Geopolitical Factor Impact of Brexit-related Events on Stocks

—An Event Study Approach on Pre and Post London Stock Market and Firm-Level Heterogeneous Effects Analysis

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Abstract: This research investigates the impacts of Brexit on stocks listed in the London Stock Exchange during 2016-2019. The event study approach is used to explore the impacts by evaluating pro and post stock market performance. This study is a more comprehensive study and an extension of Davies and Studnicka (2018), to deeper understand the heterogeneous impacts of Brexit. As a foundation, this study first conducts ratio analysis that evaluates total return, abnormal return (using CAPM), trading activity ratios and Ask-Bid spread of each stock. Second, Brexit related events were classified into two categories, by events' force of increasing or decreasing the probability of Brexit to happen, and their corresponding effects on stock movements. The findings show Brexit related events have overall negative impacts on stock returns. Further, there are significant changes in trading activities surrounding event days; different types of events have heterogeneous effects. This article shed light on intellectual understanding about the interactions between political uncertainty and financial market.

1. Introduction

The international financial media has discussed a new word "Brexit" in recent years, which is not found in any authoritative dictionary. Through a Google search, nearly 51.9 million pieces of relevant information can be found, which collectively point to a phenomenon that the global economy is paying attention to the "Brexit". As a major country in the European Union that has significant influence and special relations with the United States, Brexit may have a strong effect on Atlantic relations and Asia, thereby affecting the international landscape. As a major event affecting international politics, the stock market is difficult to remain unaffected. And multinational companies may be affected for a long time, which has attracted many scholars to study the impact of Brexit on financial markets such as the bond market. Compared to most previous research, this research takes advantage of multiple events following the Brexit Referendum in 2016. This enables me to investigate the heterogeneous effects of different events related to the likelihood of Brexit. Some of these events increase the likelihood of Brexit and some decrease the likelihood of Brexit. Investors in the financial market may respond to these two types of events asymmetrically: they only respond to negative news and ignore positives news. Another advantage of multiple events is to rule out factors affecting the stock market at the same time as one single event.

This study selected 10 very representative events listed below from nearly 100 major events since the Brexit discussion emerged in 2016 until 2019 (Timeline 2020). The criteria for an event to be a major event is either it involves large group participants voting or it is the starting date of a new phase. Classification of the 10 events as either "positive" or "negative" is also provided in Table 1: "positive" means the event implies a higher possibility of Brexit and "negative" means the lower possibility of Brexit. Some of these events involve voting in the Parliament. The voting margin of these events votes is also listed in Table 1 along with another summary information. A voting margin

close to 50% suggests that the voting outcome is more likely to surprise the stock market. Among them, there are many representative events such as the start of Brexit negotiations, the final white paper on future UK-EU relations, Boris Johnson becoming Prime Minister and the dissolution of Parliament.

Table 1: The list of main events related to Brexit

Event ID	Voting	Event Summary	Date	Implications on the Likelihood of Brexit
1	51.9%	Referendum for Brexit	23/06/2016	positive
2	83.8%	May's Plan to Trigger Article 50	07/12/2016	positive
3		Brexit negotiations commence	19/06/2017	positive
4		Finalised white paper about future UK-EU relation	06/07/2018	positive
5	68.1%	First Vote on Withdrawal Agreement	15/01/2019	negative
6	61.8%	Second Vote on Withdrawal Agreement	12/03/2019	negative
7	54.6%	Third Vote on Withdrawal Agreement	29/03/2019	negative
8		May Announce to Resign	24/05/2019	negative
9		Boris Johnson Become PM	24/07/2019	positive
10		Parliament Dissolved	06/11/2019	negative

In 2016, the previous British Prime Minister, Cameron, returned from negotiations with the European Union headquarters. He convened a cabinet meeting overnight and announced that a referendum would be held on June 23 to determine whether Britain would leave the EU. Since then, Brexit has become one of the central issues of the international community, and all sectors of government, industry and research have joined the analysis of Brexit's prospects and its various impacts. However, the analysis results provided by different parties which can be described as inconsistent.

In general, there are three phases of Brexit timeline. In the first phase, the referendum for Brexit is passed and Theresa May became the Prime Minister, who then set out a plan for negotiation with European Union. The second stage is to win the majority in the Parliament to have the Withdrawal Agreement approved. However, there were many disputes and amendments to the Agreement. During rounds of votes, the public's perception of a near-future Brexit becomes unlikely. As a consequence, Theresa May announced to resign, and the timeline of Brexit came to the next phase. Boris Johnson became the new Prime Minister, who claimed that he would push the Brexit Agenda forward and had the deal done as soon as possible. Still, the process was prolonged as on 6 November 2019, the Parliament was dissolved, and the new election began, making the prospect of Brexit uncertain again. Regardless of the outcome of the Brexit referendum, the uncertainty brought about by the event itself has begun to appear at all levels, including economic and financial. The emergence of an emergency will impact the stock market. Based on relevant data, we can estimate the short-term fluctuations and rebounds of stock prices and predict the impact of unexpected events on the stock market.

The events related to Brexit has dramatic impacts on economic politics and financial environment, this study contributes to the existing literature with comprehensive analysis. Recently, a growing number of people have found that political uncertainty has featured the financial market significantly. According to Lubos (2013), not merely in Europe but also worldwide, the impact of political uncertainty has become more and more prominent. For example, in the Greek bankruptcy in 2010, global stock prices have been affected mainly negatively, especially in the Eurozone (Mink, Mark, and Jakob, 2013). For fear of political uncertainty, we attempt to develop its variation around referendums for a particular policy. At present, one of the most representative events is the national elections of Brexit. Also, people found out that political uncertainty is priced in both the stock market and options market as predicted (Kelly, Pastor and Veronesi, 2016). Based on the event analysis method, the empirical analysis of the impact of Brexit on the world stock market and the UK stock market shows that the Brexit event negatively affects the world stock market overall.

This paper focuses on the effects of Brexit on stock performance in the London Stock Exchange. Nearly 1000 different stocks have been selected for this study. Due to various reasons such as suspension of trading, 752 of these were left for analysis. To make the analysis clearer and simpler, this paper have given all stocks random numbers (work file stock LSE) and will analyse from various aspects such as market value, daily return, the turnover rate of value or volume and the disagreement of ask and bid price on the specific day, which are the date of Brexit important events. These five ratios are general financial measurements, by using basic financial ratio analysis, we can see the change before and after the event.

2. Literature Review

Brexit referendum outcome influences the global financial markets significantly. Since the inception of Brexit referendum in 2016, there have been many papers trying to explore the impacts of Brexit on many aspects of the economy, both locally and globally. Most papers focus on equity market either in the UK or Europe or the global financial market and they reach a similar conclusion that Brexit is negative news for the stock market, meaning negative stock returns and higher volatility. Long-term benefits may not only reflect investors' expectations for future economic conditions but also expected response to internalized monetary policy (An H, Chen Y, Luo D, 2016). Previous literature has focused on the impact of Brexit on different aspects of the economy, for example, stock market, labour market, immigration, macroeconomic, currency and so on. Some research shows that Brexit brings negative effects, while others have an opposite point of views or mixed. A group of people identified some potential reactions after Brexit. They investigate this event further by doing some analyses in various sectors.

First, for Brexit's impact on the stock market, Burdekin, Hughson and Gu (2017) show that global equity market decreased by 5% following Brexit on June 24, 2016. Additionally, Gu and Hibbert (2018) find out that not only the index may drop, but also the stock volatility rises due to the uncertainty of the market. Comparing to a confirmed result, investors more anxious about uncertainty. There was wide consensus among economists that the impact of Brexit on the future state of the economy would be negative because of reductions in trade and FDI. There may be a decline in both net migration and productivity growth may become potentially lower (Treasury Committee, 2016, Ebell et al, 2016). Luke Ellis, chief executive of Man Group, said some investors put the UK into the "too hard to think about basket". It is hard to judge the trend of economics. Second, the increase in migration from Eastern to Western Europe after their accession to the European Union (EU) in 2004 caused a large increase in remittances to New Member States which is also called NMS. Langer and Tetenyi (2019) have a point of view that immigrants may be influenced significantly if the UK withdraws EU. Britain will no longer be bound by EU regulations on the free movement of people unless it has the freedom to establish its own immigration system. What does the system look like? Third, Delaney (2019) points towards that there may be possible consequential effects on interest rate levels – to the extent of decreasing such levels to near-zero levels. (to stimulate consumption?) Also, the price of commodities may go up in the future.

Brexit also influences the equity market, here provide a discussion of literature strand in this area and highlight the heterogeneous effects of Brexit on various firms. Rubbaniy, Lensvelt and Bhatti (2019) conduct research about 27 events between 2017-2018 and they finally made a different conclusion: although the overall market reactions to these events are negative, a positive market reaction to events that occurred after the Brexit referendum. This is because different groups of people have different expectations for the Brexit. For example, if someone is an investor who holds stocks from some EU listed companies, they might want the UK to stay in the EU. Conversely, if someone is not satisfied with some EU policy, they may want to leave the EU.

Shahzad, Rubbaniy, Lensvelt and Bhatti (2018) find that even though the overall market response to a series events related to the likelihood of Brexit is negative. They argued that the negative results mainly come from the Brexit referendum, and the stock market has positive reactions to events post Brexit referendum. The interpretation of this pattern is that initially, the market reacted negatively to the Brexit; however, as the UK's future economic relations with EU started to take a shape, the

market started to see the positive side of Brexit. Gu and Hibbert (2018) also find that an increase in the likelihood of Brexit led to lower stock prices and higher market implied volatility. The results are more pronounced to stocks that are sensitive to volatility shocks, implying the political news is priced through its effect on volatility risk. Gottschalk (2018) focuses on the correlation of stocks in the UK and multiple countries in European Union and finds there is a big chance of the correlation after Brexit using a technique called correlation structural break test. The findings confirm that economic integration is correlated with stock return correlation. Breinlich, Leromain, Novy, Sampson and Usman (2018) investigate the stock market at the more micro level. Their findings suggest that initial stock price movements were driven by fears of a cyclical downturn and by the sterling depreciation following the referendum.

There's also tentative evidence that market reactions to two subsequent speeches by Theresa May (her Conservative Party conference and Lancaster House speeches). They were more closely correlated with potential changes to tariffs and non-tariff barriers on UK-EU trade, indicating that investors may have updated their expectations in light of the possibility of a 'hard Brexit'. Davies and Studnicka (2018) contribute to the understanding of impacts of Brexit referendum on the stock market by showing the heterogeneous effects which depend on the firm's exposure to the EU and UK. In addition to the equity market, Chadha, Hantzsche and Mellina (2018) study the impacts on the bond market. The impacts of Brexit referendum come from two sources: worsening economic conditions and declined term premium. Besides the financial market, multiple papers explored the impacts of Brexit referendum on other aspects of the economy. Basak, Das, Marjit and Mukherjee (2019), Plakandaras, Gupta and Wohar (2017) and Maria, Luis and Tommaso(2018) studied the impacts on the currency market. They find a significant depreciation of British pound relative to other currencies following the referendum. The results are mainly driven by investors' sentiment. Estrada, Park and Koutronas (2019) studies the potential effects on Asia's trade; Toma (2018) mentioned that UK and UK banks' operations in the EU will be affected by a loss of passporting to three different degrees; Sampson (2017) thinks Brexit will lead to new barriers to trade and migration between the UK and the European Union; Langer and Tetenyi (2019) highlights the impacts on migrants. Since labour market, dis-integration affects labour supply directly through migration, and labour demand will indirectly increasing capital stock through remittances.

In a broader sense, this paper is related to the fundamental discussion about the relationship between political uncertainty and financial market. Wisniewski (2016) provides a summary of papers in this filed. In this strand of literature, events like Brexit poses great political uncertainty to the market, and financial market incorporate this uncertainty as additional risk into the pricing of financial assets, such as stocks and bonds etc. Pastor and Veronesi (2013) form a theoretical model to explain the influence of political uncertainty. They theorize that uncertainty is created as, while investors become familiar with existing policy and its implications, the government can endogenously choose a new policy at any time. This model suggests that independent of traditional risk factors, political uncertainty directly affects the risk premium. Smales (2017) takes advantage of UK Brexit referendum as a novel event to identify the correlation between financial uncertainty and political uncertainty. The paper emphasizes that unlike previous papers that focus on elections, a political event such as Brexit referendum is more like a single unexpected event. Beyond asset price, political uncertainty also has huge impacts on companies' policies of investing. An, Chen, Luo and Zhang (2015) uses data on corporate investment in China and found a strong relationship between political turnover and corporate investment. In cities where political leaders are more likely to be changed, firms invest less, and the volatility of an investment is also higher when political turnover is higher.

3. Data and Measurement

3.1 Data Source

The focus of this study is the sample of firms that are listed in the London Stock Exchange from 2016 to 2019. As a result, this process collected a sample of 1053 stocks initially. For this set of

companies, two aspects are collected: (1) daily price and trading information; and (2) affiliates' location, industry and financial information. The first set includes daily price, total return, market capitalization, total outstanding common shares and trading volume and trading value, average asking price and average bid price from Bloomberg. For the second set of information, from ORBIS database, I obtain the list of affiliates for each stock company, and the ownership information of these affiliates (namely what's the percentage of these affiliates companies are owned by the stock companies). For each affiliate, I also get information about their location, industry and asset value.

3.1.1 Exposure to UK Market

In my research, I want to highlight that Brexit events might have heterogeneous effects on stocks. Stock companies with different exposure to UK and Europe market should have a different response to the events. To measure the exposure of each stock company to these two regions, I decompose the firm's total asset by regions. To be specific, let's define the magnitude of a firm's exposure to the UK market and EU market respectively:

$$Exposure_{i,t}^{UK} = \frac{\sum_{j \in UK} S_{i,j,t} \times Asset_{j,t-1}}{Asset_{i,t-1}}$$

$$Exposure_{i,t}^{EU} = \frac{\sum_{j \in EU} S_{i,j,t} \times Asset_{j,t-1}}{Asset_{i,t-1}}$$

$Exposure_{i,t}^{UK}$ and $Exposure_{i,t}^{EU}$ are numbers that range from 0 to 1, referring to the extent of exposure of company i in year t . $Asset_{i,t-1}$ is the total asset of the listed parent company i in year $t-1$ (the most recently observed asset value from the balance sheet); $Asset_{i,t-1}$ is the total asset of any affiliate j of a listed company in year $t-1$ (the most recently observed asset value from the balance sheet); $S_{i,j,t}$ is the fraction of firm j's equity owned by company j in year t.

An interactive variable between these two exposures is used to study if companies with high exposure in both regions are likely to behave differently from other firms:

$$Exposure_{i,t}^{UK} \times Exposure_{i,t}^{EU}$$

One possibility about this type of companies is they will be less responsive to the Brexit events since they have good geographical diversification; another possibility is they respond more than other firms because companies with high exposure in both UK and EU are firms that have frequent trade between the two regions. Brexit will make trade between UK and EU more difficult, therefore this type of firms might be impacted the strongest.

3.1.2 Measures about Stock Trading Behaviours

To study the impacts of Brexit related events on the stock market, specification on aspects of stock trading behaviors of interest in the need to be stated. This part constructs five variables to capture the patterns of stocks in different dimensions, listed below in Table 2a. The first two are about stock's performance: total return and abnormal return. The total return is simply calculated using the stock price and dividend paid. Abnormal return is by controlling the "normal" return due to the stock's exposure to systematic risk. This utilizes the CAPM model to capture the "normal" return, which is the beta of the individual stock and market excess return. The difference between the stock's excess return and beta $\times$ market excess return is the "abnormal" return (or alpha) which cannot be explained by the CAPM model. Therefore, this part of return can be contributed by various news from the market, including Brexit events.

The second set of these variables is about the trading activities of the stocks. How actively investors are trading the stocks is also important for us to understand what happened before and after the events. The measures of trading activities are calculated in two ways: the ratio between the value of stocks traded within one day and the total market value of the stock; the ratio between the number of stocks traded within one day and the total number of outstanding common shares. The last

measure is a measure for the liquidity of the stock, which is the difference between the average ask price and bid price divided by the closing price of the stock. The larger this ratio is, the less liquid the stock is in the market. The heterogeneous beliefs about the stock's value among investors will increase when there is some new information. For example, before the Brexit referendum, investors are uncertain about the voting results, and the voting results of Brexit will potentially have huge impacts on these firms, but different investors' belief on the likelihood of voting for "yes" is heterogeneous, therefore the discrepancy between ask and bid price will be large during the days before the referendum

Table 2a. Financial Analysis of Ratios to Compare Pre and Post Stock Performance

variables	Measures
Total Return (%)	$R_{i,t} = 100 \times \dfrac{Price_t + Dividend_t}{Price_{t-1}}$
Abnormal Return ($\alpha_{i,t}$) (%)	CAPM model: $R_{i,t} - rf = \alpha_{i,t} + \beta_i(R_{m,t} - rf)$ (rf is risk free rate)
Trading Activity (value %)	$100 \times \dfrac{Trading\ Value_t}{MKTVALUE_t}$
Trading Activity (volume %)	$100 \times \dfrac{Trading\ Volume_t}{Outstanding\ Shares_t}$
Ask-Bid Spread	$100 \times \dfrac{Ask_t - Bid_t}{Price_t}$

3.2 Summary Statistics

Before conducting empirical analysis, having a basic understanding of the data and its patterns is helpful. Figure 1 plots the general patterns of the stock market in the London Stock Exchange. It is a plot assuming if 1 £ is invested in the UK stock market from 1 January 2016, what's the value of this investment. For example, an investor invested 1 £ in the UK stock market at the beginning of 2016 will have a portfolio worth about 1.3 £ at the end of 2019. The dashed lines are the dates of the major events related to Brexit. We can tell there are indeed ups and downs surrounding these event days. Especially in the day that Boris Johnson became Prime Minister (24/07/2019), there is a big jump in the UK stock market.

Figure 1: Market Index of the London Stock Exchange (Set 1/1/2016 index value=1)

3.3 Summary Statistics

Table 2b shown the summary of statistics for the key variables for my research. The table has two

panels of information. Panel A is about affiliates characteristics and Panel B is about stock information. First, for stock companies' affiliates characteristics, among the 752 companies' stock, on average, one company has 76.45 affiliates. However, the median for number of affiliates is 12, which suggests the distribution of this variable is highly skewed, so later in my regression, log (number of affiliates) transformation of variable is used, such that the results of my regression will not be biased by the skewness of this variable. With the affiliates, a stock company on average has 16% of its total asset exposed to Europe and 76% exposed to the UK, 8% to the rest of the world. For the variable $Exposure_{i,t}^{UK} \times Exposure_{i,t}^{EU}$, which measures the stock company has exposure to both regions. From the statistics, more than half of the stock companies have no affiliates in Europe as the stock companies in my sample are listed in the London Stock Exchange. Two additional variables: $Exposure_{i,t}^{UK,Same\ Industry}$ and $Exposure_{i,t}^{EU,Same\ Industry}$ are also considered in the models, which only includes those affiliates in the same industry as the core business of the stock company.

In panel B, the summary statistics about stock variables are shown. There are more observations because this is based on daily trading data. For information about trading activities, there are missing values which makes the number of observations for these variables less than for return and market value. My sample consists of stocks of various size, the smallest firm only have a market capitalization of 0.01 (£Million) and the largest market capitalization is 970 Billion £. On average, the daily total return is very small, and the median is 0. But the variation of total return is huge. In terms of trading activities, on average 0.29% of all the outstanding total shares are traded every day and 0.06% of all the market value of the stock is traded. The difference in these numbers tells us that stocks with smaller capitalization are traded more frequently. Ask-Bid spread is significantly different from 0, indicating that the market is not perfectly liquid.

4. Empirical Analysis and Results

4.1 Main Empirical Strategy

In the main empirical analysis of this paper, an event study approach is used to study the impacts of Brexit events on the stock market. For the event study, there are several elements. It is cited from the "The heterogeneous impact of Brexit: Early indications from the FTSE", which is also an event study written by Davies and Studnicka (2018).

$$y_{i,t} = \gamma \times Post_t^e + Controls + \varepsilon_{i,t}$$

In this baseline regression model about event study, $y_{i,t}$ is the outcome variable we are interested in about a firm i in year t. It can be one of the variables we mentioned earlier: total return, abnormal return, $Post_t^e$ is the key independent variable in this event study, it's a dummy variable that takes 1 if the year is after event e. We use a time window of 20 days for the main results. Results for different length of time window will also be shown as a robustness check. $Controls$ include firm fixed effects and weekday fixed effects.

If the main coefficient γ is positive and as $y_{i,t}$ is the total return, which can be interpreted as the Brexit-related event has positive on the stock performance; alternatively, if γ is negative, and $y_{i,t}$ is the total return, then we can interpret this as the Brexit-related event has negative on the stock performance; in the case of $\gamma = 0$, it implies the financial market is insensitive to the Brexit news.

Another important component of the event study is the length of the time window. Essentially, the event study compares the outcome variable in a short period before and after the event date, then the length of period for comparison matters. Too short-horizon may neglect the long-run effects of the event; too long horizon may bring in too many noises that can obscure the effects of the events. Therefore, different lengths of time window is used as robustness checks: (-1,_+1), (-2,+2), (-3,+3), (-4,+4), (-5,+5), (-10,+10), (-15,+15) where $(-t, +t)$ means that the analysis only focus observations from t days before the event to t days after the event, then in the baseline regression, the main coefficient γ effectively is the difference between the average value of the outcome variable for days $0, 1, 2, \ldots t$ after the event and the average value of the outcome variable for days $1, 2, \ldots t$ before

the event.

4.2 Aggregate Results

In this part, the overall reaction of the stock market to events related to Brexit is shown, regardless of the type of events and firm characteristics. The analysis based on this part can provide a general picture of how Brexit news impacts the stock market.

Before showing regression results, a preliminary preview of the main results in figures is provided. In Figure 2, the mean value of main outcome variables is plotted (total return, trading activities by value and by volume, Ask-Bid Spread) in a time window of (-20 days, +20 days). The plot provides straightforward patterns about the stock market around the event day. The dashed lines are for the 95% confidence interval. The confidence interval tells us that 95% of the observations lie within the confidence interval:

- The upper line is:

$$Mean + 1.96 \times SD/\sqrt{N}$$

- and the lower line is:

$$Mean - 1.96 \times SD/\sqrt{N}$$

Where $Mean$ is the average value of all the observations for each date, SD is the standard deviation and N is the number of observations. From the four subfigures in Figure 2, we can make a general conclusion that indeed Brexit related events have impacts on the stock market. For total return, there are no obvious patterns before the event day, in the day of the event, the average return is about 0.2% and the day after the event, there is a sharp decrease of total return by 0.8%, to -0.6% one day after the event. The significant negative return also exists two days after the event. For trading activities in terms of value and volume, the patterns are quite similar. In general, there is a peak of trading activities around the event day, but on the exact day of the event, trading is not active. For example, for trading activity measured by volume, the day before the event has an average trading activity of 0.35% and the number drops to 0.25% on the day of the event and then climbs to 0.32% one day after the event. For Ask-Bid spread, there is no significant change around the day of the event.
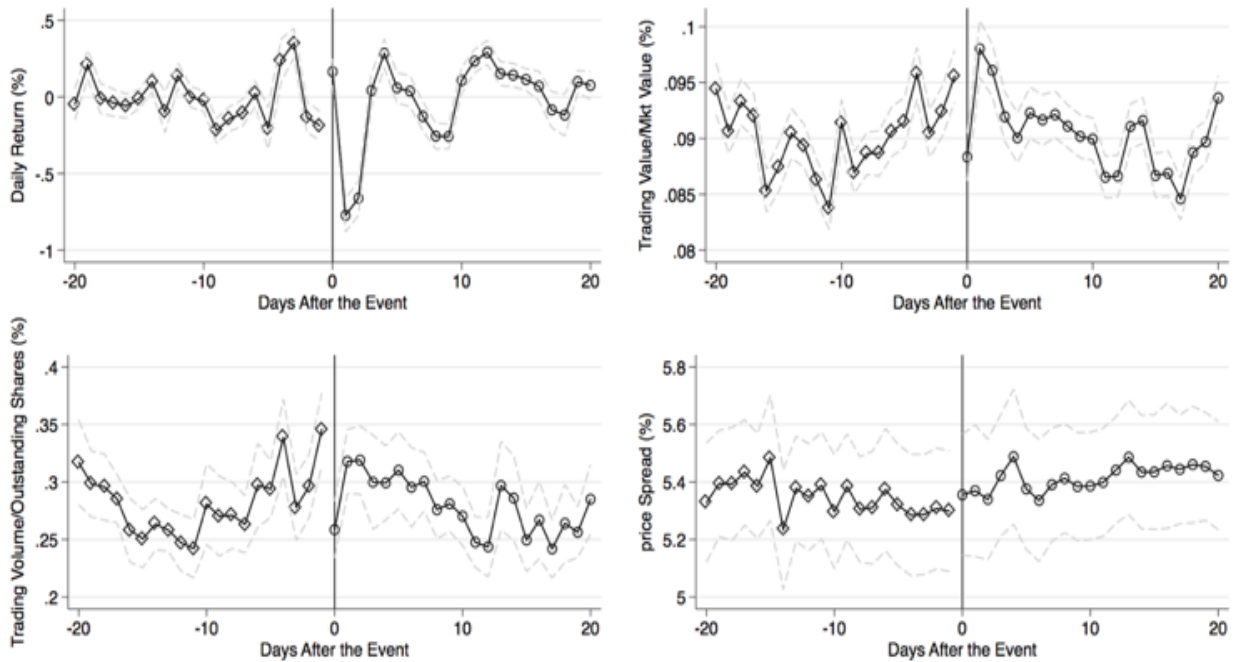

Figure 2: Stock Market Patterns Surrounding Brexit Related Events (solid line: the mean value, dashed line: 95% confidence interval)

These findings are quite informative about what happened around event days. In general, Brexit news is perceived as negative news for investors as most investors believe that Brexit will reduce the profits of firms listed in the London Stock Exchange. The impacts are only realized after the event and persist for several days because most of this news is released late during the day when the stock market is closed, then the information is incorporated into the stock price the day after. This is consistent with the market efficiency hypothesis. Also, according to findings of trading activities, we can see that there is a boom of trading around event days as investors believe that Brexit events have important implications for the asset price. Before the event, they expect there is an event upcoming even though they don't know the results of the event which usually involves voting in the Parliament: whether the event increase or decreases the probability of Brexit. The political uncertainty drives up trading activities. Moreover, on the day of the event, there is a pause on the upward trend of trading as investors are more likely waiting for the results of the event and once the results come out, trading jumps up again the next day.

For baseline regressions, the impact of events is quantified. Table 3a and 3b show the results of the baseline regressions for different dependent variables and various lengths of time windows. There are five different dependent variables: total return, abnormal return, trading activity ratio by value, trading activity ratio by volume, and Ask-Bid spread. Then seven different time windows are used: (-1, +1), (-2, +2), (-3, +3), (-4, +4), (-5, +5), (-10, +10), (-15, +15). Besides, for each specification, stock fixed effects and weekday fixed effects is included. Stock fixed effects are included to control for stock-specific factors that don't change over time. For example, some stocks are more popular than other stocks, namely their trading activity ratio is higher than other stocks. Weekday fixed effects are included because previous literature has documented strong weekday fixed effects (French 1980).

In terms of return, both total return and abnormal return are analyzed. In Panel A of Table 3a, the coefficient for independent variable $\overline{POST}$ is v in the baseline regression. The coefficient can be interpreted as the impact of events on the stock's total return. Across all specifications, the coefficients are negative. For example, if we compare within a very narrow time window (-1, +1), the effect is -0.862%, which corresponds to the drop of return from 0.2% to -0.6% in Figure 2. If we extend e time window, the coefficients are still negative but converge to -0.246%. This is because, with a longer horizon, the coefficients are the average effect of the impact over several days after the event. The impact of the event is the strongest one day after the event and then diminish over time. When we turn to results for abnormal returns in Panel B, the results are similar. For abnormal returns, in the time window of (-1, +1), the effect is -0.376%, suggesting the events decrease the stock market return by 0.376% relative to the return one day before the event. The magnitude of the effect is smaller for abnormal return compared to that for total return. This implies that it's important to control for the "normal" movement of stock return by using the CAPM model. In Panel A, the effects of the event are overestimated because there is some other bad stock-specific news that reduces stock returns.

Table 3b is about trading activities and Ask-Bid spread. According to baseline regressions, the average impact of the events on trading activities is small. This is counterintuitive at first sight because it's inconsistent with our observations in Figure 2. This is because the baseline regression captures the average difference before and after the events. However, the patterns for trading activities are more complicated. Trading activities peak around event day (except for the event day itself), so the difference between trading activities before and after the event is small. In that sense, the mechanism for why Brexit events have an impact on trading activities is not the same as that for returns. Investors trade actively as long as they know there is important news upcoming, while returns depend on the nature of the news: good or bad. The impact on Ask-Bid spread is significant but the magnitude is relatively small. For example, in Table 2b's summary statistics, the average value of Ask-Bid spread is 5.19%, but the impact ranges from 0.06% to 0.114% across different specifications of the time window.

4.3 Results by Event Type

This part is to show the impacts of Brexit related news are heterogeneous for a different type of events. In Table 1, events are classified into two categories: (1) higher probability of Brexit; (2) lower probability of Brexit. Therefore, the baseline model is extended to the following model:

$$y_{i,t} = \gamma_1 \times Post_t^e + \gamma_2 \times Post_t^e \times HigherBrexitEvent_e + Controls + \varepsilon_{i,t}$$

Compared to the baseline model, one additional independent variable $Post_t^e \times HigherBrexitEvent_e$ is added where $HigherBrexitEvent_e$ is a dummy variable. If the event e increase the probability of Brexit, then the variable equals 1 otherwise it is 0. Coefficients γ_1 they measure the effect of events that decrease the probability of Brexit; Coefficients γ_2 they measure the effect of events that increase the probability of Brexit. Similar to the previous part of the analysis, this part starts from a graphical analysis by plotting the mean values (and confidence intervals) of key variables. Since "trading activity by volume" and "trading activity by value" have similar results, here only display the results for "trading activity by volume" in the main results and results for "trading activity by value" is in the Appendix. In general, from Figure 3, we can conclude that the effects of the events indeed depend on the nature of the events. The market is more sensitive to news that will increase the probability of Brexit than that will decreases the probability of Brexit. For example, the two sub-figures at the top of Figure 3 plot the patterns for total returns. The left one only uses the five events that increase the probability of Brexit and the right one is for the five events that decrease the probability of Brexit. The patterns on the left are quite similar to the one in Figure 2 for total return. The first day after the event, the return drops from 0.3% to -1.7%. On the right, the subfigure about lower Brexit probability events, the impact is almost zero. Moreover, the day before the event, there is even a small significant negative return. We can interpret this as: on the day before the event, investors are pessimistic about the upcoming event. Secondly, for Ask-Bid spread which measures the liquidity of stocks, there is a clear upward trend surrounding the Brexit event, indicating that when there is news that Brexit is more likely to happen, the market is becoming less liquid. On the other hand, the impacts of lower Brexit probability events are insignificant. In terms of trading activities, patterns we observed previously in Figure 2 exists for both types of events.

The findings in Figure 3 is important as it shows the market has asymmetric reactions to different types of events related to Brexit. Especially for returns, the higher probability of Brexit is perceived as bad news for the market while the lower probability of Brexit is not good news. It makes sense because originally the UK is integrated with the European Union, therefore "staying in EU" will not bring much positive effect to the stock market
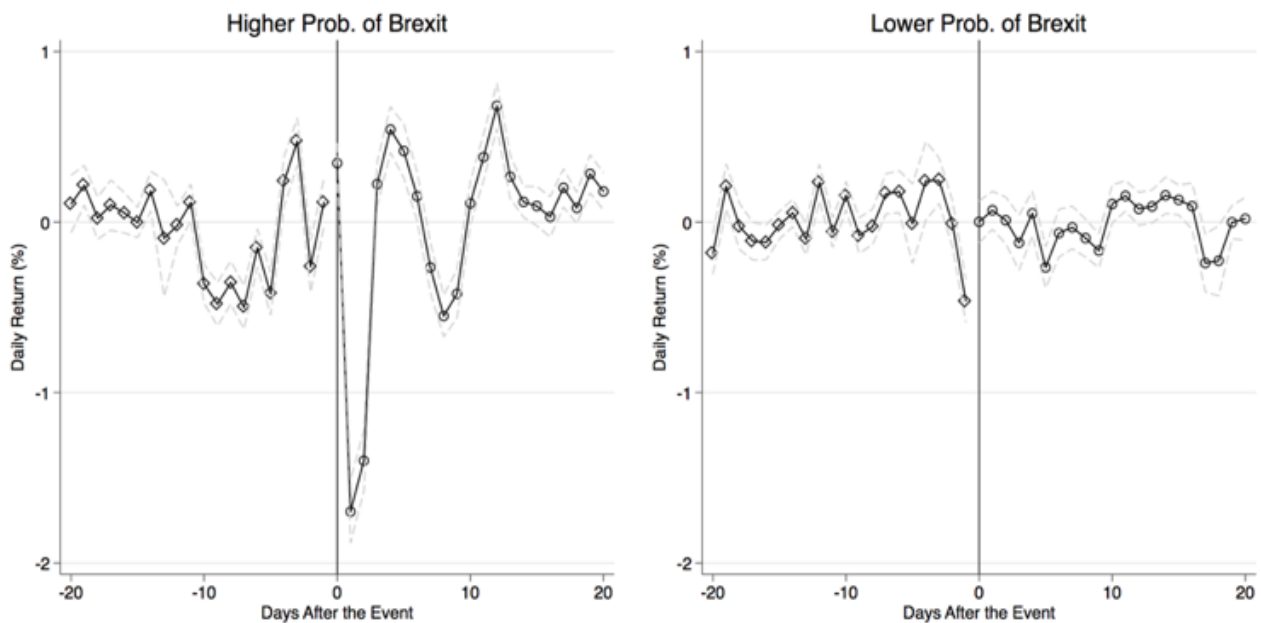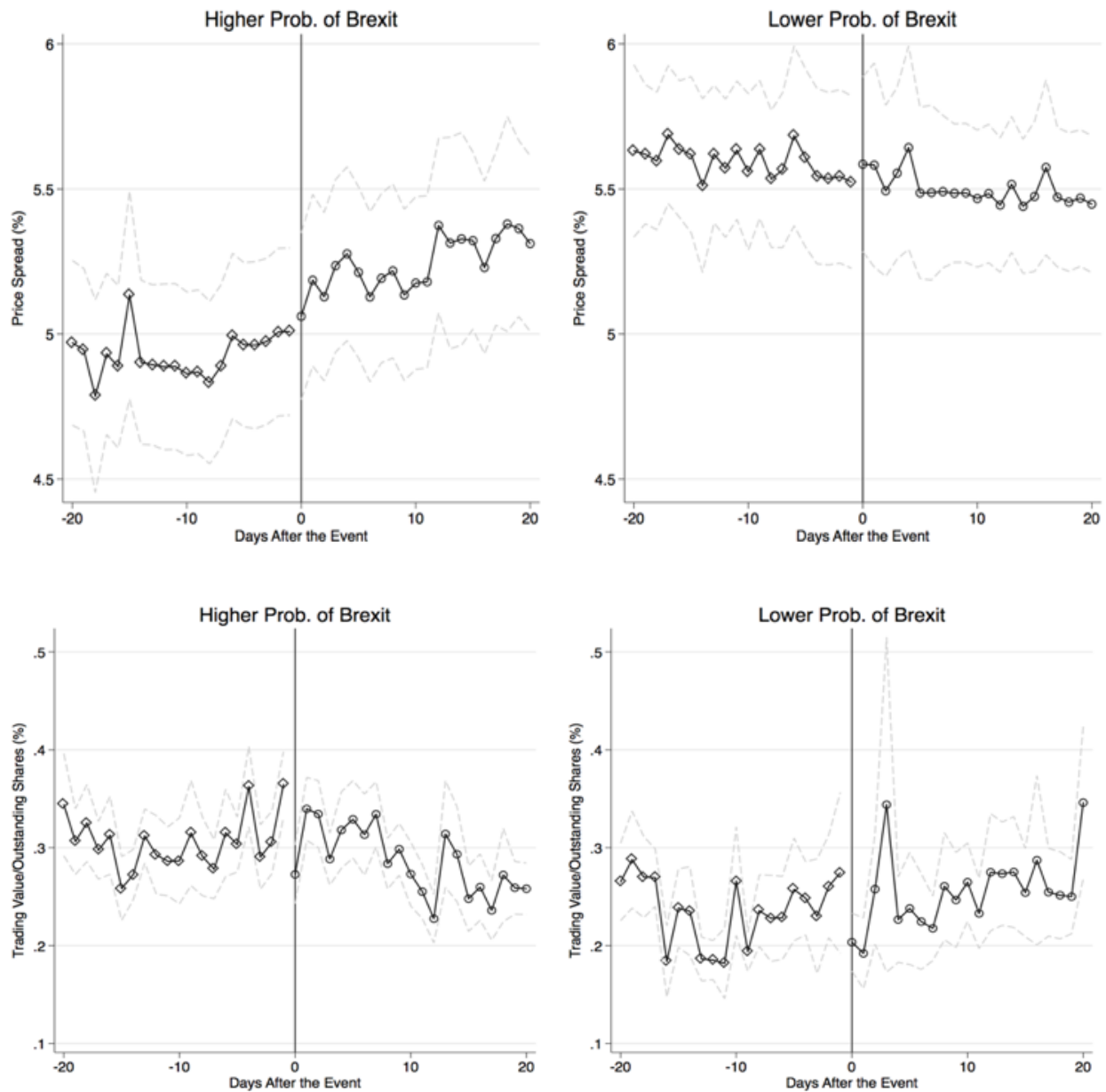
Figure 3: Stock Market Patterns Surrounding Brexit Related Events (By Event Types)

Table3a: The Impact of Brexit-related Events on Stock Returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Dependent Variable= Total Return							
Time Window	*(-1, +1)*	*(-2, +2)*	*(-3, +3)*	*(-4, +4)*	*(-5, +5)*	*(-10, +10)*	*(-15, +15)*
POST	-0.862***	-0.677***	-0.500***	-0.354***	-0.246***	-0.246***	-0.246***
	(0.06)	(0.05)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Constant	-0.231**	-0.476***	-0.152**	-0.179***	-0.197***	-0.197***	-0.197***
	(0.08)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17718	29529	41340	53150	64961	64961	64961
Adjusted R-Squared	0.326	0.225	0.141	0.104	0.069	0.069	0.069
Panel B: Dependent Variable= Abnormal Return							
Time Window	*(-1, +1)*	*(-2, +2)*	*(-3, +3)*	*(-4, +4)*	*(-5, +5)*	*(-10, +10)*	*(-15, +15)*
POST	-0.376***	-0.259***	-0.195***	-0.204***	-0.121***	-0.121***	-0.121***
	(0.06)	(0.05)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Constant	-0.351***	-0.433***	-0.243***	-0.193***	-0.222***	-0.222***	-0.222***
	(0.08)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17718	29529	41340	53150	64961	64961	64961
Adjusted R-Squared	0.322	0.215	0.146	0.109	0.072	0.072	0.072

Table3b: The Impact of Brexit-related Events on Trading Activities & Liquidity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable= Trading Activity (by Value)							
Time Window	*(-1, +1)*	*(-2, +2)*	*(-3, +3)*	*(-4, +4)*	*(-5, +5)*	*(-10, +10)*	*(-15, +15)*
POST	0.000	0.004***	0.004***	0.001**	0.001**	0.001**	0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.084***	0.093***	0.091***	0.090***	0.090***	0.090***	0.090***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14603	24934	35279	45643	56021	56021	56021
Adjusted R-Squared	0.780	0.708	0.674	0.650	0.638	0.638	0.638
Dependent Variable= Trading Activity (by Volume)							
Time Window	*(-1, +1)*	*(-2, +2)*	*(-3, +3)*	*(-4, +4)*	*(-5, +5)*	*(-10, +10)*	*(-15, +15)*
POST	-0.013	0.011	0.020	0.005	0.007	0.007	0.009
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.263***	0.299***	0.281***	0.281***	0.274***	0.274***	0.301***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9068	15225	21405	27581	33809	33809	33809
Adjusted R-Squared	0.608	0.505	0.428	0.413	0.399	0.399	0.398
Dependent Variable= Ask-Bid Spread							
Time Window	*(-1, +1)*	*(-2, +2)*	*(-3, +3)*	*(-4, +4)*	*(-5, +5)*	*(-10, +10)*	*(-15, +15)*
POST	0.096*	0.060*	0.080***	0.114***	0.104***	0.104***	0.104***
	(0.04)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	5.429***	5.405***	5.328***	5.319***	5.320***	5.320***	5.320***
	(0.05)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weekday Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16562	28284	40005	51729	63456	63456	63456
Adjusted R-Squared	0.965	0.952	0.946	0.927	0.923	0.923	0.923

5. Conclusions

This article studies the financial impact of the topical Brexit and its related events on stocks, particularly the top 752 stocks that are traded on the London Stock Exchange, during the Brexit era: 2016-2019. The idea is based on and extended upon previous literature to see financial ratios movement, using an event study approach to conduct regression model analysis. The models use returns and trading activities (five different commonly measured financial performance ratios) as the dependent variable and the constructed exposure variable as the independent variable. The logic behind the exposure variable is that companies who exposed more to both UK and EU would face challenge as the two would break up. While we find general negative effects of Brexit-related events on stock markets similar to previous studies, this study took a deeper dive in understanding the firm level characteristics that see heterogeneous effects, particularly: firms with (1) higher asset exposure to the UK; (2) affiliates both in UK and EU Countries; and (3) Affiliate in the EU Countries, and in the Same Industry of the Core Business, tend to be more affected by the Brexit-related events.

The results are statistically significant with support from robustness checks developed here with various time windows along with reasonable control variables. Therefore, we feel confident to infer that Brexit-related events have overall negative effects on stock markets and in addition have heterogeneous effects on firm level characteristics. This article contributes to the general financial markets and Brexit particular related event studies, the results confirm the previous findings in the literature and adds additional insights especially in the firm micro level characteristics effects. These results may be used to guide governmental policy or firm actions to operate risk management and business adjustments linked to Brexit, or even to infer the more recent discussions on Italy and Greece to exit European Union

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