-3.6268***
AR (0)	-10.85%	-3.7505***
AR (-1)	0.11%	-0.2994

***denotes significance at 1%, ** - at 5%, * - at 10%

The table above shows that the 1% significant reaction of abnormal returns starts on the day of the event. As it was expected, the abnormal returns of days 0 and +1 are negative, verifying the assumption that the news caused the British banks to have lower returns.

In order to build a more general image in the mind of the reader, the overall effect needs to be depicted. For this purpose, cumulative abnormal returns need to be calculated:

Table 2. *Cumulative abnormal returns in (-1, +1) event window*

Date	Mean	t-statistic
CAR(0, +1)	-22.40%	-3.9279***
CAR(-1, +1)	-9.74%	-3.4744***

***denotes significance at 1%, ** - at 5%, * - at 10%

The table above shows that all of the cumulative abnormal returns in the event window are 1% significant. Furthermore, they all depict the negative reaction of the stock returns reaching the lowest point in the window of (0, +1). Average CAR of this particular window equals -14.53%, leading to a conclusion that there is a substantial negative effect on the Brexit announcement observed in these three days.

Now, let's take a look on the observation over the longer period of time.

Table 3. *Abnormal returns in (-4, +4) event window*

Date	**Mean**	**t-statistic**
AR (+4)	-1.12%	-1.1024
AR (+3)	1.09%	0.7667
AR (+2)	-0.60%	-0.4497
AR (+1)	-11.55%	-3.6268***
AR (0)	-10.85%	-3.7505***
AR (-1)	0.11%	0.2994
AR (-2)	1.00%	2.6191**
AR (-3)	-0.05%	-0.1461
AR (-4)	2.56%	2.8182**

***denotes significance at 1%, ** - at 5%, * - at 10%

Unfortunately, not many conclusions can be drawn from these values, since most of them are insignificant. Besides, it becomes clear that there was no effect before the event. Thus, aiming for more precision, the overall effect needs to be tested throughout the period of time after the referendum:

Table 4. *Cumulative abnormal returns in (0, +7) event window*

Date	Mean	t-statistic
CAR(0, 1)	-22.40%	-3.9279***
CAR(0, 2)	-23.00%	-3.8193***
CAR(0, 3)	-21.91%	-4.4086***
CAR(0, 4)	-23.02%	-4.6115***
CAR(0, 5)	-24.20%	-4.6366***
CAR(0, 6)	-24.21%	-4.7201***
CAR(0, 7)	-29.88%	-4.7228***

***denotes significance at 1%, ** - at 5%, * - at 10%

The conclusion was made that there was no stock returns reaction observed before the event. Therefore, the latest event window that is (0, +7) provides the results that have the strongest explanatory power in this case. The obtained results depict a strong consistency with prior expectations. Namely, all of the cumulative abnormal returns of the 8-day event window are strongly negative with an average of -24.09%. Moreover, all of them are 1% significant. Overall, the last table provides a strong evidence of the British banks to be significantly worse off due to the referendum result.

Summarizing an obtained output, it can be concluded that there is not enough evidence to reject the first hypothesis as it was verified with the help of an event study.

4.2 Cross-sectional results

The model that was introduced in the previous part will be constructed with a total amount of 3 regressions. The original output obtained for the regression can be found in Appendix B.

Furthermore, the tests for normality of the dependent variables distribution are included in Appendix C. To start with, the first regression will estimate an influence throughout the event date and one day following the event.

$$CAR(0,+1) = \alpha + \beta 1\text{Size} + \beta 2\text{Domestic\_Accounts} + \beta 3\text{PE} + \beta 4\text{EPS} + \beta 5\text{Dividend\_Yield} + \varepsilon$$

Table 5. *Regression 1 output*

	Regression 1
Dependent variable	CAR (0; +1)
Variable	Coefficient(t-stat)
C	0.0131505(-0.44)
Size	**0.965441(2.79)****
Domestic Accounts	0.422172(0.97)
PE	0.0007573(0.90)
EPS	2.106254(1.00)
Dividend Yield	-0.014388(-0.89)
R-squared	0.9543
Adjusted R-squared	0.9289
F-statistic	37.58
Prob(F-stat)	0.0000

***denotes significance at 1%, ** - at 5%, * - at 10%

The first regression provided us with a 5% significant 'Size' variable with the coefficient of 0.97. That means that with every additional unit of the total assets' natural logarithm value, the cumulative abnormal return of the current window increases by approximately 0.97 percent. All the other variables are not significant. Therefore, there are two potential conclusions, they either have no influence on the dependent variable or the event window was not chosen right. In order to test these assumptions, two other regressions will be conducted.

In the second regression, one more day will be added to the estimation process:

$$CAR(0,+2) = \alpha + \beta 1\text{Size} + \beta 2\text{Domestic\_Accounts} + \beta 3\text{PE} + \beta 4\text{EPS} + \beta 5\text{Dividend\_Yield} + \varepsilon$$

The output of the second regression is depicted in the table below:

Table 6. *Regression 2 output*

Regression 2	
Dependent variable	CAR (0; +2)
Variable	Coefficient(t-stat)
C	-0.0227091(-0.90)
Size	**1.826163(6.26)*** **
Domestic Accounts	-0.5891816(0.97)
PE	0.000564(0.79)
EPS	2.69e-11(0.34)
Dividend Yield	-8.71e-07(-0.48)
R-squared	0.9709
Adjusted R-squared	0.9547
F-statistic	60.00
Prob(F-stat)	0.0000

***denotes significance at 1%, ** - at 5%, * - at 10%

There is one significant variable presented by the second regression: 'Size' (1%), the one that is representative in testing the second hypothesis. The influence captured by this variable equals 1.83, again, implying an increase of 1.83% in the cumulative abnormal return in case of having an additional unit of total assets' natural logarithm value. This is already the second regression in a row that shows the significant influence of the bank size on cumulative abnormal returns, showing a strong evidence for the second hypothesis not to be rejected.

Finally, the third regression will be extended until the end of the event window that was chosen to be the most precise in the event study part of the research:

$$CAR(0,+7) = \alpha + \beta_1 \text{Size} + \beta_2 \text{Domestic\_Accounts} + \beta_3 \text{PE} + \beta_4 \text{EPS} + \beta_5 \text{Dividend\_Yield} + \varepsilon$$

The output of the final regression is described by the following table:

Table 7. *Regression 3 output*

Regression 3	
Dependent variable	CAR (0; +7)
Variable	Coefficient(t-stat)
C	-0.0473051(-0.91)
Size	**1.313878(2.21)***
Domestic Accounts	0.042418(0.06)
PE	-0.0014447(-0.99)
EPS	4.65e-11(0.29)
Dividend Yield	-1.80e-06(-0.49)
R-squared	0.8902
Adjusted R-squared	0.8291
F-statistic	14.59
Prob(F-stat)	0.0004

***denotes significance at 1%, ** - at 5%, * - at 10%

'Size' variable was found to be 10% significant. The coefficient of 1.31 depicts the strong impact on the dependent variable. It can also be interpreted in the same way as it was done with the first two regressions.

All of the three regressions in the various event windows showed the positivity of the bank size influence on cumulative abnormal returns. In the 2-days event window, the regression had the 'Size' variable significant at 5%. The 3-days event window showed 1% significance of the same variable. Finally, in the 8-days event window, the crucial variable for testing the second hypothesis was also significant, this time at 10%.

Summarizing all the prior outputs, there is enough evidence to conclude that the second hypothesis cannot be rejected.

5. Conclusion

In conclusion, the underlying thesis analyses the impact of the Brexit referendum result on the stock returns of the listed banks headquartered in the United Kingdom. It was measured by conducting an event study that was followed by testing of different components affecting this impact. The second research question of the paper is aimed at observing the bank size component in particular. Both of the operations were applied to two different event windows to provide a reader with a more precise representation of the measured influence.

The findings of the research show that there is solid evidence for the British banking industry to be worse off as a result of the Brexit referendum. The average cumulative abnormal return (CAR) of the banking industry measured within 9 days is -22.3%. The positive impact of the variable denoting the bank size on the CAR values was proved to be significant in all of the three regressions performed. The results of the two parts of the research were not able to provide enough evidence for the first and the second hypotheses to be rejected leading to a conclusion that both of them were verified.

The relevance of the research can be explained by the fact that it uses the analysis methods from the prior literature and applies it to an investigation of the recent event. It is worth mentioning that the event's effect, the whole thesis is based on, was not yet clearly analyzed and discussed in the existing literature. Thus, the underlying paper can be one of the starting points for the deep analysis of the Brexit vote economic influence.

One of the main limitations of the paper is the relatively small sample of banks investigated. The reason for that is the limited number of British banks that are publicly listed implying that all the information on their returns' performance is available. Therefore, even though the results are quite persuasive, they cannot guarantee high reliability.

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Appendix A: List of observed banks

1. CURTIS BANKS GROUP
2. ROYAL BANK OF SCTL.GP.
3. BANK OF GEORGIA GROUP
4. ONESAVINGS BANK
5. SECURE TRUST BANK
6. HSBC HOLDINGS
7. LLOYDS BANKING GROUP
8. BARCLAYS
9. STANDARD CHARTERED
10. VIRGIN MONEY HOLDINGS
11. CLOSE BROTHERS GROUP
12. CARIBBEAN INVESTMENT
13. RASMALA
14. ALDERMORE GROUP
15. SHAWBROOK GROUP

Appendix B: Regressions output

Regression 1 – CAR (0, 1)

Source	SS	df	MS	Number of obs	=	15
				F(5, 9)	=	37.58
Model	.651731062	5	.130346212	Prob > F	=	0.0000
Residual	.031212539	9	.00346806	R-squared	=	0.9543
				Adj R-squared	=	0.9289
Total	.682943601	14	.048781686	Root MSE	=	.05889

CAR01	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Size	.965441	.3459607	2.79	0.021	.1828235	1.748059
DomesticAc~s	.422172	.4360735	0.97	0.358	-.5642947	1.408639
PE	.0007573	.0008447	0.90	0.393	-.0011536	.0026682
EPS	9.23e-11	9.27e-11	1.00	0.345	-1.17e-10	3.02e-10
DividendYi~d	-1.91e-06	2.14e-06	-0.89	0.395	-6.75e-06	2.93e-06
_cons	-.0131505	.0300633	-0.44	0.672	-.0811585	.0548574

Regression 2 – CAR (0, 2)

Source	SS	df	MS	Number of obs	=	15
				F(5, 9)	=	60.00
Model	.739305064	5	.147861013	Prob > F	=	0.0000
Residual	.02217997	9	.002464441	R-squared	=	0.9709
				Adj R-squared	=	0.9547
Total	.761485034	14	.054391788	Root MSE	=	.04964

CAR02	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Size	1.826163	.2916371	6.26	0.000	1.166434	2.485892
DomesticAc~s	-.5891816	.3676001	-1.60	0.143	-1.420751	.2423876
PE	.000564	.0007121	0.79	0.449	-.0010469	.0021749
EPS	2.69e-11	7.82e-11	0.34	0.739	-1.50e-10	2.04e-10
DividendYi~d	-8.71e-07	1.80e-06	-0.48	0.640	-4.95e-06	3.21e-06
_cons	-.0227091	.0253427	-0.90	0.394	-.0800383	.03462

Regression 3 – CAR (0, 7)

Source	SS	df	MS	Number of obs	=	15
				F(5, 9)	=	14.59
Model	.748152112	5	.149630422	Prob > F	=	0.0004
Residual	.092310313	9	.010256701	R-squared	=	0.8902
				Adj R-squared	=	0.8291
Total	.840462426	14	.06003303	Root MSE	=	.10128

CAR07	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Size	1.313878	.5949595	2.21	0.055	-.0320136	2.65977
DomesticAc~s	.042418	.7499292	0.06	0.956	-1.65404	1.738876
PE	-.0014447	.0014527	-0.99	0.346	-.0047309	.0018416
EPS	4.65e-11	1.59e-10	0.29	0.777	-3.14e-10	4.07e-10
DividendYi~d	-1.80e-06	3.68e-06	-0.49	0.637	-.0000101	6.52e-06
_cons	-.0473051	.0517008	-0.91	0.384	-.1642605	.0696502

Appendix C: Tests for Normality:

Test1 - CAR (0, 1):

	Skewness/Kurtosis tests for Normality				joint	
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)		Prob>chi2
CAR01	15	0.3977	0.2050	2.69		0.2600

Test2 - CAR (0, 2):

	Skewness/Kurtosis tests for Normality				joint	
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)		Prob>chi2
CAR02	15	0.1655	0.8352	2.26		0.3224

Test3 - CAR (0, 7):

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
CAR07	15	0.6093	0.2325	1.93	0.3819