



# Impact of Brexit news on the stock prices of european insurance companies: an event study approach based on indexation and sub-indexation

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Accepted: 10 September 2022 / Published online: 10 October 2022  
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**Abstract** The Brexit referendum in June 2016 led to different publications analysing stock market reactions. This study addresses a research gap, regarding the consideration of other Brexit events and the focus on stock prices of European insurance companies, by using a further refined event study approach based on indexation and sub-indexation. In scope are 17 listed insurance companies based in the European Union or the United Kingdom represented by the Insurance Index. To analyse potential dependencies between abnormal returns and the location of the company (European Union or United Kingdom) or the share of insurance business written in the United Kingdom, the Insurance Index is divided into four sub-indices. The results show significant positive or negative abnormal returns of the Insurance Index. In addition, the sub-indices react differently to the events under consideration. Trends are suggesting that significant abnormal returns may depend on the location and the share of insurance business written in the United Kingdom.

**Keywords** Brexit · Event Study · Insurance Market · Outperformance of European insurance companies · Abnormal Returns

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## **Auswirkungen von Brexit-Nachrichten auf die Aktienkurse europäischer Versicherungsunternehmen: Ein Ereignisstudien-Ansatz basierend auf Indexierung und Sub-Indexierung**

**Zusammenfassung** Das Brexit-Referendum im Juni 2016 führte zu verschiedenen Veröffentlichungen, in denen die Reaktionen der Aktienmärkte analysiert wurden. Diese Studie schließt eine Forschungslücke in Bezug auf die Berücksichtigung anderer Brexit-Ereignisse und den Fokus auf Aktienkurse europäischer Versicherungsunternehmen, indem ein weiter verfeinerter Ereignisstudienansatz auf der Grundlage von Indexierung und Sub-Indexierung verwendet wird. Untersucht werden 17 börsennotierte Versicherungsunternehmen mit Sitz in der Europäischen Union oder im Vereinigten Königreich, die durch den Insurance Index zusammengefasst werden. Um mögliche Abhängigkeiten zwischen abnormalen Renditen und dem Standort des Unternehmens (Europäische Union oder Vereinigtes Königreich) oder dem Anteil des im Vereinigten Königreich gezeichneten Versicherungsgeschäfts zu analysieren, wird der Insurance Index in vier Sub-Indices unterteilt. Die Ergebnisse zeigen signifikant positive oder negative abnormale Renditen des Insurance Index. Darüber hinaus reagieren die Sub-Indices unterschiedlich auf die betrachteten Ereignisse. Trends deuten darauf hin, dass signifikante abnormale Renditen vom Standort und dem Anteil des im Vereinigten Königreich gezeichneten Versicherungsgeschäfts abhängen können.

### **1 Introduction**

On 23 June 2016, about 52% of the British population voted for leaving the European Union (EU), also known as the Brexit referendum. Since then, there has been much speculation about the impact of Brexit on the worldwide economy. This decision is one of the most significant changes in the United Kingdom (UK) economic history.

The Brexit referendum led to different publications analysing the impact of this event on the stock market using event study methodology. To date, the existing event study publications in the context of Brexit consider mainly the Brexit referendum. There are nearly no studies on the impact of other Brexit news on the stock market. In addition, there is no study explicitly analysing the impact of Brexit on the stock prices of European insurance companies.

From the authors' point of view, Brexit news could lead to uncertainties and thus to changes in stock prices, especially in the insurance market, due to the following aspects (Deloitte [n.d.](#); EIOPA [n.d.](#); GDV [2017](#); Insurance Europe [2021](#); Mortimer et al. [2021](#)):

1. The European insurance market is one of the most important insurance markets in the world, alongside North America and the Asia-Pacific market.
2. The European insurance measure is characterised by a high degree of internationalisation and harmonisation.
3. The European Passport, which allows insurance companies conducting cross-border insurance business in all EU member states based on a qualified authorisa-

tion in the home country, will no longer apply to insurance companies conducting cross-border business between UK and EU after Brexit.

4. The European Solvency II supervisory regime, which has been implemented to abolish country-specific differences in insurance supervision will no longer be applicable in the UK due to Brexit.

This study closes the identified research gaps by using an event study approach based on indexation and sub-indexation for the European insurance market that analyses the influence of other important Brexit news in addition to the Brexit referendum. The hypotheses to be verified are based on the general research question, for which events abnormal returns exist and why.

In the last few years, there have been various events related to Brexit that could have an impact on stock market developments. The study focuses on the insurance industry and will analyse the impact of four key Brexit events on the stock prices of European and UK insurance companies.

Therefore, this article is structured as follows: After the introduction, a literature review is done and research gaps are defined. The next chapter deals with the methodology and the research design. The following chapter presents the results of the four key events. With a conclusion and verification of the hypotheses this article ends.

## 2 Literature review and hypotheses

### 2.1 State of research—event studies in the context of Brexit

Since 2016, there have been various publications that have examined the impact of Brexit on the stock market. An overview of relevant publications, the used events and the methods used are given in Table 1, below. The interpretation of the results follows afterwards. This overview does not intend to be exhaustive; it includes the most important sources from the authors' point of view.

Overall, those publications show that the Brexit referendum had an impact on the stock markets. All studies, relating to different markets, countries or sectors, show (positive or negative) abnormal returns due to the Brexit referendum in June 2016.

A study from 2016 (Raddant 2016) analysing the impact of the Brexit referendum on the European stock market concludes that European stock prices have dropped by around 10% in the short term after the Brexit vote. The study was based on a set of 428 stocks, market indices, and exchange rates from the markets in the UK, Germany, Spain, France, and Italy.

The publication of Ramiah, Pham, and Moosa (2017) on sectoral effects of Brexit on the British economy confirms the movements on the stock market as well. According to this study, the British banking, leisure, and travel sectors were particularly affected by the Brexit referendum in 2016. The study shows cumulative abnormal returns of up to -16%.

Cazan (2017) analysed Brexit implications over the England Banking System by using the event study methodology. The results have shown that in the post-event

**Table 1** Relevant Event Study Publications in the context of Brexit

Publication	Year	Methodology	Events
The response of European stock markets to the Brexit (Raddant 2016)	2016	Analysis of the correlation of market indices, stock volatility and the special role of stocks from the financial sector using a multivariate GARCH model	Brexit Referendum (June 2016)
The sectoral effects of Brexit on the British economy: early evidence from the reaction of the stock market (Ramiah et al. 2017)	2017	Assessment of the impact of Brexit against expectations measured by abnormal returns using the event study methodology	Brexit Referendum (June 2016)
Brexit implications over the England Banking System—An Event Study Approach (Cazan 2017)	2017	Event study on a panel of 11 financial institutions listed on the London Stock Exchange	Brexit Referendum (June 2016)
The Economic Effects of Brexit: Evidence from the Stock Market (Breinlich et al. 2018)	2018	Two-step procedure to estimate the impact of several Brexit-related variables on the abnormal returns of UK-listed firms	Brexit Referendum (June 2016); Two speeches by Theresa (October 2016 and January 2017)
Performance of Exchange Traded Funds during the Brexit Referendum: An Event Study (Alkhatib and Harasheh 2018)	2018	Event study market model on daily and abnormal returns of the selected ETFs with respect to FTSE 250 around the event date	Brexit Referendum (June 2016)
Stock Market Reactions to Brexit: Case of Selected CEE and SEE Stock Markets (Škrinjarić 2019)	2019	Analysis of reactions of selected Central and Eastern European and South and Eastern European stock markets to the Brexit referendum using event study methodology	Brexit Referendum (June 2016)
Brexit referendum and European stock markets: a sector analysis (Kenourgios et al. 2020)	2019	Performance of an event study to measure cumulative abnormal returns during the post-referendum announcement period	Brexit Referendum (June 2016)
Impact of Brexit: Evidence from Stock Markets—An event study analysis of the Oslo Stock Exchange and the London Stock Exchange (Deva and Madhuchandra 2020)	2020	Event study analysis of the Oslo Stock Exchange and the London Stock Exchange	Brexit Referendum (June 2016)

Source: Own elaboration

window, the values of the abnormal and cumulative abnormal returns have dropped significantly, the market impact being negative.

Another study conducted in 2018 (Breinlich et al. 2018) also shows that the Brexit referendum and the associated fear of a cyclical downturn led to movements on the stock market.

The Performance of exchange-traded funds during the Brexit has been analysed by Alkhatib and Harasheh (2018). The study shows that the world equity's ETFs significantly respond to the event by having a significant positive abnormal return

on the event date. In addition, an important observation is the presence of significant negative abnormal returns five and four days before the event date.

A study by Škrinjarić (2019) focused on the impact of Brexit on the Central and South-Eastern European stock markets. The results indicate mixed results regarding the abnormal cumulative return series, but the volatility series were found to be significantly affected by the mentioned event.

Kenourgios et al. (2020) performed a sector analysis of the Brexit referendum using event study methodology. A negative effect is observed in the financial sector across both the EU-28 and eurozone samples, whereas basic materials and health care sectors are influenced positively across the European region.

In 2020, Deva and Madhuchandra (2020) published a study on the impact of Brexit as an event study analysis of the Oslo Stock Exchange and the London Stock Exchange. The results show that the immediate impact was greater for the London Stock Exchange than the Oslo Stock Exchange.

## 2.2 Research gaps and aims of the study

The existing event study publications in the context of Brexit consider mainly the Brexit referendum. To date, there are nearly no studies on the impact of other Brexit news on the stock market.

Although the above-mentioned studies analyse different markets, countries, and sectors, no study explicitly analyses the impact of Brexit on the stock prices of European insurance companies. Based on the current state of research and the reasons mentioned in section I. Introduction, it can be assumed that the stock prices of European insurance companies also react to the Brexit referendum and other Brexit news of the past years with abnormal returns.

This study, therefore, aims to close this research gap by conducting an event study for the European insurance market that analyses the influence of other important Brexit news in addition to the Brexit referendum.

Event studies are based on the calculation of (daily and cumulative) abnormal returns. Definitions and details of the methodology are introduced later.

The research gap will be closed by answering the following research questions (Q1–Q3) with the use of the event study methodology.

- *Q1*: Do Brexit news lead to daily or cumulative abnormal returns for European insurance companies represented by the Insurance Index?
  - $H0_{Q1}$ : Daily and cumulative abnormal return of the Insurance Index on a given day/in a defined window is equal to zero.
  - $HA_{Q1}$ : Daily and cumulative abnormal return of the Insurance Index on a given day/in a defined window is not equal to zero.
- *Q2*: Are the abnormal returns dependent on the domicile (EU or UK) of the insurance companies?
- *Q3*: Are the abnormal returns related to the proportion of insurance business written in the UK?
  - $H0_{Q2, Q3}$ : Daily and cumulative abnormal return of each Sub-Index on a given day/in a defined window is equal to zero.

- $HA_{Q2, Q3}$ : Daily and cumulative abnormal return of each Sub-Index on a given day/in a defined window is not equal to zero.

### 3 Methodology and research design

#### 3.1 Event study methodology

The efficient market hypothesis published by Fama (1970) is a key theory for financial economics and the basis for the event study methodology. The event study methodology assumes that the capital markets are efficient in a semi-strong form and describes an empirical financial research technique that allows assessing the impact of an event on the stock price of a company (Bodie et al. 2011; Pauser 2007). Transferred to this study, this means that the impact of Brexit news on the stock prices of the insurance industry is examined. The first event study has been published by James Dolley in (1933). In the following decades, the methodology of the event study was frequently applied and further refined via different publications (MacKinlay 1997).

Important publications are by Stephen Brown and Jerold Warner (1980, 1985). Overall, the basic format of an event study has never fundamentally changed (Pauser 2007; Deva and Madhuchandra 2020; Khotari and Warner 2006).

According to MacKinlay (1997), there is a general flow on an event study that is characterised by the following steps: Event definition, selection criteria, estimation window, abnormal return calculation, testing framework and result interpretation.

#### 3.2 Data basis and indexation

The sample comprises a total of 17 insurance companies listed on the stock exchange, of which six are based in the UK and 11 in the EU. The insurance companies represent a mix of different lines of business and the sample is representative of the insurance market—considering the limited number of European and UK insurance companies listed on the stock exchange.

For further analysis, the sample is aggregated into the main index, the Insurance Index which covers the whole sample of 17 insurance companies.

In term of index types, a distinction is made between price indices, performance indices, and price-weighted indices (Heese 2014).

This study uses the price index, as this is also the index type of the benchmarks (EUROSTOXX 50 and FTSE 100) chosen as part of the event study. Although this selection leads to the limitation that differences in dividends cannot be analysed, it is considered appropriate due to consistency. Furthermore, analysis of dividend differences is not in the scope of this study.

The stock price data (in Euro) is extracted from the source boerse.de. The period used extends from 2 January 2015 to 31 March 2021. The raw data extracted has been adjusted for the days on which no data was available for at least one insurance company. The index weighting is based on the market capitalisation of each insur-

ance company. The starting point for the index is 2 January 2015. At this date, the index value is set at 1000.

For further analysis and a better understanding of the dependencies on location (EU or UK) and the share of insurance business written in the UK, these 17 insurance companies are divided into four homogeneous groups, the sub-indices. The grouping (sub-indexing) is based on the following criteria:

- *Sub-Index 1*: Based in the EU and less than 20% insurance business written in the UK
- *Sub-Index 2*: Based in the EU and more than 20% insurance business written in the UK
- *Sub-Index 3*: Based in the UK and less than 50% insurance business written in the UK
- *Sub-Index 4*: Based in the UK and more than 50% insurance business written in the UK

The measure used to determine the insurance business written in the UK is the gross premiums written as at the end of the 2018 or 2019 financial year (depending on the availability of data). This information is published annually by the insurance companies in scope in their Solvency and Financial Condition Report, which contains information on the Quantitative Reporting Template (QRT) S.05.02—breakdown of underwriting performance by geographical area. This QRT does not show all countries, but the 5 largest and the home country. This approach is considered suitable due to the identical presentation and thus high comparability of the individual reports. If a company operates business in the UK but this is not shown in the QRT, it can be considered immaterial.

For insurance companies based in the EU, 20% of insurance business written in the UK is chosen because a geographical area covering more than 20% of the insurance business is assumed to be material.

Following the Regulation of the European Commission laying down implementing technical standards with regard to the templates for the submission of information to the supervisory authority, the QRT S.05.02 must cover as many countries as necessary to reach 90% of the total gross written premiums (European Commission 2015). Conversely, this regulatory requirement means that the remaining 10% of gross written premiums is considered immaterial and therefore does not require reporting. Since these 10% represent the minimum materiality threshold as interpreted by the authors, and to make a clearer distinction regarding the dependency on the insurance business written in the UK, the materiality threshold is raised slightly and set at 20%. As to the authors, this materiality threshold is considered to be appropriate for further analysis.

For insurance companies based in the UK, this size is adjusted to 50% so that at least two insurance companies are listed in each group.

Table 2 shows the 17 insurance companies in scope, their International Securities Identification (ISIN), location, and the breakdown of the written insurance business by geographical regions.

It was a conscious decision to not use the existing index STOXX Europe 600 Insurance, which comprises a total of 30 insurance companies.

**Table 2** Sub-indexation based on gross written premiums

Group	Company (ISIN)	Country	% UK	% EU	% Other
1	Ageas N.V. (BE0974264930)	Belgium	13.0	87.0	0.1
1	Allianz (DE0008404005)	Germany	4.5	74.8	20.6
1	Assicurazioni Generali S.p.A. (IT0000062072)	Italy	0.0	94.7	5.3
1	AXA S.A. (FR0000120628)	France	9.1	60.8	30.1
1	CNP Assurances S.A. (FR0000120222)	France	0.0	78.2	21.8
1	KBC Groep N.V. (BE0003565737)	Belgium	0.0	100.0	0.0
1	Mapfre, SAReg (ES0124244E34)	Spain	3.2	55.5	41.3
1	Nürnberger Beteiligungs-AG (DE0008435967)	Germany	0.0	100.0	0.0
2	AEGON N.V. (NL0000303709)	Netherlands	47.2	11.4	41.4
2	Hannover Rück (DE0008402215)	Germany	22.5	20.8	56.6
2	Munich Re AG (DE0008430026)	Germany	27.6	20.9	51.5
3	Lloyds Banking Group (GB0008706128)	United Kingdom	42.4	7.9	49.7
3	Prudential plc (GB0007099541)	United Kingdom	30.6	0.0	69.4
4	Admiral Group plc (GB00B02J6398)	United Kingdom	74.9	15.0	10.1
4	Aviva plc (GB0002162385)	United Kingdom	56.0	33.6	10.4
4	Direct Line Insurance Group (GB00BY9D0Y18)	United Kingdom	100.0	0.0	0.0
4	Standard Life Aberdeen plc (GB00BF8Q6K64)	United Kingdom	91.8	8.2	0.0

Source: Own elaboration, based on companies' Solvency and Financial Condition Reports

On the one hand, this index does not match the structure of the study, as only insurance companies domiciled in the EU or the UK are in scope, whereas the STOXX Europe 600 Insurance includes many companies based in Switzerland. On the other hand, the use of the STOXX Europe 600 Insurance could have led to inconsistencies between this index and the four sub-indices. There would have been limitations in the replication of the STOXX Europe 600 Insurance and therefore in the formation of the sub-indices, as not all the data required would have been available for the insurance companies listed in the index.

The use of the STOXX Europe 600 Insurance could therefore have led to limitations, which were counteracted by the formation of the own index (Insurance Index).



The creation of the Insurance Index based on the 17 selected insurance companies offers the advantages that the sample can be selected according to clear criteria, such as company headquarters in the EU or the UK or availability of data, and the index creation (Insurance Index and sub-indices) is based on consistent data and methodology.

### 3.3 Parameters of the event study

#### 3.3.1 Event definition

This study comprises event studies on four key events in the context of Brexit. The first event in this study is the Brexit referendum dated 23 June 2016. In addition to the Brexit referendum, the impact of three other Brexit key events on the stock prices of insurance companies will be analysed. This study defines the following four events as Brexit key events:

1. Brexit referendum on 23 June 2016
2. Election in the UK on 12 December 2019
3. Withdrawal of the UK from the EU on 31 January 2020
4. Last minute Brexit deal on 24 December 2020

The event window usually starts a few (three, five or ten) trading days before the actual event day (Benninga 2008). In this study, the event window comprises in all cases the event date, as well as five trading days before and after the event  $[-5; 5]$ , to consider possible early announcements and delayed effects as well.

#### 3.3.2 Selection criteria

For the study, the Insurance Index and the four sub-indices are used. The total sample reflected in the Insurance Index comprises 17 listed insurance companies from different countries and lines of business. For further analysis, the Insurance Index is divided into homogeneous groups, the four sub-indices, depending on the location of the insurance company (EU or UK) and the share of the insurance business written in the UK.

#### 3.3.3 Estimation window

In many event studies, the observation period starts 250 days before the event, following the calendar year (Corrado 2011). Since the data set used was adjusted for the days on which no data was available for at least one insurance company, the 250 trading days are not applied.

Instead, the estimation window for each event starts exactly one year before the event date. A longer event window is not used to prevent potential overlapping effects with events other than those being investigated in the study.

The estimation windows can therefore differ from one event date to the next, depending on the number of days with trading information available. Table 3 sum-

**Table 3** Estimation Window and Event Window based on Events

Event	Event Date	Event Window	Estimation Window
Referendum	23.06.2016	[-5; 5] 16.06.–30.06.2016	[-233; -6] 23.06.2015–15.06.2016
UK Election	12.12.2019	[-5; 5] 05.12.–19.12.2019	[-241; -6] 12.12.2018–04.12.2019
Withdrawal	31.01.2020	[-5; 5] 24.01.–07.02.2020	[-241; -6] 31.01.2019–23.01.2020
Brexit Deal	23.12.2020 <sup>a</sup>	[-5; 5] 16.12.2020–05.01.2021	[-251; -6] 23.12.2019–15.12.2020

Source: Own elaboration

<sup>a</sup>The event took place on 24.12.2020. The date has been adjusted to 23.12. for the event study due to unavailability of price data on 24.12.

marizes the different event dates, event window, and estimation window length for the four events under consideration.

Although the defined windows of Event “Withdrawal” and Event “Brexit Deal” overlap by about six weeks, the same estimation window is used for all events in order to apply a consistent methodology. Alternative calculations that have shortened the estimation window for Event “Brexit Deal” to 10 months and thus do not include this overlap show almost identical results. The shortening of the estimation window does not lead to any material differences in the significance of abnormal returns.

### 3.3.4 Abnormal return calculation

The abnormal return of a stock is the actual return of a stock minus the expected return (Haryanto et al. 2018; MacKinlay 1997).

For the actual return, logarithmic returns are used as they have the advantage that they are more robust and more likely to have a normal distribution, which simplifies the selection of the testing framework later (Corrado and Truong 2008; Müller 2007). They are calculated as follows (Strong 1993, p. 535):

$$R_{it} = \ln \left( \frac{P_{it}}{P_{it-1}} \right) \quad (1)$$

- $P_{it}$  = price of stock  $i$  on day  $t$
- $P_{it-1}$  = price of stock  $i$  on day  $t-1$

The Sharpe market model below is used to calculate the expected returns. It is based on market-specific and company-specific factors that are reflected in the equation of the model (Sharpe 1963; Binder 1998).

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} + \varepsilon_i \quad (2)$$

- $\alpha_i$  = Estimated parameter for the estimation period
- $\beta_i$  = Estimated parameter for the estimation period that reflects the sensitivity of the individual stocks to the benchmark
- $R_{mt}$  = Market return on day  $t$
- $\varepsilon_i$  = Stochastic disturbance variable with an expected value of 0

The market model is an OLS regression. The parameters  $\alpha$  and  $\beta$  are determined via a linear regression in the estimation window. The event window is not considered in the regression to get independent results. The market return used in the market model depends on the benchmark. There are two alternatives for a corresponding benchmark, the industry index, or the country index. On the one hand, a broadly based country index can be used, which shows the general market developments in a territorial area. On the other hand, it is possible to use an industry index that shows the general developments of a specific industry. In this case, two country indices are chosen as benchmarks since the Insurance Index already represents an industry index. To adequately take into account both geographical regions under consideration (EU and UK), the EUROSTOXX 50 and the FTSE 100 are selected as benchmarks. Both indices are classically price indices, like the Insurance Index.

The abnormal return of a stock in the event window is the actual return of a stock minus the expected return (Haryanto et al. 2018).

$$AR_{it} = R_{it} - E(R_{it}) \quad (3)$$

- $R_{it}$  = daily return of stock  $i$  on day  $t$
- $E(R_{it})$  = expected return of stock  $i$  on day  $t$

In addition to the daily abnormal returns, cumulative abnormal returns can also be calculated. For this purpose, the observed daily abnormal returns are aggregated to derive general conclusions about the event. The aggregation of daily returns is done on the dimension of time. The concept of cumulative abnormal return is necessary to reflect a multi-period event window (MacKinlay 1997; Zureck 2016).

$$CAR_{it} = \sum_{t=1}^n AR_{it} \quad (4)$$

Besides the daily abnormal returns in the event window, the study examines the cumulative abnormal returns for the following 15 periods for each event as well: [-5;5], [-4; 4], [-3; 3], [-2; 2], [-1; 1], [0; 5], [0; 4], [0; 3], [0; 2], [0; 1], [-5; 0], [-4; 0], [-3; 0], [-2; 0] and [-1; 0].

### 3.3.5 Testing framework

The testing framework tests the significance of the daily and cumulative abnormal returns. It is based on the defined hypotheses and serves to statistically verify them (Kurek 2020).

The significance of the abnormal daily and cumulative returns is tested for each event individually. The selected testing framework uses the t-test, which is a parametric test. According to Brown and Warner (1985), “since the degrees of freedom exceeds 200, the test statistic is assumed unit normal”.

The null hypothesis  $H_0$  to be verified for each Index and each day/window under review is that the abnormal return on a given day/in a defined window is equal to zero (Brown and Warner 1985; Zureck 2016).

The test statistics of stock  $i$  on day  $t$  is shown below (Brown and Warner 1985; Zureck 2016).

$$t_{AR_{it}} = \frac{AR_{it}}{SE(AR_{it})} \quad (5)$$

$$SE(AR_{it}) = \sqrt{\frac{\sum_{t=-6}^{t=-x} (AR_{it} - \overline{AR})^2}{n}} \quad (6)$$

- $SE(AR_{it})$ = Standard error of abnormal returns in the estimation window
- $AR_{it}$ = Abnormal return of stock  $i$  on day  $t$
- $\overline{AR}$ = Average abnormal return in the estimation window
- $n$ = Size of the sample (estimation window)
- $-6$ = End of estimation window based on event window  $[-5; 5]$
- $x = n + 5$  based on event window  $[-5; 5]$

The significance test for the cumulative abnormal returns follows the significance test for the abnormal returns (Zureck 2016).

$$t_{CAR_{it}} = \frac{CAR_{it}}{SE(AR_{it})} \quad (7)$$

- $SE(AR_{it})$ = Standard error of abnormal returns in the estimation window
- $CAR_{it}$ = Cumulative abnormal return

To test the significance of the abnormal returns, the t-values calculated based on the t-statistic are converted into  $p$ -values. A  $p$ -value smaller than 0.05 means that the null hypothesis must be rejected.

## 4 Results

Daily and cumulative abnormal returns were calculated for the Insurance Index as well as for the four sub-indices for all four events under consideration. The market return is based on the market model. Abnormal returns were calculated by using two different benchmarks (EUROSTOXX 50 and FTSE 100). Results for each event are presented in the following sections.

**Table 4** Daily and cumulative abnormal returns—Brexit referendum

		Benchmark: FTSE 100																			
		Benchmark: EURO STOXX 50						Insurance Index													
<i>t</i>		Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4	Insurance Index	Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4	Insurance Index	Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4						
		AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value	AR <sub><i>t</i></sub>	p-value						
+5		-1.6%	0.055	-0.9%	0.201	-0.3%	0.738	-3.9%	0.021 *	-0.3%	0.868	-0.5%	0.725	0.2%	0.920	0.8%	0.623	-2.9%	0.127	0.7%	0.710
+4		1.0%	0.199	0.3%	0.695	-0.2%	0.820	2.6%	0.121	1.7%	0.260	3.0%	0.044 *	2.7%	0.098	2.0%	0.206	3.9%	0.041 *	3.2%	0.081
+3		1.3%	0.119	-0.6%	0.403	-1.2%	0.165	5.6%	0.001 **	1.9%	0.209	2.8%	0.060	1.4%	0.379	0.7%	0.673	6.3%	0.001 **	2.9%	0.109
+2		-6.2%	0.000 ***	-3.9%	0.000 ***	-2.1%	0.011 *	-12.0%	0.000 ***	-6.9%	0.000 ***	-8.7%	0.000 ***	-6.3%	0.000 ***	-4.5%	0.004 **	-14.7%	0.000 ***	-9.3%	0.000 ***
+1		-8.1%	0.000 ***	-4.7%	0.000 ***	-0.3%	0.750	-16.4%	0.000 ***	-9.7%	0.000 ***	-15.1%	0.000 ***	-12.5%	0.000 ***	-7.6%	0.000 ***	-22.6%	0.000 ***	-15.7%	0.000 ***
0		0.2%	0.834	0.1%	0.861	0.0%	0.967	0.3%	0.874	0.3%	0.851	2.0%	0.167	2.0%	0.220	1.8%	0.261	2.2%	0.241	2.1%	0.253
-1		1.5%	0.057	1.2%	0.092	0.9%	0.297	1.9%	0.252	2.5%	0.104	2.3%	0.125	1.7%	0.296	1.4%	0.379	3.1%	0.105	3.4%	0.061
-2		0.8%	0.344	0.0%	0.963	0.2%	0.826	1.2%	0.467	3.2%	0.037 *	1.3%	0.369	0.8%	0.603	0.9%	0.571	1.4%	0.456	3.5%	0.053
-3		2.8%	0.001 ***	1.0%	0.176	1.0%	0.223	6.4%	0.000 ***	2.6%	0.089	5.2%	0.000 ***	3.9%	0.016 *	3.7%	0.019 *	8.3%	0.000 ***	4.5%	0.013 *
-4		1.3%	0.120	0.2%	0.837	0.5%	0.516	3.5%	0.036 *	1.1%	0.487	2.1%	0.157	1.2%	0.471	1.5%	0.351	4.1%	0.032 *	1.7%	0.350
-5		-0.8%	0.313	-0.3%	0.724	-0.8%	0.313	-1.4%	0.413	-1.8%	0.241	-1.4%	0.349	-0.5%	0.738	-1.2%	0.447	-2.4%	0.208	-2.6%	0.157
		Insurance Index	Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4	Insurance Index	Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4	Insurance Index	Sub-Index 1	Sub-Index 2	Sub-Index 3	Sub-Index 4					

**Table 4** (Continued)

Window	Benchmark: EURO STOXX 50						Benchmark: FTSE 100																							
	CAR <sub>t</sub>	p-value	CAR <sub>t</sub>	p-value	CAR <sub>t</sub>	p-value	CAR <sub>t</sub>	p-value	CAR <sub>t</sub>	p-value	CAR <sub>t</sub>	p-value																		
[-5;5]	-7.8%	0.000	***	-7.5%	0.000	***	-2.3%	0.006	**	-12.2%	0.000	***	-5.4%	0.001	***	-7.0%	0.000	***	-5.5%	0.001	***	-0.7%	0.647	***	-13.2%	0.000	***	-5.6%	0.002	***
[-4;4]	-5.5%	0.000	***	-6.3%	0.000	***	-1.2%	0.157	*	-6.9%	0.000	***	-3.3%	0.030	*	-5.1%	0.001	***	-5.1%	0.002	**	-0.3%	0.851	***	-7.9%	0.000	***	-3.7%	0.042	*
[-3;3]	-7.8%	0.000	***	-6.7%	0.000	***	-1.5%	0.067	*	-13.1%	0.000	***	-6.1%	0.000	***	-10.2%	0.000	***	-9.0%	0.000	***	-3.7%	0.018	*	-15.9%	0.000	***	-8.6%	0.000	***
[-2;2]	-11.8%	0.000	***	-7.1%	0.000	***	-1.4%	0.096	*	-25.1%	0.000	***	-10.6%	0.000	***	-18.2%	0.000	***	-14.3%	0.000	***	-8.1%	0.000	***	-30.5%	0.000	***	-16.0%	0.000	***
[-1;1]	-6.4%	0.000	***	-3.3%	0.000	***	0.6%	0.495		-14.3%	0.000	***	-6.9%	0.000	***	-10.8%	0.000	***	-8.8%	0.000	***	-4.5%	0.005	**	-17.2%	0.000	***	-10.2%	0.000	***
[0;5]	-13.3%	0.000	***	-9.7%	0.000	***	-4.0%	0.000	***	-23.9%	0.000	***	-12.9%	0.000	***	-16.5%	0.000	***	-12.6%	0.000	***	-6.9%	0.000	***	-27.7%	0.000	***	-16.2%	0.000	***
[0;4]	-11.8%	0.000	***	-8.7%	0.000	***	-3.8%	0.000	***	-20.0%	0.000	***	-12.7%	0.000	***	-16.0%	0.000	***	-12.8%	0.000	***	-7.7%	0.000	***	-24.8%	0.000	***	-16.9%	0.000	***
[0;3]	-12.8%	0.000	***	-9.0%	0.000	***	-3.6%	0.000	***	-22.7%	0.000	***	-14.4%	0.000	***	-19.0%	0.000	***	-15.5%	0.000	***	-9.7%	0.000	***	-28.7%	0.000	***	-20.0%	0.000	***
[0;2]	-14.1%	0.000	***	-8.4%	0.000	***	-2.4%	0.004	**	-28.2%	0.000	***	-16.3%	0.000	***	-21.8%	0.000	***	-16.9%	0.000	***	-10.4%	0.000	***	-35.1%	0.000	***	-22.9%	0.000	***
[0;1]	-7.9%	0.000	***	-4.5%	0.000	***	-0.3%	0.719		-16.2%	0.000	***	-9.4%	0.000	***	-13.1%	0.000	***	-10.5%	0.000	***	-5.8%	0.000	***	-20.3%	0.000	***	-13.6%	0.000	***
[-5;0]	5.7%	0.000	***	2.3%	0.002	**	1.7%	0.038	*	12.0%	0.000	***	7.8%	0.000	***	11.6%	0.000	***	9.1%	0.000	***	8.0%	0.000	***	16.8%	0.000	***	12.7%	0.000	***
[-4;0]	6.5%	0.000	***	2.6%	0.001	***	2.6%	0.002	**	13.4%	0.000	***	9.6%	0.000	***	13.0%	0.000	***	9.6%	0.000	***	9.2%	0.000	***	19.2%	0.000	***	15.2%	0.000	***
[-3;0]	5.2%	0.000	***	2.4%	0.001	**	2.0%	0.015	*	9.8%	0.000	***	8.6%	0.000	***	10.9%	0.000	***	8.5%	0.000	***	7.7%	0.000	***	15.0%	0.000	***	13.5%	0.000	***
[-2;0]	2.5%	0.002	**	1.4%	0.057		1.0%	0.223		3.4%	0.043	*	6.0%	0.000	***	5.6%	0.000	***	4.5%	0.006	**	4.0%	0.011	*	6.8%	0.000	***	9.0%	0.000	***
[-1;0]	1.7%	0.035	*	1.4%	0.063		0.8%	0.317		2.2%	0.193		2.8%	0.070		4.3%	0.004	**	3.7%	0.024	*	3.1%	0.046	*	5.3%	0.006	**	5.5%	0.003	***

Source: Own elaboration

With \*\*\* is denoted significant at 0.1%, with \*\* at 1% and with \* at 5%

#### 4.1 Results event 1—Brexit referendum (23 June 2016)

To analyse the impact of the Brexit referendum on the stock prices of insurance companies, the event window extends from 16 June to 30 June 2016. The estimation window starts one year before the event date. The daily and cumulative abnormal returns including their significance based on the corresponding  $p$ -values are shown in Table 4.

The study shows that significant daily and cumulative abnormal returns were achieved against both benchmarks in the event window of the Brexit referendum for all indices considered. In particular, there were significant negative daily abnormal returns on the two days after the Brexit referendum. The strongest negative abnormal returns are generated by Sub-Index 3 (UK based; less than 50% UK business), followed by Sub-Index 4 (UK based; more than 50% UK business). Using the market model with the EUROSTOXX 50 as the benchmark, Sub-Index 3 has a max negative abnormal return of  $-16.44\%$  and Sub-Index 4 has a max negative abnormal return of  $-9.71\%$ . Using the market model with the FTSE 100 as the benchmark, Sub-Index 3 achieves negative abnormal returns of  $-22.57\%$  and Sub-Index 4 of  $-15.71\%$  max.

The cumulative abnormal returns for the 15 periods considered provide numerous significant results. It is noticeable that the periods before the Brexit referendum tend to have positive abnormal returns, while the periods including data after the Brexit referendum show negative abnormal returns.

Overall, higher (positive and negative) abnormal returns are generated compared to the FTSE 100 than to the EUROSTOXX 50.

#### 4.2 Results event 2—election in the UK (12 December 2019)

For the analysis of the impact of the UK elections on the stock prices of insurance companies, the event window extends from 5 December to 19 December 2019. The estimation window starts one year before the event date. The daily and cumulative abnormal returns including their significance based on the corresponding  $p$ -values are shown in Table 5.

The study shows that only some significant daily and cumulative abnormal returns were achieved against both benchmarks in the event window of the election in the UK.

In particular, there were significant positive daily abnormal returns on day one after the UK election. The strongest positive abnormal returns are generated by Sub-Index 3 (UK based; less than 50% UK business), followed by Sub-Index 4 (UK based; more than 50% UK business). Using the market model with the EUROSTOXX 50 as the benchmark, Sub-Index 3 has a max positive abnormal return of  $4.86\%$  and Sub-Index 4 has a max positive abnormal return of  $5.41\%$ . Using the market model with the FTSE 100 as the benchmark, Sub-Index 3 achieves positive abnormal returns of  $6.12\%$  and Sub-Index 4 of  $6.06\%$  max.

For the cumulative abnormal returns, several time windows show significant abnormal returns. It is interesting to note that Sub-Index 1 (EU based; less than 20% UK business) has significant negative cumulative abnormal returns, especially in





**Table 5** (Continued)

Benchmark: EURO STOXX 50		Benchmark: FTSE 100																											
Window	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value															
[-5;5]	0.2%	0.719	-1.4%	0.001	**	0.0%	0.935	4.0%	0.022	*	1.3%	0.288	2.1%	0.026	*	0.3%	0.710	1.2%	0.180	6.7%	0.001	**	2.8%	0.039	*				
[-4;4]	1.2%	0.031	*	-0.2%	0.711	1.2%	0.055	4.5%	0.010	**	1.7%	0.166	2.7%	0.004	**	1.2%	0.141	2.1%	0.015	*	6.7%	0.001	**	2.8%	0.034	*			
[-3;3]	2.0%	0.001	***	0.3%	0.460	2.0%	0.001	**	4.6%	0.008	**	5.2%	0.000	***	2.5%	0.008	**	0.8%	0.303	2.2%	0.012	*	5.4%	0.008	**	5.6%	0.000	***	
[-2;2]	1.2%	0.031	*	-0.4%	0.362	0.3%	0.681	5.5%	0.002	**	2.1%	0.090	4.4%	0.012	*	2.5%	0.007	**	0.8%	0.324	1.1%	0.213	7.4%	0.000	***	3.1%	0.020	*	
[-1;1]	0.9%	0.116		-0.6%	0.162	-0.3%	0.653	4.4%	0.012	*	3.5%	0.005	**	2.6%	0.005	**	0.9%	0.234	0.9%	0.287	6.9%	0.001	***	4.8%	0.000	***			
[0;5]	0.9%	0.101		-0.4%	0.386	0.3%	0.682	4.3%	0.014	*	1.9%	0.118	5.6%	0.002	**	2.1%	0.026	*	0.7%	0.400	1.0%	0.269	6.0%	0.004	**	2.8%	0.034	*	
[0;4]	2.1%	0.000	***	1.0%	0.032	*	1.0%	0.114	5.1%	0.004	**	4.0%	0.001	**	2.4%	0.009	**	1.3%	0.111	1.0%	0.259	6.1%	0.003	**	2.7%	0.041	*		
[0;3]	2.4%	0.000	***	1.2%	0.008	**	1.7%	0.005	**	5.1%	0.004	**	4.0%	0.001	**	2.8%	0.003	**	1.6%	0.049	1.9%	0.035	*	5.7%	0.005	**	4.3%	0.001	**
[0;2]	2.6%	0.000	***	0.7%	0.123	0.8%	0.214	8.1%	0.000	***	4.2%	0.001	***	3.2%	0.000	***	1.3%	0.111	1.1%	0.218	9.0%	0.000	***	4.7%	0.000	***			
[0;1]	1.4%	0.013	*	-0.2%	0.673	-0.3%	0.573	5.5%	0.002	**	4.3%	0.001	***	2.8%	0.003	**	1.1%	0.188	0.6%	0.492	7.4%	0.000	***	5.3%	0.000	***			
[-5;0]	-0.6%	0.299		-0.9%	0.037	*	0.0%	0.946	0.3%	0.860	-1.8%	0.154	0.6%	0.500	0.2%	0.811	0.9%	0.303	0.9%	0.303	2.1%	0.303	-0.8%	0.529					
[-4;0]	-0.7%	0.205		-1.0%	0.024	*	0.6%	0.367	-0.4%	0.799	-1.8%	0.140	0.9%	0.335	0.5%	0.557	1.9%	0.035	1.9%	0.035	1.9%	0.350	-0.7%	0.618					
[-3;0]	-0.3%	0.621		-0.7%	0.092	0.6%	0.304	0.1%	0.945	0.1%	0.962	0.1%	0.962	0.3%	0.724	-0.2%	0.812	1.1%	0.230	1.1%	0.230	1.0%	0.617	0.5%	0.694				
[-2;0]	-1.3%	0.027	*	-1.0%	0.028	*	-0.2%	0.785	-1.9%	0.270	-3.2%	0.009	**	-0.1%	0.909	0.1%	0.919	0.7%	0.418	0.7%	0.418	-0.2%	0.907	-2.4%	0.075				
[-1;0]	-0.4%	0.491		-0.3%	0.469	0.4%	0.502	-0.5%	0.777	-1.9%	0.114	0.5%	0.617	0.5%	0.617	0.5%	0.560	1.0%	0.241	1.0%	0.241	0.8%	0.708	-1.3%	0.326				

Source: Own elaboration  
With \*\*\* is denoted significant at 0.1%, with \*\* at 1% and with \* at 5%

**Table 6** Daily and cumulative abnormal returns—withdrawal of the UK from the EU

		Benchmark: FTSE 100																		
		Benchmark: EURO STOXX 50						Benchmark: FTSE 100												
<i>t</i>	Insurance Index	Sub-Index 1		Sub-Index 2		Sub-Index 3		Sub-Index 4		Insurance Index		Sub-Index 1		Sub-Index 2		Sub-Index 3		Sub-Index 4		
		AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>	<i>p</i> -value	AR <sub><i>t</i></sub>
+5	0.8%	0.211	0.3%	0.534	0.6%	0.306	2.6%	0.132	-0.6%	0.635	0.5%	0.584	0.1%	0.921	0.4%	0.646	2.2%	0.265	-0.8%	0.568
+4	0.4%	0.454	0.7%	0.133	0.1%	0.884	-0.2%	0.929	0.8%	0.506	1.0%	0.285	1.2%	0.121	0.5%	0.530	0.6%	0.782	1.2%	0.370
+3	0.2%	0.783	0.6%	0.203	0.6%	0.313	-0.7%	0.693	-1.3%	0.283	1.0%	0.268	1.4%	0.067	1.3%	0.123	0.4%	0.846	-0.7%	0.577
+2	-0.5%	0.414	-0.4%	0.351	-0.9%	0.155	-0.3%	0.866	-0.5%	0.714	1.1%	0.232	1.0%	0.201	0.5%	0.552	1.9%	0.329	0.6%	0.638
+1	-0.4%	0.509	0.0%	0.953	0.9%	0.134	-2.2%	0.197	-0.7%	0.585	0.2%	0.841	0.4%	0.576	1.4%	0.088	-1.3%	0.526	-0.3%	0.817
0	0.2%	0.722	0.1%	0.852	0.0%	0.955	0.3%	0.860	1.0%	0.428	-0.9%	0.325	-1.0%	0.214	-0.9%	0.288	-1.2%	0.559	0.2%	0.873
-1	0.3%	0.568	0.0%	0.926	-0.3%	0.643	1.7%	0.321	0.5%	0.676	-0.8%	0.376	-1.1%	0.167	-1.3%	0.131	0.1%	0.978	-0.3%	0.845
-2	-0.1%	0.865	0.1%	0.905	-0.1%	0.871	-0.8%	0.662	0.4%	0.723	0.1%	0.875	0.3%	0.685	0.1%	0.911	-0.5%	0.805	0.6%	0.640
-3	0.3%	0.664	0.4%	0.364	0.6%	0.357	0.5%	0.769	-1.8%	0.142	1.4%	0.111	1.4%	0.073	1.7%	0.052	2.5%	0.216	-1.1%	0.424
-4	0.0%	0.965	0.1%	0.788	-0.2%	0.768	-1.1%	0.515	1.7%	0.159	-2.6%	0.005	**	-2.2%	0.006	**	-2.5%	0.004	**	0.988
-5	0.1%	0.878	-0.2%	0.708	0.0%	0.939	1.4%	0.425	-1.2%	0.339	1.1%	0.217	0.7%	0.361	1.0%	0.253	3.0%	0.136	-0.5%	0.704
	Insurance Index	Sub-Index 1		Sub-Index 2		Sub-Index 3		Sub-Index 4		Insurance Index		Sub-Index 1		Sub-Index 2		Sub-Index 3		Sub-Index 4		

**Table 6** (Continued)

Window	Benchmark: EURO STOXX 50										Benchmark: FTSE 100									
	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value
[-5;5]	1.3%	0.037 *	1.6%	0.001 ***	1.4%	0.018 *	1.3%	0.459	-1.6%	0.211	2.2%	0.018 *	2.4%	0.002 **	2.3%	0.008 **	2.7%	0.173	-1.0%	0.467
[-4;4]	0.4%	0.488	1.5%	0.002 **	0.8%	0.198	-2.7%	0.117	0.2%	0.857	0.5%	0.552	1.6%	0.041 *	0.9%	0.287	-2.5%	0.214	0.3%	0.823
[-3;3]	0.0%	0.991	0.7%	0.161	0.9%	0.151	-1.4%	0.407	-2.3%	0.059	2.2%	0.018 *	2.6%	0.001 **	2.8%	0.001 ***	1.9%	0.330	-0.9%	0.492
[-2;2]	-0.4%	0.471	-0.4%	0.436	-0.3%	0.623	-1.3%	0.466	0.8%	0.514	-0.3%	0.752	-0.3%	0.703	-0.1%	0.871	-0.9%	0.645	0.9%	0.503
[-1;1]	0.2%	0.790	0.0%	0.972	0.7%	0.273	-0.2%	0.902	0.8%	0.506	-1.5%	0.096	-1.6%	0.039 *	-0.7%	0.385	-2.4%	0.234	-0.4%	0.790
[0;5]	0.7%	0.249	1.2%	0.010 **	1.4%	0.021 *	-0.4%	0.797	-1.2%	0.316	2.9%	0.002 **	3.2%	0.000 ***	3.3%	0.000 ***	2.7%	0.179	0.2%	0.869
[0;4]	-0.1%	0.922	0.9%	0.049 *	0.8%	0.198	-3.1%	0.078	-0.7%	0.597	2.4%	0.010 *	3.1%	0.000 ***	2.9%	0.001 ***	0.5%	0.818	1.0%	0.462
[0;3]	-0.5%	0.398	0.2%	0.640	0.7%	0.253	-2.9%	0.094	-1.5%	0.233	1.4%	0.129	1.9%	0.016 *	2.4%	0.006 **	-0.1%	0.962	-0.2%	0.873
[0;2]	-0.7%	0.263	-0.4%	0.420	0.1%	0.893	-2.2%	0.200	-0.1%	0.905	0.4%	0.680	0.5%	0.551	1.1%	0.215	-0.5%	0.809	0.5%	0.690
[0;1]	-0.2%	0.760	0.1%	0.899	0.9%	0.120	-1.9%	0.265	0.3%	0.805	-0.7%	0.434	-0.5%	0.493	0.5%	0.519	-2.4%	0.224	-0.1%	0.943
[-5;0]	0.8%	0.194	0.5%	0.310	0.1%	0.894	2.0%	0.241	0.7%	0.586	-1.6%	0.082	-1.8%	0.024 *	-1.9%	0.024 *	-1.1%	0.572	-1.0%	0.464
[-4;0]	0.7%	0.252	0.7%	0.165	0.0%	0.955	0.6%	0.708	1.9%	0.134	-2.7%	0.003 **	-2.5%	0.002 **	-2.9%	0.001 ***	-4.1%	0.040 *	-0.5%	0.724
[-3;0]	0.7%	0.234	0.5%	0.262	0.2%	0.725	1.8%	0.306	0.1%	0.926	-0.1%	0.907	-0.3%	0.672	-0.4%	0.605	0.9%	0.662	-0.5%	0.713
[-2;0]	0.5%	0.449	0.1%	0.831	-0.3%	0.569	1.3%	0.464	1.9%	0.118	-1.6%	0.088	-1.7%	0.027 *	-2.1%	0.014 *	-1.6%	0.422	0.6%	0.666
[-1;0]	0.6%	0.354	0.0%	0.925	-0.2%	0.684	2.0%	0.243	1.5%	0.226	-1.7%	0.062	-2.1%	0.009 **	-2.2%	0.010 *	-1.1%	0.578	0.0%	0.972

Source: Own elaboration  
 With \*\*\* is denoted significant at 0.1%, with \*\* at 1% and with \* at 5%



**Table 7 (Continued)**

Window	Benchmark: FTSE 100																			
	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value	CAR <sub>it</sub>	p-value										
[-5;5]	-0.1%	0.935	-1.2%	0.295	-2.1%	0.133	2.6%	0.226	4.2%	0.018 *	0.7%	0.788	-0.5%	0.823	-1.1%	0.687	3.6%	0.301	4.5%	0.054
[-4;4]	-1.0%	0.372	-1.5%	0.205	-3.2%	0.024 *	1.2%	0.581	1.2%	0.486	0.2%	0.924	-0.3%	0.894	-2.0%	0.470	2.6%	0.441	2.3%	0.326
[-3;3]	-0.5%	0.619	-0.9%	0.467	-2.2%	0.118	1.2%	0.588	0.5%	0.761	-0.1%	0.958	-0.5%	0.846	-1.7%	0.543	1.7%	0.625	0.8%	0.746
[-2;2]	-0.4%	0.712	-1.0%	0.397	-0.9%	0.535	1.4%	0.518	0.2%	0.898	0.5%	0.846	-0.2%	0.942	0.2%	0.930	2.5%	0.470	0.6%	0.783
[-1;1]	1.7%	0.116	0.4%	0.721	-0.2%	0.910	6.4%	0.003 ***	3.0%	0.091	5.3%	0.031 *	3.8%	0.109	4.0%	0.160	10.8%	0.002 **	5.4%	0.021 *
[0;5]	0.7%	0.532	-0.7%	0.577	-1.0%	0.482	4.6%	0.034 *	3.2%	0.070	1.9%	0.448	0.4%	0.853	0.6%	0.844	6.1%	0.077	3.7%	0.110
[0;4]	0.7%	0.500	-0.2%	0.878	-0.9%	0.546	3.4%	0.117	3.3%	0.066	2.8%	0.249	1.8%	0.449	1.5%	0.600	6.0%	0.084	4.7%	0.043 *
[0;3]	1.3%	0.226	0.7%	0.569	-0.3%	0.845	3.9%	0.078	2.7%	0.125	3.3%	0.185	2.5%	0.300	2.1%	0.467	6.2%	0.072	3.9%	0.100
[0;2]	1.0%	0.373	0.5%	0.652	0.0%	1.000	2.7%	0.210	1.7%	0.343	3.0%	0.221	2.4%	0.309	2.5%	0.372	5.2%	0.130	2.8%	0.233
[0;1]	2.0%	0.067	1.0%	0.409	0.3%	0.834	6.1%	0.006 **	2.7%	0.129	4.2%	0.086	3.1%	0.200	2.8%	0.316	8.8%	0.011 *	4.2%	0.074
[-5;0]	0.4%	0.746	0.3%	0.778	-0.8%	0.574	0.5%	0.818	2.0%	0.261	1.1%	0.668	1.0%	0.678	0.0%	0.993	1.3%	0.695	2.5%	0.287
[-4;0]	-0.6%	0.590	-0.4%	0.731	-2.0%	0.157	0.3%	0.895	-1.0%	0.556	-0.3%	0.890	-0.2%	0.948	-1.9%	0.512	0.6%	0.867	-0.7%	0.754
[-3;0]	-0.7%	0.497	-0.6%	0.600	-1.6%	0.259	-0.2%	0.938	-1.2%	0.500	-1.1%	0.646	-1.0%	0.684	-2.1%	0.456	-0.6%	0.851	-1.4%	0.553
[-2;0]	-0.3%	0.818	-0.6%	0.599	-0.5%	0.703	1.2%	0.587	-0.5%	0.794	-0.3%	0.910	-0.6%	0.791	-0.6%	0.829	1.1%	0.739	-0.4%	0.854
[-1;0]	0.8%	0.442	0.4%	0.761	-0.1%	0.934	2.9%	0.188	1.3%	0.465	3.4%	0.171	2.7%	0.252	2.8%	0.321	5.9%	0.085	2.9%	0.209

Source: Own elaboration

With \*\*\* is denoted significant at 0.1%, with \*\* at 1% and with \* at 5%

the periods before the event, while Sub-Index 3 and Sub-Index 4 have significant positive cumulative abnormal returns in the periods including after event date data.

### 4.3 Results event 3—withdrawal of the UK from the EU (31 January 2020)

To analyse the impact of the withdrawal of the UK from the EU on the stock prices of insurance companies, the event window extends from 24 January to 07 February 2020. The estimation window starts one year before the event date. The daily and cumulative abnormal returns including their significance based on the corresponding *p*-values are shown in Table 6.

The results show that almost every index has one day of abnormal returns compared to the benchmark FTSE100. For the Insurance Index, Sub-Index 1 (EU based; less than 20% UK business), Sub-Index 2 (EU based; more than 20% UK business), and Sub-Index 3 (UK based; less than 50% UK business), there are significant negative daily abnormal returns four days before the event.

In terms of cumulative abnormal returns, significant abnormal returns are mainly realised against the benchmark FTSE 100.

In particular, Sub-Index 1 and Sub-Index 2 (both covering insurance companies based in the EU) show significant negative abnormal returns in the periods before the event, whereas the time windows also include data after the event date tend to show significant positive abnormal returns.

The indices covering insurance companies based in the UK, by contrast, show almost no significant results.

### 4.4 Results event 4—last minute Brexit deal (24 December 2020)

For the analysis of the impact of the Last-Minute Brexit Deal on the stock prices of insurance companies, the event window extends from 16 December 2020 to 05 January 2021. The estimation window starts one year before the event date. The daily and cumulative abnormal returns including their significance based on the corresponding *p*-values are shown in Table 7.

Overall, the study does not show significant results in daily abnormal returns: neither against the benchmark EUROSTOXX 50 nor the benchmark FTSE 100. The analysis of the cumulative abnormal returns shows isolated time windows with significant results. These are observed in the indices covering insurance companies based in the UK. In individual time windows, significant positive abnormal returns are realised by Sub-Index 3 and Sub-Index 4.

## 5 Conclusion

### 5.1 Research questions and hypotheses

The study aimed to analyse the impact of Brexit news on the stock prices of insurance companies using the event study methodology.

In addition to the Brexit referendum often examined in previous studies, this study also considers the election in the UK, the UK's withdrawal from the EU and the last-minute Brexit deal.

Overall, the results show that significant positive or negative abnormal returns were achieved in most of the events considered. The results are discussed below in relation to the defined research questions.

- *Q1*: Do Brexit news lead to daily or cumulative abnormal returns for European insurance companies represented by the Insurance Index?
  - $H_{0Q1}$ : Daily and cumulative abnormal return of the Insurance Index on a given day/in a defined window is equal to zero.
  - $H_{A_{Q1}}$ : Daily and cumulative abnormal return of the Insurance Index on a given day/in a defined window is not equal to zero.

For this research question, the significant abnormal returns of the Insurance Index are analysed. For each abnormal daily return in the event period and for each cumulative abnormal return, a significance test verifying  $H_{0Q1}$  was performed. Thus, for each event, 11 daily abnormal returns and 15 cumulative abnormal returns were tested for each benchmark which led to 22 daily abnormal returns and 30 cumulative abnormal returns in total. Table 8 shows the number of significant abnormal returns of the Insurance Index.

The most significant abnormal returns on the Insurance Index were achieved in connection with the Brexit referendum. Overall,  $H_{0Q1}$  was rejected for seven out of 22 daily abnormal returns. Of the seven significant abnormal returns, six are significant with a probability of error of less than 0.1%. Among the cumulative abnormal returns of the Insurance Index, all those generated in connection with the

**Table 8** Number of significant abnormal returns—Insurance Index

Event	Number of significant $AR_{it}$	Thereof significant at 5% (*)	Thereof significant at 1% (**)	Thereof significant at 0.1% (***)	Number of significant $CAR_{it}$	Thereof significant at 5% (*)	Thereof significant at 1% (**)	Thereof significant at 0.1% (***)
<i>Brexit Referendum</i>	<b>7</b>	1		6	<b>30</b>	1	2	27
<i>General UK Election</i>	<b>4</b>	4			<b>18</b>	6	7	5
<i>UK leaves EU</i>	<b>1</b>		1		<b>6</b>	4	2	
<i>Last Minute Brexit Deal</i>					<b>1</b>	1		

Source: Own elaboration

Brexit referendum were significant. The majority of these (27) had a probability of error of less than 0.1%.

There were also significant abnormal returns on the Insurance Index during the UK election. Four daily abnormal returns are significant with a probability of error of less than 5%. The cumulative returns led to the rejection of  $H_{0Q1}$  in 18 cases.

The withdrawal of the UK from the EU led to much less significant results. The last-minute Brexit deal led to only one significant cumulative abnormal return in the event window.

Related to the research question, in particular the Brexit referendum led to daily and cumulative abnormal returns for listed insurance companies. But also, the UK election led to a non-negligible number of daily and cumulative abnormal returns. The withdrawal of the UK from the EU and the last-minute Brexit deal only caused significant abnormal returns in a very small number of cases.

- *Q2*: Are the abnormal returns dependent on the domicile (EU or UK) of the insurance companies?
- *Q3*: Are the abnormal returns related to the proportion of insurance business written in the UK?
  - $H_{0Q2, Q3}$ : Daily and cumulative abnormal return of each Sub-Index on a given day/in a defined window is equal to zero.
  - $HA_{Q2, Q3}$ : Daily and cumulative abnormal return of each Sub-Index on a given day/in a defined window is not equal to zero.

To answer the research questions *Q2* and *Q3*, detailed analyses were carried out for the four sub-indices. For each abnormal daily return in the event period and for each cumulative abnormal return, a significance test verifying  $H_{0Q1, Q2}$  was performed. Thus, for each event 11 daily abnormal returns and 15 cumulative abnormal returns were tested for each benchmark which led to 22 daily abnormal returns and 30 cumulative abnormal returns for each Sub-Index in total. Table 9 summarizes the number of significant abnormal returns of the sub-indices.

When comparing the number of significant daily and cumulative abnormal returns of the four sub-indices, it is noticeable that the indices generate a different number of significant results.

For the Brexit referendum, in the daily abnormal returns,  $H_0$  can be rejected most often for Sub-Index 3, followed by Sub-Index 4. For the cumulative abnormal returns,  $H_0$  is also rejected the most (29 times) for Sub-Index 3 and Sub-Index 4. Most of the significant results are also significant with a probability of error of 0.1%.

Comparing the sub-indices that cover the same location, i.e., Sub-Index 1 and Sub-Index 2 for insurance companies domiciled in the EU and Sub-Index 3 and Sub-Index 4 for insurance companies based in the UK, it can be observed that in both cases the index showing less significant daily abnormal returns is the one covering insurance companies writing a large part of their insurance business in the UK.

The results related to the Brexit referendum thus indicate that insurance companies located in the UK tend to have more significant abnormal returns than insurance companies located in the EU. In addition, the indices that have companies with



**Table 9** Number of significant abnormal returns—Sub-Indices

Event	Number of significant AR <sub>it</sub>	Thereof significant at 5% (*)	Thereof significant at 1% (**)	Thereof significant at 0.1% (***)	Number of significant CAR <sub>it</sub>	Thereof significant at 5% (*)	Thereof significant at 1% (**)	Thereof significant at 0.1% (***)
<i>Sub-Index 1: Based in the EU and less than 20% insurance business written in the UK</i>								
Brexit Referendum	5	1		4	28	1	4	23
General UK Election	2	1	1		7	5	2	
UK leaves EU	1		1		15	6	6	3
Last Minute Brexit Deal					–			
<i>Sub-Index 2: Based in the EU and more than 20% insurance business written in the UK</i>								
Brexit Referendum	4	2	1	1	21	5	4	12
General UK Election					6	4	2	
UK leaves EU	1		1		11	5	2	4
Last Minute Brexit Deal					1	1		
<i>Sub-Index 3: Based in the UK and less than 50% insurance business written in the UK</i>								
Brexit Referendum	12	4	2	6	29	1	1	27
General UK Election	2		2		20	3	12	5
UK leaves EU	1	1			1	1		
Last Minute Brexit Deal					5	2	3	
<i>Sub-Index 4: Based in the UK and more than 50% insurance business written in the UK</i>								
Brexit Referendum	6	2		4	29	2	2	25
General UK Election	4	1	1	2	16	5	4	7
UK leaves EU					–			
Last Minute Brexit Deal					3			

Source: Own elaboration

a strong dependence on UK insurance business (Sub-Index 2 and Sub-Index 4) tend to have less significant results than the indices that cover companies that write little business in the UK (Sub-Index 1 and Sub-Index 3).

In the context of the UK election on 12 December 2019, Sub-Index 4 generates the most significant daily abnormal returns. Again, the indices covering insurance companies located in the UK seem to generate more significant results than those located in the EU.

In the event of the UK leaving the EU, more significant results can be observed for the indices covering insurance companies based in the EU.

The last-minute Brexit deal leads to only a very small number of significant results for all sub-indices. However, again more significant results are observed for the indices that include insurance companies based in the UK.

With regard to the research questions, most events led to daily or cumulative abnormal returns. Nevertheless, the results show that the sub-indices for each event have a different number of significant results. There are therefore trends suggesting that significant positive or negative abnormal returns may depend on the location and the share of insurance business written in the UK.

## 5.2 Interpretation of the results

Overall, the results of the event study show that positive or negative abnormal returns (daily and cumulative) were realised for both the Insurance Index and the four sub-indices. It can be observed that significant abnormal returns are mostly present after the event date. The number of abnormal returns and their significance differ clearly from event to event. Most abnormal returns for the Insurance Index as well as for the sub-indices are related to the Brexit referendum. Event 3 (Withdrawal of the UK from the EU) and Event 4 (Last Minute Brexit Deal) instead led to only individual significant abnormal returns.

Looking more closely at the results of the four sub-indices, there are trends for certain events which suggest that abnormal returns may depend on the location of insurance companies and the proportion of insurance business written in the UK.

In summary, three of the four events show that more significant abnormal returns were generated by insurance companies domiciled in the UK than by insurance companies based in the EU. In particular for Event 1 (Brexit referendum), Sub-Index 3 and Sub-Index 4 show strongly negative significant abnormal returns after the event date. This could indicate that there was more uncertainty about the development of companies based in the UK in connection with the Brexit referendum than for companies based in the EU.

Even though, based on this observation, it could be assumed that the companies with a material share of business written in the UK show more significant abnormal returns, in 3 out of 4 events, the indices that include a material share of insurance business written in the UK (Sub-Index 2 and Sub-Index 4) show less significant abnormal returns on an absolute basis than the indices that include insurance companies with immaterial shares of insurance business written in the UK (Sub-Index 1 and Sub-Index 3).

One explanation for this could be that investors assume that insurance companies with a significant share of UK insurance business deal with the resulting developments and necessary adjustments at an earlier stage and more extensively than insurance companies for which the insurance business is written in the UK only represents an immaterial proportion. This confidence advantage could thus lead to more rational investor behaviour and less abnormal returns. However, both index types (with a material and with an immaterial proportion of insurance business written in the UK) show the same tendencies of abnormal returns (positive or negative) in most cases. Only the number of significant results differs in terms of dependence on insurance business written in the UK.

Based on the results, the location of the company seems to have a more noticeable effect on the abnormal returns than the share of the insurance business written in the UK.

### 5.3 Limitations of the study and outlook

Although the study is based on well-founded and proven theoretical and methodological approaches, different assumptions and decisions may have an impact on the results, which need to be taken into account in further use and interpretation.

First it has to be mentioned that there is a limitation in connection with the formation of the sub-indices. The grouping is based on criteria and materiality thresholds set by the authors. In addition, indexation could potentially dilute the individual company results, so additional analysis on an individual company basis would be useful as a further research step to verify the results.

Second, decisions regarding the choice of benchmarks and parameters used for the event study can also have an impact on the results. The observation window started exactly one year before the event date, whereas the event window covers five days before and five days after the event. The other publications on Brexit event studies as listed under “State of Research” show that there is no clear specification for the length of the estimation and event window. Nevertheless, shorter or longer estimation and event windows could change the number of significant abnormal returns.

The selection of events analysed in the context of Brexit does not exclude the possibility that other events could have led to abnormal returns. Overlapping effects between the individual events cannot be ruled out either.

The authors are overall satisfied that the method used is appropriate for investigating the research questions and hypotheses defined and that it provides meaningful results.

Due to the further developed event study methodology based on indexation and sub-indexation, there is room for wider applications. The application is not limited to the insurance market, as the methodology can also be applied in this form to other industries. Furthermore, the methodology can also be applied to other events, especially those that cause a shift in cross-border political situations. Further research could be, for example, whether the stock prices of insurance companies with a material proportion of US insurance business reacted differently to events related to the 2020 US election than those that do not write insurance business in the United

States, or whether the stock prices of listed insurance companies reacted differently to certain events related to the European refugee crisis than in other industries.

**Funding** Open Access funding enabled and organized by Projekt DEAL.

**Conflict of interest** A. Müller and S. Reuse declare that they have no competing interests.

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