Are UK industries resilient in dealing with uncertainty? The case of Brexit

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Abstract

Given the European Union (EU)'s central role in regulating various sectors, the decision to leave poses profound questions for UK industries in upheaval. This paper adopts an event-study methodology to examine, at sectoral level, the dynamics of stock prices surrounding the announcement of the UK's EU membership referendum on 24 June 2016. We find that the adjustment of stock prices is inconsistent with the Uncertain Information Hypothesis assuming that policy changes are typically associated to a decrease of stock prices, but once the uncertainty-induced event is reduced, stock prices would increase again. Analyzing seven sectors of British stock index, we show that the Brexit had a significant impact on the valuation of UK companies. While all industries face increasing uncertainty, the referendum outcome had varying sectoral effects. Specifically, the responses of banks and financial services, defense and airlines, real estate and technology to the Brexit event were even more severe than the reactions of oil and gas, pharmaceuticals and consumer goods. The lack of opportunity to benefit from the European passporting rules to establish businesses, to access to EU's Research and Development funds and to hire the skilled workers have been offered to explain the adverse effects of Brexit on UK industries.

JEL codes: G12; G15.

Keywords: Brexit; uncertainty; stock market; sectoral-level analysis; UK; event-study methodology.

1. Introduction

The 2016 was a bad year for traders and investors. First, the recession scare in January following the great Chinese currency deterioration, the market decrease of oil price attaining $25 a barrel coupled with sharp credit markets tumbling. Second, the nk of Japan pursued the European experiment with negative interest rates, which arises a vexing question about the appropriateness of global central banks to help avoiding an untoward event of a real economic downturn. Add to this the geopolitical development; On Friday, 24 June 2016, it was officially announced that the United Kingdom (UK) voted to withdraw from the European Union (EU), resulting in what is commonly known as "Brexit". This result was surprising by the vast majority of capital market participants and even on the day of the referendum, bookmakers' odds supposed a 90 percent chance that the withdrawal of the UK from the EU would fail (Bloomberg 2016). In fact, the historic decision by British voters to pursue Brexit was very shocking for investors and regulators. The traders' panicky knee-jerk response highlights their belief that the decision to leave the Europe would harm the home-grown businesses. Soon after the Brexit results, many experts have predicted that UK stocks will crash markedly given the uncertainty over the potential timing and terms of a managed UK exit from the European Union. David Reid -Portfolio Manager at Black Rock- has gone

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a step further, forecasting which stock-market sectors will get hit hardest in the onset of Brexit. Some sectors are expected to lose less than others.

To mitigate harmful consequences, UK industries (especially the largest losers from the announcement of Brexit) have to make important economic choices based on the resulting policy environment (Brogaard and Detzel 2015; Schiereck et al. 2016). In fact, the referendum on the UK's EU membership can be viewed as a sharp change in UK government policy. Normally, policy changes lead to a drop of stock prices, especially when the anxiety over such change is greater. Accordingly, Tielmann and Schiereck (2017) provided evidence that Brexit had strong detrimental impacts on UK financials and logistics companies owing to the wider uncertainty with respect to the future UK-EU relationship. Several financial institutions placed their EU headquarter in the UK to gain from the developed UK financial market (in particular, the financial technology also known as "Fintech") and the European passporting rules to undertake investments in other EU members. Nevertheless, the Brexit vote exacerbated fears regarding the prospects of the operations of international financial and banking institutions and the regulatory environment, since it is unclear whether the institutions located in the UK will remain enjoy a full access to EU financial markets.

Prior research on the impact of sudden events and changes in government policy documented an adverse influence on share markets. For example, Kolaric and Schiereck (2016) investigated the reactions of airline stock prices over the terrorist attacks in Paris and Brussels. By examining 27 of the biggest U.S., Canadian, and European airlines firms, they deduced that the adjustment of stock prices is in line with the assumption of efficient capital markets. The reaction to the attack events seems significant for all the companies studied, due to the unprecedented damages caused by this sudden event and the particular attention these events receive from the media and social networking. Potentially, they showed that the largest companies are more threatened by the attacks than the smaller industries, and thus the effect of a sudden event on the performance of companies depend on their sizes. They also suggested that stocks do not depend to the net income in the year prior to the event. So far, the empirical research on Brexit remains rather limited, with some analyses focusing on the overall impact of Brexit for different countries (Balis 2016; Bouoiyour and Selmi 2016; Ham 2016), while others concentrate on specific sectors, whose core business is directly affected by the UK's withdrawal from EU such as logistics (Tielmann and Schiereck 2017) and airlines (Kolaric and Schiereck 2016). Bouoiyour and Selmi (2016) tried to test whether the way in which Brexit was disseminated by media causes disquiet among investors in UK and Europe. Using quantile regression model and frequency domain causality test, they showed that the reactions of UK and EU equities to Brexit are heterogeneous. Indeed, the stock market of Germany suffered more than that of UK and France. In addition, Oehler et al. (2017) carried out an event study analysis to investigate the abnormal stock returns following the Brexit referendum. They documented that stocks of firms with larger proportions of domestic sales realized more negative abnormal returns than stocks of firms with more sales abroad. In other words, they deduced that the international diversification help to mitigate the detrimental influences of Brexit on stock abnormal returns. Besides, Bouoiyour and Selmi (2017) tested whether the way in which Brexit was communicated in social media affect the performance of UK defense and aerospace stocks. They showed that the uncertainty surrounding the Brexit event puts at risk defense and aerospace companies (negative and significant influence on defense and aerospace stock returns) that benefit from EU membership with access to

integrated European supply chains, Research and Development funding and collaborative procurement programmes. Moreover, Ramiaha et al. (2017) assessed the effect the EU referendum results on various sectors of the British economy. They found that Brexit has a mixed influence on the abnormal returns with sharp sector-by-sector differences. They indicated also that the banking and travel and leisure sectors were typically more responsive to the Brexit outcome.The present study explores, at sectoral level, the British stock market behavior around the announcement of the Brexit result and addresses the following questions. Do markets anticipate the Brexit outcome? Are British stock markets efficient? Are stock markets resilient in dealing with the uncertainty arising from this event? Is there homogeneity in stock market behavior around the Brexit result between the different sectors? What would be the investing implications of Brexit? We explore these questions using a standard event study methodology that examines the abnormal returns behaviors for several sectors of the British equity market (Financials, Oil and Gas, Real estate, Defense and Airlines, Pharmaceuticals and Biotechnology, Consumer goods and Technology) around the announcement date. This study complements and contributes to the existing literature by testing the Uncertain Information Hypothesis (UIH) of Brown et al. (1988). This hypothesis assumes that markets absorb news and political trends into asset prices in anticipation of the event (in this case, the Brexit result). Policy changes may lead generally to falling stock prices, particularly if the uncertainty is greater (Pastor and Veronesi 2012). Much of the uncertainty surrounding the Brexit outcome may be resolved after the announcement date, i.e., once the uncertainty over Brexit is mitigated, stock prices would rise again (Pantzalis et al. 2000).

The remainder of the paper is organized as follows. In Section 2, we present our formal hypothesis and describe the methodology and the data sources. Section 3 reports and discusses the empirical findings. Section 4 concludes and provides some policy implications for UK companies in upheaval.

2. Hypotheses, methodology and data

Since Efficient Market Hypothesis has arisen in the 1960s (Fama 1965), it has been subject to a huge number of researches. In efficient capital markets, we anticipate that equity prices will adjust at once without any overreaction and that the necessary adjustments become smaller if a certain kind of event occurs repeatedly. Nonetheless, as Lo (2004) argued, there is no consensus among finance academics as to whether stock market is efficient. Most of them believe the market is weak-form efficient (Doran et al. 2010); Grossman and Stiglitz (1980) even claimed that a perfectly efficient market is impossible. This contradiction has yielded to the emergence of new hypotheses in behavioral finance including the Uncertain Information Hypothesis of Brown et al (1988). The Uncertain Information Hypothesis assumes that anxiety will rise in financial markets following the occurrence of unexpected event. So that investors cannot appropriately respond to unanticipated new information and thus they could in the early stages set security prices below their fundamental values. Moreover, this hypothesis asserts that the stock return is stronger than the average return over periods when no event-induced uncertainty happens. The first hypothesis to be tested consists, therefore, of two parts:

$$H1_a : CAR_{-5;0} \succ 0$$

$$(1)$$

$$H1_b : CAR_{0;+1} \succ 0 \tag{2}$$

When the event-induced uncertainty is reduced, positive abnormal returns are expected in the time period following the occurrence of the event. In this study, we assess the five-day period after the announcement date to test our second hypothesis:

$$H2 : CAR_{+1;+5} \succ 0 \tag{3}$$

This research is interested on the UK referendum and evaluates, at sectoral level, the impact of the UK's decision to leave the EU on UK stock market prices. The referendum outcome was not announced until June 24 2016, which we subsequently view as the Brexit announcement day. Our sample data include seven sectors of stock indices. The sector indices offer some insights of the performance of the UK equity market. The selected industries include financials (banks, insurance, reinsurance and financial services), real estate, oil and gas (oil and gas producers, oil equipment, and services, distribution and alternative energy), pharmaceuticals and biotechnology, technology (software and computer services, and technology hardware and equipment), defense and airlines, and consumer goods. Each sector index represents a capitalization-weighted portfolio of the largest UK firms in this sector. The sectoral UK stock market data are available at Datastream database. For defense and airlines, we use NMX2710 share price index where the historical data are available in UK live charts (http://www.livecharts.co.uk/share_prices/historic-data-NMX2710-start-30).

In practice, we define the day "0" as the day of the event for a given equity. Thereafter, the estimation and event windows can be determined (Figure 1). The interval [t1+1, t2] is the event window with length l2=t2-t1-1, whereas the interval [t0+1, t1] is the estimation window with length l1=t1-t0-1. The length of the event window often depends on the ability to accurately date the announcement date. If one is able to date it precisely, the event window will be less lengthy and capturing the abnormal returns will be more proper and effective. We should mention here that the length of the event window including the event days normally range between 21 and 121 days (Peterson 1989). For our case of study, we use for each sector a maximum of 120 daily stock return observations for the period around the day of the Brexit vote, beginning at day - 115 and ending at day + 5 relative to the event. The first 110 days (-115 through -5) is denoted as "the estimation period", and the following 11 days (- 5 through + 5) is designated as "the event period".

Figure 1. Data structure of an event study
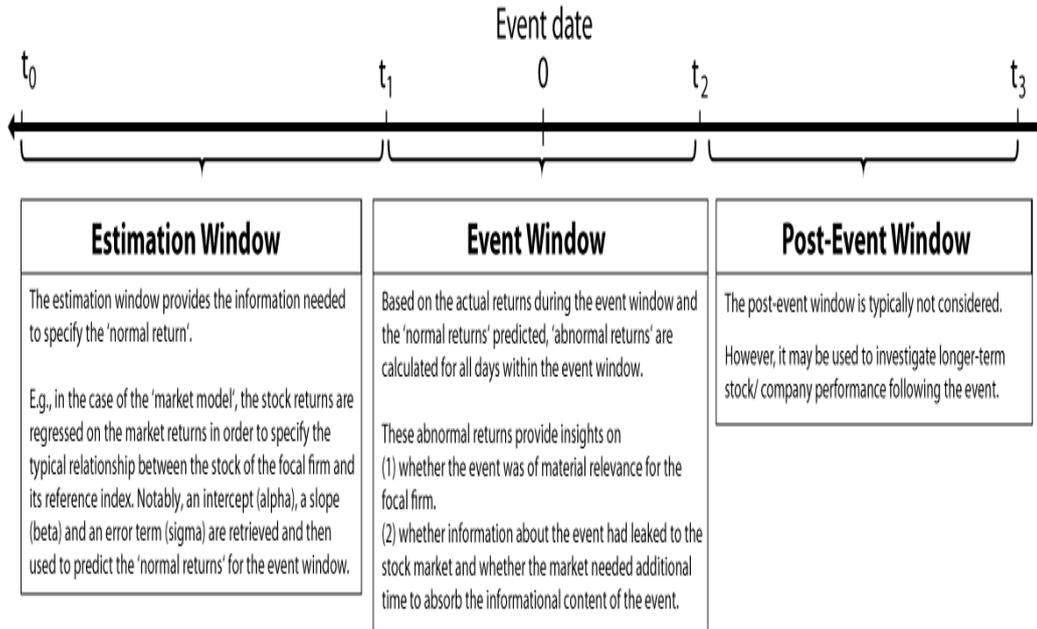
Source: Benninga (2008, pp. 372).

Based on the return model chosen, event studies consist generally of applying an event window only (for example, the market-adjusted model) or an event and an estimation window (for instance, the market model). Most common, the market model is carried out. It predicts normal returns with a regression investigation that regresses stock returns on market returns over the estimation window. Through this assessment, the relationship between the stock and its reference index is captured in two parameters ($\hat{\alpha}_i$ and $\hat{\beta}_i$). Figure 1 sketches the data structure used by event studies and offers information on how this data structure is employed by the market model. The cumulative abnormal return (CAR) for a sector i during the event window [τ_1 ; τ_2] surrounding the event day $t = 0$, where [τ_1 ;τ_2] = $\in$ [-5 ;+5] , is expressed as follows:

$$CAR_{i,[\tau_1,\tau_2]} = \sum_{t=\tau_1}^{\tau_2}(R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{M,t})$$

(4)

where $CAR_{i,[\tau_1,\tau_2]}$ is the cumulative abnormal return of share i during the event window [τ_1; τ_2], $R_{i,t}$ is the realized return of stock i on day t^1, $R_{M,t}$ is the return of the benchmark index of sector i, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the regression estimates from an ordinary least squares (OLS) regression for 105 trading day estimation period until t = -10. We employ the Datastream's value-weighted total return stock market index of sector i's country of origin as the benchmark index. As mentioned above we set our event day for the Brexit event to Friday, 24 June 2016, at the close of the trading day in the United Kingdom.

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[1] The daily stock returns are calculated as the first natural logarithmic difference of the underlying stock price.

We next assess if the equity market reaction to the announcement of the Brexit outcome varies with the characteristics of the firm making the investment. McConnell and Nantell (1985), Keown et al., (1999) and Jones and Danbolt (2004) indicated that the equity market response to the occurrence of an unanticipated event vary with company size, with investments by small companies being related with wider abnormal returns. Indeed, we hypothesize that the level of abnormal returns will be negatively associated to company size. Burton et al. (1999) claimed that the market reacts differently to the announcement of joint ventures compared to single company investments; it responds more favorably to joint ventures when investments are heavily risky. Accordingly, Woolridge and Snow (1990) and Jones and Danbolt (2004) and Jones et al. (2004) asserted that joint ventures announcements are likely to be associated with weaker but significant positive abnormal returns. Throughout this study and based on the existing literature, we hypothesize that joint ventures announcements will exert a positive effect on the abnormal returns of the different sectors under study. Furthermore, we account for the effect of growth opportunities on the abnormal returns. We hypothesize that the equity return will react more strongly to investment announcements by firms with valuable growth opportunities than for other companies, even though in their investigation of UK investment announcements, Burton et al. (1999) showed insignificant influence of the growth opportunities on the abnormal returns. In this study, we incorporate in the regression to be estimated two indicators for growth opportunities, and assume that companies with high price-earnings ratios or low dividend yields will witness more favorable stock market response to the announcement of Brexit outcome than other companies. Moreover, Woolridge and Snow (1990) and Chaney and Devinney (1992), using US data, argued that the stock market on average react positively to product diversification announcements associated with pronounced mean abnormal returns. In the same context, Jones et al. (2004) investigated the stock market response to investment announcements in the UK, and found positive response of the mean abnormal returns to new product or service innovations by UK companies of 0.87%. Recently, Kolaric and Schiereck (2016)' findings revealed that the reactions of stock returns to the uncertainty surrounding an event may depend on the net income of a firm in the year before the occurrence of the event, and on whether the studied industries are regionally or internationally focused companies.

The sectoral analysis of reactions of abnormal returns to the announcement of Brexit outcome is then undertaken using a linear regression model. The regression to be estimated is expressed as follows:

$$CAR_{i,[\tau_1,\tau_2]} = \delta_0 + \delta_1 Brexit + \delta_2 Size + \delta_3 JV + \delta_4 PE + \delta_5 DY + \delta_6 PDI + \delta_7 EU + \delta_8 Netincome + \varepsilon_i \qquad (5)$$

where $CAR_{i,[\tau_1,\tau_2]}$ is the dependent variable, *Brexit* is a dummy variable which takes the value of one on the first day of trading after the referendum and zero otherwise, created to capture the immediate risk, *size* is the logarithm of the total assets of a firm in U.S. dollars in the year prior to the event, *JV* is a dummy variable taking a value of 1 for joint ventures and 0 otherwise, *PE* is the price-earnings ratio, and *DY* is the dividend yield (in percentage) calculated by dividing the dollar value of dividends paid in a given year per share of stock held by the dollar value of one share of stock,, *PDI* is a dummy variable to control for the announcement of a product diversification investment, which takes a

value of 1 for new product launches, and 0 otherwise; *EU* is defined as 1 if the company's headquarter is located in Europe, and the *Net income* is the logarithm of the net income of a firm in dollars in the year prior to the event, and ε_i is the error term.

3. Discussion of results

3.1. Results

Figure 2. The cumulative abnormal returns of UK stock price index in response to Brexit by industry: [−5; + 5] event window
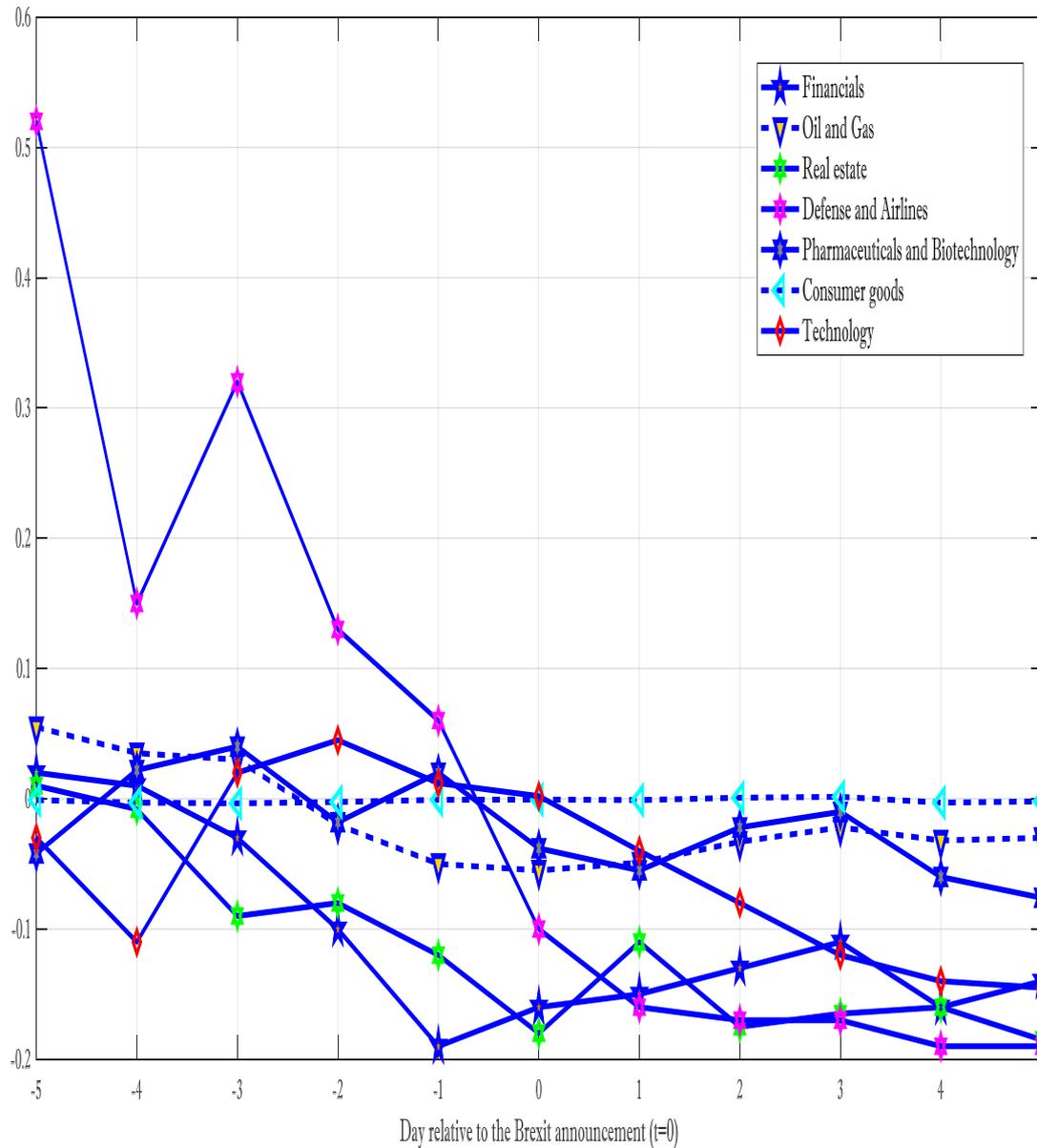

Figure 2 graphically depicts the cumulative abnormal return performance of UK industries for the announcement on 24 June 2016. The standard market model

according to Dodd and Warner (1983) and Brown and Warner (1985) is employed for the determination of the CAR. Positive and negative CARs imply favourable and unfavourable outcomes, respectively. We show that the UK stock price responses of different sectors surrounding the Brexit seem dissimilar either for the announcement day CAR or the [−5; + 5] event window CAR. The Brexit is associated to severe stock prices declines for financials, real estate and defense and airlines from the day relative to the announcement of Brexit (t=0). For technology, a drop of the stock price is shown after the Brexit vote or particularly for [0; +5] event window CAR. However, oil and gas, pharmaceuticals and biotechnology and consumer goods do appear less sensitive to the day relative to the Brexit announcement or [0; 0] event window CARs. The findings of the event study of the CAR performances around the announcement of the Brexit outcome are not in line with the UIH hypothesis. In the majority of sectors, we note a sharp decrease of abnormal returns in the day relative to the announcement of the Brexit outcome (t=0), without surging again after the Brexit vote.

Table 1 takes a look at the stock response to the Brexit announcement for Financials, Oil and Gas, Real estate, Defense and Airlines, Pharmaceuticals and Biotechnology, Consumer goods and Technology. The results show that the stock market reactions are negative and significant for almost all the industries under study and irrespective whether [0; 0], [0; +1] and [+1; +5] window event CARs are accounted for, except for Oil and Gas where we find an insignificant specific-share response for [0; 0] and [+1; +5] window event. But the reaction appears much less detrimental for pharmaceuticals and biotech and consumer goods. In a nutshell, we can distinguish three groups of sectors: The first one includes Financials, Defense & Airlines, Real Estate and Technology where the stock prices fall strongly in the day of the announcement of Britain's withdrawal from the EU membership and in the post-Brexit announcement by utilizing the [0; 0], [0; +1] and [+1; + 5] event window CAR as the endogenous variable. The second group is formed by Oil and Gas companies where their responses seem insignificant after the Brexit vote, and slightly negative in the day relative to the referendum announcement (t=0). The third group contains the sectors which experienced a moderate influence whatever the window event CAR investigated (i.e., Pharmaceuticals and Biotech and Consumer goods). Because some of these sectors are cyclical while the others are defensive, one can expect that various industries could respond distinctly to changes in the economy and as a result the anxiety over Brexit would have varying sectoral effects. With respect portfolio allocation, investors and traders seek to shift the portfolio into sectors that appear less influenced by sudden events or risks.

J. Bouoiyour, R. Selmi, Are UK industries resilient in dealing with uncertainty? The case of Brexit

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Table 1. Industry-level effects of Brexit on UK stock abnormal returns

	Financials	Oil and Gas	Real estate	Defense and Airlines	Pharmaceuticals and Biotechnology	Consumer goods	Technology
				[0,0] window event			
Constant	0.467892** (0.0064)	0.8913* (0.0315)	0.34987* (0.0461)	0.73219** (0.0068)	0.61793*** (0.0005)	0.827961** (0.0056)	-0.505** (0.0052)
Brexit	-0.0386** (0.0045)	-0.0058 (0.0386)	-0.0621* (0.0326)	-0.0492** (0.0087)	-0.001981** (0.0042)	-0.001197** (0.0089)	0.03186*** (0.0004)
JV	0.00641* (0.0530)	0.0054* (0.0613)	-0.00356 (0.3678)	0.00321* (0.0404)	0.00774* (0.0263)	0.00196** (0.0034)	0.0011* (0.0697)
Size	-0.10139* (0.0835)	-0.051** (0.0016)	-0.023** (0.0021)	-0.0164* (0.0111)	-0.02375* (0.0369)	-0.00958* (0.0673)	-0.01793* (0.0224)
PE	0.05489* (0.0216)	0.05097* (0.0142)	0.0168** (0.0079)	0.0735** (0.0058)	0.03456 (0.1632)	0.07970* (0.0292)	0.06285* (0.0145)
DY	-0.0314** (0.0078)	-0.02892* (0.0474)	-0.0920* (0.0691)	-0.0263* (0.0486)	-0.0263** (0.0054)	-0.02345* (0.0475)	-0.0129* (0.0757)
PDI	0.0934** (0.0095)	0.0814* (0.0636)	0.085** (0.0090)	0.10362* (0.0116)	0.08913* (0.0169)	0.10509* (0.0312)	0.09872* (0.0672)
EU	0.02456* (0.0403)	0.0254** (0.0072)	0.0121* (0.0538)	0.04154*** (0.0003)	0.05396** (0.0091)	0.043521 (0.0416)	0.03219 (0.0369)
Net income	-0.03456 (0.3185)	-0.05126 (0.4768)	-0.0469* (0.0580)	0.03689 (0.24692)	-0.10678 (0.3589)	-0.09451 (0.2865)	-0.01342 (0.3259)
Adjusted R²	0.88	0.90	0.84	0.89	0.90	0.89	0.87
F-value	3.4523	4.0987	3.6172	3.8210	4.0562	4.1178	4.2365
				[0,+1] window event			
Constant	-0.87134*** (0.0001)	-0.40923* (0.0352)	-0.318** (0.0014)	-0.4009* (0.0305)	-0.378911*** (0.0000)	-0.41238*** (0.0005)	0.347377 (0.2900)
Brexit	-0.15478*** (0.0003)	-0.03458 (0.2061)	-0.1651* (0.0884)	0.12345 (0.1385)	-0.00432* (0.0178)	-0.00216** (0.0083)	-0.13326* (0.0991)
JV	0.00868*** (0.0000)	0.0004** (0.0011)	0.00450 (0.1843)	0.0016* (0.0133)	0.0013** (0.0045)	0.0041*** (0.0001)	0.002561* (0.0148)
Size	-0.00681** (0.0010)	-0.0023** (0.0012)	-0.09043 (0.5893)	-0.00729* (0.0732)	-0.00356*** (0.0004)	-0.00416** (0.0052)	-0.031872* (0.0447)

	Financials	Oil and Gas	Real estate	Defense and Airlines	Pharmaceuticals and Biotechnology	Consumer goods	Technology
PE	0.01432*** (0.0000)	0.013*** (0.0000)	0.01566* (0.0290)	0.04782* (0.0997)	0.03119*** (0.0000)	0.02653*** (0.0001)	0.03264* (0.0330)
DY	-0.0533*** (0.0000)	-0.110*** (0.0000)	-0.0995* (0.0598)	-0.1392* (0.0851)	-0.137*** (0.0000)	-0.0695*** (0.0008)	-0.059** (0.0065)
PDI	0.03039* (0.0309)	0.06641* (0.0532)	0.0258** (0.0097)	0.02351* (0.0164)	0.03594*** (0.0006)	0.051092* (0.0107)	0.02892** (0.0076)
EU	0.10139* (0.0835)	0.0529** (0.0016)	0.0923** (0.0021)	0.0864* (0.0111)	0.02372 (0.2369)	0. 09583* (0.0673)	0.07942* (0.0224)
Net income	-0.07621 (0.2216)	-0.050977 (0.1142)	-0.16823 (0.1079)	-0.03587** (0.0058)	0.092123 (0.1632)	-0.07970 (0.2292)	-0.08283 (0.2014)
Adjusted R²	0.89	0.88	0.90	0.84	0.89	0.90	0.89
F-value	4.6789	4.3392	4.0078	4.1139	3.9956	3.8726	4.0179
[+1,+5] window event							
Constant	-0.748055 (0.3617)	-0.402721 (0.7487)	0.33815 (0.3371)	-0.6518*** (0.0000)	-0.6286* (0.0109)	-0.565019 (0.2963)	-0.847395* (0.0548)
Brexit	-0.17542** (0.0068)	0.14493 (0.2574)	-0.2103* (0.0158)	0.16521 (0.4315)	-0.001586** (0.0044)	-0.00214** (0.0062)	-0.15958* (0.0465)
JV	0.002459* (0.0346)	0.00679* (0.0538)	0.00298* (0.0207)	0.00667** (0.0014)	0.007236* (0.0120)	0.069456* (0.0391)	0.0090* (0.0101)
Size	-0.02156* (0.0317)	-0.02728* (0.0245)	-0.0207* (0.0105)	-0.0093*** (0.0000)	-0.05521* (0.0955)	-0.00945** (0.0079)	-0.00924* (0.0897)
PE	0.00310* (0.0372)	0.001*** (0.0000)	0.0036* (0.0302)	0.00934** (0.0012)	0.0060** (0.0079)	0.00266* (0.0780)	0.0068* (0.0943)
DY	-0.117354* (0.0155)	-0.1044** (0.0060)	-0.072** (0.0091)	-0.08913*** (0.0000)	-0.10638* (0.0140)	-0.10314** (0.0039)	-0.08258* (0.0848)
PDI	0.02389* (0.0250)	0.0251** (0.0030)	0.0314** (0.0002)	0.02311** (0.0012)	0.02842* (0.0714)	0.05394 (0.3617)	0.0246* (0.0781)
EU	0.10164** (0.0091)	0.1187** (0.0062)	0.1092** (0.0001)	0.10361** (0.0046)	0.0906** (0.0019)	0.10261* (0.0963)	0.11475* (0.0498)
Net income	-0.016097** (0.0010)	-0.0081** (0.0087)	-0.0061* (0.0185)	-0.00834*** (0.0003)	-0.180776 (0.4638)	-0.009222** (0.0067)	-0.00943* (0.0892)
Adjusted R²	0.82	0.86	0.94	0.91	0.89	0.90	0.90
F-value	4.5914	4.3819	4.1278	4.3189	4.2655	4.1892	4.2372

Notes: All regressions are controlled for heteroskedasticity and the p-values are given in parentheses. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Furthermore, the coefficient for *SIZE* is also significant and persistently negative for financials, real estate and defense and airlines across all the windows studied, suggesting that largest companies are likely to be more threatened by the Brexit fear than the smallest industries. The announcement of product diversification projects lead to significant and positive abnormal returns for all sectors, with the exception of Consumer goods. We show also that joint ventures announcements are significantly associated with small but significant positive abnormal returns for all the sectors under consideration. Additionally, we document a positive (negative) relationship between price-earnings ratio (dividend yield) and abnormal returns. Our findings are, therefore, in line with the literature suggesting that companies with high price-earnings ratios and low dividend yields will experience positive stock market responses. The results for the dividend yield suggest that there is a negative but small adjustment to abnormal return depending on the dividend yields. Further, the profits of UK industries do not help to consistently explain the stock prices evolution, as the net income's coefficient seems only significant for financials and real estate sectors using the [+1; + 5] event window CAR as the dependent variable. Also, the location of companies' headquarters help to explain the abnormal returns, as the coefficients for *EU* are significant for the different sectors, except some cases.

3.2.   Interpretations

The results indicate that Financials is one of the most damaged sectors from Brexit. The UK financial system is strongly interconnected with the Europe. A Brexit could thus jeopardize UK financial stability. The withdrawal from the EU would end passporting rights, making the UK operations of European Economic Area (EEA) banks and European operations of UK banks harder to pursue. With the Britain's exit from the EU, much of UK activities denominated in Euros might likely to move to the Eurozone. Relocating such activities would undoubtedly generate burly uncertainty into the financial system. Further, barring a negotiated agreement after the Brexit announcement, some sectors like insurance and funds sector would be highly threatened by losing access to the single market. Being cut out from European Union' capital market could make the British financial industry less competitive in longer time horizons.

The Brexit affects also negatively and strongly Defense and Airlines companies. A lack of investment over geopolitical instability would likely erode the competitive position of defense and aerospace firms and adversely impact their revenue and profitability. The UK defense and aerospace firms are likely to be heavily damaged due to its highly integrated supply chains[2] across Europe and its great dependence to Europe's Research and Development (R&D) funds. Specifically, the current Britain's decision to quit EU would harmfully affect mobility of skilled resources. For example, the increased integration across EU and UK has facilitated the Airbus access to highly skilled workers. This mobility is vital to the operating model and proves the efficacy of an EU dominated supply chain. More precisely, Airbus has a widest proportion of UK workers based in France and Germany (with less extent Spain, Everitt et al. 2016) that can be deployed at any time. Moreover, the EU employs funding competitions called Framework Programmes to deliver research grants while attempting to improve all

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[2] The Airbus is an example of a fully integrated supply chain; its wings in Britain, fuselages in France, and tails in Germany and Spain.

sectors among European countries including defence and aerospace. UK benefited largely from these grants. For instance, the seventh Framework Programme that runs between 2007 and 2013 awarded around 14 per cent of the total €33 billion funding to the UK economy where almost 6 per cent was attributed to aerospace, security and arm sector. In this way, Brexit would harm innovation, trade and competitiveness. In this context, Nick Sanders, Executive Chairman Gardner Aerospace[3] proclaimed "I would think that life would be a lot more difficult for Gardner outside of the EU. Our biggest customer is based in France and anything that made trade more difficult would be a negative for us. Items such as customs documentation and potential import duties would add considerably to cost and bureaucracy." In brief, Brexit presents a real risk to the UK defense and aerospace technological bases. Specifically, the European aerospace and defense companies rely on heavier partnerships to share appropriate technological and industrial programs. One can mention, for instance, that the latest UK Strategic Defense and Security Review (2015) opened the way for a protraction of a partnership across UK and France, aimed at stimulating unmanned combat aerial vehicle designed for aircraft carrier-based operations. Overall, with the vote to leave Europe, the Defense and Airlines sector tumbled from lessened access to R & D funds, the reduced technological partnership and the climbed tax and administrative burdens that would undoubtedly have a detrimental influence on the defense and aerospace industries operating across the British Channel (Balis 2016; Ham 2016; Bouoiyour and Selmi 2017).

Besides, the real estate market will face challenging issues with the UK vote to leave Europe. The devaluation of the British pound could trigger inflationary pressures and a rise in interest rates, which would in turn erode disposable income and lead to less homes being built, especially if accompanied with job losses and declining house prices. Accordingly, the UK Head of real estate asserted that two thirds of investors believed that voting to leave EU would slow down investment into UK property companies over the period of uncertainty until new terms of engagement with Europe are being worked out. Moreover, like all commodities, real estate prices are determined by supply and demand. The demand will collapse, but the good news for investors is that supply will decrease too. The cheaper pound will be good news for some investors, too. Exports will be cheaper for foreign buyers, that is to say that some firms will be positively influenced, supporting industrial and warehouse rents. Expectedly, the UK may be attractive as it becomes cheap compared to other European markets such as France and Germany. There is also positive news for student accommodation, as UK university fees for overseas students will drop sharply.

Further, Brexit is likely to exert a strong effect on technology. This outcome is not surprising; London is seen as the financial capital of Europe and the most irresistible city for startups. It has been an attractive location for several big tech industries (for example, Apple, Cisco, IBM and Google) to achieve European operations. With the onset of Brexit, London will lose these positions. Also, Startups seeking access to European grants and different EU programs and projects, like for example the Horizon 2020 program, will likely move their operations to European cities. Additionally, UK tech companies will lack the opportunity to participate in a European-funded project for next-generation mobile technology. It is obvious then that in the onset of Brexit, EU nationals will need over the next years visas to work and reside in the United Kingdom.

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[3] The Gardner Aerospace is the Europe's largest independent manufacturer of aerospace detailed parts.

These circumstances will harm the capability of UK tech firms to hire the engineers, data scientists, as well as the information technology workers they need from Europe.

Nevertheless, the UK Pharmaceuticals and Biotechnology and Consumer goods-focused companies appear less damaged. One of the potential elements that may explain this outcome is that these companies are among those likely to go unscathed from a weaker pound Sterling since they bring their sales outside the UK. The depreciation of Sterling vis-à-vis the dollar will make the products of these companies more competitive and result in a sharp boost when converted back into British pound. Interestingly, Pharmaceuticals and Biotech industries are not highly sensitive to macroeconomic and financial uncertainties; even in times of economic distress and political turmoil, people do not stop requiring life-saving drugs. Laying aside these short-term effects for pharmaceutical firms, the Britain's withdrawal from the EU may present a long-term challenge to both Pharmaceuticals and Biotechnology companies. In particular, the Britain's "divorce" with Europe will have implications for the way drugs are regulated. Potentially, the ambition of Britain to become the third largest Biotech cluster in the world, after Boston and San Francisco becomes doubtful, according to the proclamation of the chief executive of the Association of the British Pharmaceutical Industry. Likewise, the Britain's Oil and Gas industries react slightly to the Brexit announcement since they do business mostly in U.S. dollars around the world; in this way, oil might play a "safe haven" role. It is also expected that after the decision to leave EU, UK will implement its own renewable and low carbon energy policy, and thus, the alternative energy sector will not be highly influenced.

4. Conclusions and some policy implications

The Britain's exit from the European Union and the uncertainty associated with it receive nowadays far-reaching attention. This article seeks to shed some light on the costs of "Brexit" by examining the reactions of different sectors of UK stock market to the Brexit announcement.

Even though the initial effect of any major event may involve a negative abnormal returns because of higher levels of uncertainty as the new information is being assessed and absorbed, once the long-term costs of Brexit are analyzed, equity markets may return to their pre-event condition. Inconsistently with the Uncertain Information Hypothesis, the reactions stock values of UK firms are not reversed within our window of analysis. Our findings indicate that the British industries are not resilient in dealing with uncertainty. The event-study methodology conducted in this study around the day of Brexit vote uncovers evidence of negative abnormal returns but with different degrees. In particular, Financials, Defense and Airlines, Real estate and Technology face series of difficult challenges following the Brexit vote, with a host of pressing issues facing the sectors, whereas Oil and GGas, Pharmaceuticals and Biotechnology and Consumer goods experienced a moderate influence.

Several elements can explain how Financials, Defense and Airlines, Real estate and Technology are the biggest losers. Among them, one can cite the Britain's ability to still enjoy European passporting rules to establish investments, to participate in European funded-projects (i.e., the increased doubts over the UK's capability to win future project grants), without ignoring the opportunity to recruit skilled workers. The UK was, in 2014/2015, the most attractive destination for foreign direct investment in the EU with the USA, India and France being the widest contributors. Foreign investors who perceive investment opportunities in UK firms as a gateway to accessing EU

markets can be put off by the current UK's withdrawal. This decision would complicate the investment negotiations with potential partners like China and India. Indeed, when UK belonged to Europe, negotiations were easier given the growing importance of Europe as a world power. Moreover, much of the debate around Britain's membership of the EU has focused on the need to limit the flow of immigration. But how and to what extent such decision will affect the many UK businesses which employ EU migrants and rely abundantly on the international talent? The EU's Office for National Statistics (Eurostat) indicated that 2,108,000 skilled workers from European countries reside in Britain. With potential skills in industries including Fintech, Logistics, Big Data, engineering and information Technology, EU migrants play a vital role in the development of UK economy. Even though, it is unclear up to now what status European migrants would have in the onset of the Brexit and to what extent this decision will impact the extent of movement policy, there are great concerns about the significant effect of Brexit on the ability of UK industries to hire the highly skilled workers that they need. It must be added that a reduction in the movement of migrant labour may result to less homes being built, which can lead to real troubles for the property companies and then to housing crisis.

Mitigating the Brexit costs depends potentially on how the UK and the remaining Member States of the EU might manage their relationships following the announcement of Brexit. With the decision of Britain's electorate to withdraw from the EU, leaders will try to search effective and drastic strategies to anchor their Britain's foreign policy in the next years. For Financials, for example, the British government would seek to undertake parallel EU and non-EU compliant frameworks to improve the flexibility of the UK as a financial centre attracting a large variety of global banks and financial services providers. For Airlines sector, the continuation of a liberal and deregulated aerospace market within the UK and Europe, implying that all European and British airlines can continue to operate as they yet do, is one of the most important points UK authorities will have to urgently negotiate with their European counterparts. For Technology, to preserve its leadership in innovation and long-run support of the digital economy, high tech-companies must call for continued cohesion and collaboration with their EU partners.

Acknowledgement

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