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Editorial: How to Apply the Event Study Methodology in STATA? An Overview and a Step-by-Step Guide for Authors

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Abstract

The event study methodology, which is gaining recognition in the business and marketing disciplines, is a technique used to capture the impact of significant events and announcements at the firm level and country level. Originating from the finance and economics disciplines, and being widely used in the finance literature, the method has recently attracted the attention of business and marketing researchers, particularly in the aftermath of Covid-19, which has adversely affected all kinds of businesses across the world. The event study methodology can be implemented to measure the impact of a major corporate announcement (e.g. new product development) or a significant event on corporate financial performance, profitability, and market valuation over a specific event window, such as a few days (a short window) or a few years (a long window). In this article, we provide a detailed explanation of the step-by-step procedure for implementing the event study methodology in STATA, using Covid-19-related death announcements from the United States, France, Spain, Italy, China, and the United Kingdom. We also provide STATA commands that can be used by researchers when implementing the event study methodology.

Keywords: Event study**,** Research methodology, Corporate announcement, Covid-19, STATA commands

1. Introduction

The classical event study methodology (hereafter 'ESM') is rooted in finance, and its basic premise is based on the fundamental view that capital markets reflect publicly available information on the firms' stock prices. Thus, the ESM measures the effects of particular corporate events on a firm's prospects and stock price movements by calculating the abnormal returns. However, the ESM is rarely used outside the accounting and finance disciplines. In view of this observation, the present article extends the previous methodological papers published in the *Industrial Marketing Management* journal (e.g. Ullah et al., 2018, 2020; Lim et al., 2019). The purposes of the present article are twofold: (a) to provide an overview of the ESM as applied within the business-to-business (B2B) marketing literature; and (b) to equip non-specialists with an understanding of the ESM and its application in marketing research by providing a step-by-step guidance on how to apply the method.

In the marketing discipline and at the micro level, ESM-related corporate events might include firm announcements about new product launches, mergers and acquisitions, new market entries, etc. or announcements made by other entities, such as governments, regulatory bodies, and competitors (Sorescu et al., 2017). A fine example of a macro-level event in recent times is the Covid-19 global pandemic, which has adversely affected many businesses around the world. Business researchers need to understand the short-term and long-term impact of major events, including macro-level events (e.g. Covid-19) and micro-level (firm-specific) events.

A close analysis of recent articles in the *Industrial Marketing Management* journal reveals that authors have predominantly used survey-based econometrics, time series, cross-sectional and panel data, qualitative interviews, case study methodologies, and standard regression estimations to evaluate the relationships between variables of interest. However, the field of business marketing could significantly benefit from the application of the ESM. This approach enables researchers to more accurately capture the financial impacts of firm-specific marketing initiatives than conventional customer-oriented measures, such as satisfaction. In addition, event studies are based on 'objective' forward-looking financial market data that is free from the influence of managers, as opposed to 'subjective' performance measures, which are prone to biases that stem from management perceptions.

The ESM offers several advantages to researchers, including, firstly, the ability to examine the impact of specific events on corporate financial performance (Brown & Warner, 1980). In this regard, scholars can empirically isolate and measure the impact of various events, whether internal (e.g. new product announcements, major R&D investment announcements, appointments of senior executives, dividend announcements, corporate press releases, etc.) or external (e.g. entries of direct competitors, introductions of new laws, etc.), on the firm(s) under observation (Lubatkin & Shrieves, 1986; de Mortanges & Rad, 1998; Delattre, 2007; Sorescu et al., 2017). Secondly, by focusing on stock prices, the ESM provides both an objective measure of firm performance (Fama et al., 1969) and an unambiguous assessment of the impact of different corporate events on shareholder value (McWilliams & Siegel, 1997). Lastly, the ESM is a versatile analytical technique that permits authors to estimate the impact of corporate announcements and events over short (Cowan, 1992) or long event windows (Brown & Warner, 1985). The ESM thus makes it possible for researchers to understand the impact of specific corporate events on stock prices, market valuation, and profitability over time periods ranging from just a few days to several years.

In the B2B marketing research published in the *Industrial Marketing Management* journal, only a handful of studies have applied the ESM. These studies have used the ESM to assess the impact of various firm-level announcements, such as: (a) assessing the impact of announcements of additional internet-based channels of distribution (i.e. eChannels) on the economic value added (EVA) and market value added (MVA) (Cheng et al., 2007); (b) assessing the impact of merger announcements on marketing performance (Rahman &

Lambkin, 2015); (c) evaluating the impact of media announcements relating to firms' outsourcing on abnormal stock returns (Lee & Kim, 2010); (d) assessing market reactions to brand alliance announcements (Cao & Yan, 2017); (e) examining the impact of marketing alliance announcements on the focal firm's abnormal stock returns (Oh et al., 2018); (f) evaluating the impact of CEO endorsements (measured by the presence of a CEO quotation in a press release) of sales and marketing leaders on firm performance (Vaid & Ahearne, 2018); and (g) measuring the impact of announcements of new executives taking up marketing and sales positions (Vaid et al., 2020). The growing number of B2B studies that used ESM in recent years signals the relevance of this methodology for business marketing research. Nevertheless, very few scholars have attempted to introduce the ESM to the marketing and business research communities. Sorescu et al. (2017) carried out a comprehensive literature review on the ESM, and they offer a good conceptual understanding of how the ESM can be implemented in marketing research. We extend the work of Sorescu et al. (2017) by introducing specific STATA commands that can be used when applying the ESM in different research settings.

We identify the steps that can be used by researchers to implement the ESM, and we demonstrate STATA commands that can be used by researchers to compute the abnormal returns before and after the event date. We also discuss various aspects of STATA codes that can be used to determine the event window. The commands reported in this paper can be applied to assess the impact of different firm-level and other macro-level events on corporate performance.

Accordingly, we focus on the Covid-19 outbreak as a major macro-economic event and demonstrate how to statistically capture the impact of such an event on major markets around the world. The Covid-19 outbreak serves as a useful reference point in this ESM paper, as it is a significant event that has had a considerable impact on the performance of businesses around the globe. Covid-19 has resulted in high volatility in the financial and commodity markets on a scale that has not been witnessed in recent history (Wigglesworth, 2020). The strict population lockdowns introduced by many governments around the world have also had unimaginable consequences for the consumer markets. Many businesses, ranging from small retail enterprises to large high-street stores, have experienced sudden losses of market shares (Romei, 2020). Millions of people have been put out of work whilst many businesses have undergone temporary or permanent closure, severely threatening the survival of many economies (Carlsson-Szlezak et al., 2020; Gopinath, 2020). These consequences of the Covid-19 crisis make the ESM even more relevant in current marketing research.

Previously, the ESM has been more widely used in accounting and finance research to examine the impact of various events on corporate stock prices (e.g. Binder, 1998; Boyd et al., 2010; Corrado, 2011; Ball & Brown, 2013). Although the use of the ESM in marketing research has increased over the years (Beckers et al., 2017), it is still conspicuously low when compared with the fields of accounting, finance, and management (Sorescu et al., 2017; Das et al., 2020). In this regard, the objective of the present paper is to encourage marketing researchers to consider applying the ESM to analyse how various firm performance measures (e.g. revenue, profitability, and customer perceptions) are impacted by firm-level events such as news of R&D investment, new product releases, or even company branding. We attempt to do this by providing readers with a step-by-step account of the procedure to follow when conducting ESM research. For demonstration purposes, we utilise a sample of 18 major global companies. These companies are drawn from six countries that comprise some of the largest economies in the world: China, Italy, Spain, France, the United Kingdom (UK), and the United States (US). Finally, we believe that this article will serve as a handy manual for researchers wishing to take advantage of the benefits that the ESM has to offer. The contributions of this article are interdisciplinary in nature. Thus, postgraduate students and early career researchers from a range of social sciences backgrounds, as well as other non-specialists, could find it useful.

Journal reviewers assessing papers on studies that have employed the ESM and contributors to the *Industrial Marketing Management* journal could also find it beneficial.

Although the ESM is suitable in interdisciplinary research, there are some caveats, as with any other econometric approach. Firstly, the assumptions behind the ESM may not fit all situations. For example, we live in an imperfect world where stock prices may not always fully and precisely reflect all of the available information pertaining to a company, whilst the ESM assumes that markets are always efficient. Secondly, estimating an ideal event window can be daunting initially, although it becomes easier once an individual has become more acquainted with the ESM. Thirdly, researchers must consciously choose the most appropriate model (i.e. perform model selection) to estimate the expected returns, as the choice of model has the potential to affect the results, in terms of the size and significance of the abnormal returns.

The rest of the paper is organised as follows: Section 2 performs a review of the existing ESM literature, Section 3 presents the step-by-step procedure for implementing the ESM in STATA, and, finally, we provide a succinct overview of the ESM in the conclusion.

2. The ESM

2.1 Origins, History, and Development Over the Years

The origin of the ESM can be traced to the work of James Dolley in the early 1930s, which sought to understand how securities prices behaved following corporate announcements relating to stock splits (i.e. when a company divides its existing shares into multiple shares) (see Dolley, 1933). The ESM was adopted by various scholars over the next few decades, when the technique underwent further refinement or (as in MacKinlay, 1997) sophistication. Some of the notable contributors to the development of the ESM include Myers & Bakay (1948), Barker (1956, 1957, 1958), Ashley (1962), Ball & Brown (1968) and Fama et al. (1969) (see also MacKinlay, 1997; Corrado, 2011). For instance, the work of Ray Ball and Philip Brown, which examined the impact of analysts' earnings forecasts on corporate income (see Ball &

Brown, 1968), is credited for suggesting the splitting of events into 'good news or bad news' as a way of controlling the challenge of high variance in ESM studies (Brown & Warner, 1985). Fama et al.'s (1969) influential ESM work examined the adjustment of stock prices to stock splits, where they observed the behaviour of security prices before and after releases of new information concerning stock splits. Following their work, Fama et al. (1969) came to be viewed in the literature as the originators of the concept of the event window in the ESM (see, for instance, Ball & Brown, 2013). The studies by Ball & Brown (1968) and Fama et al. (1969) are also observed in the literature as having the most significant influence on the contemporary ESM (see Brown & Warner, 1980; MacKinlay, 1997; Corrado, 2011; Ball & Brown, 2013). Over the years, the ESM has been widely applied in the accounting, economics, and finance realms, owing mainly to the ease of accessing financial data from databases such as, most notably, the University of Chicago's Centre for Research in Security Prices (CRSP) (Binder, 1998; Corrado, 2011). Other notable contributors to the ESM include Brown & Warner (1980, 1985), who provide useful directions on how to conduct estimations using monthly and daily data, respectively, and McWilliams & Siegel (1997), who recommend a short event window of 1–2 days for unanticipated events.

Although we use Covid-19, an enduring and unprecedented event, as the catalyst occurrence in our analysis, the event window that we have selected for each country is based on the days when each of the studied countries reported the highest number of Covid-19-related deaths during the early stages of the first wave of the pandemic in 2020. This decision was informed by prior research that has used enduring events such as sponsorship deals (Tsiotsou & Lalountas, 2005) or product placement in films (Wiles & Danielova, 2009). In these studies, the authors judiciously used the date of announcement of the events as the basis for their chosen event windows.

2.2 Key features, procedure, and properties

Before outlining the step-by-step procedure, we provide a discussion of the underlying concepts and terminology used in the ESM.

2.2.1 Event definition: As pointed out in the preceding sections, the ESM focuses on examining the impact of corporate events (comprising new information and/or announcements) on a range of firm performance measures, such as stock prices and firm earnings (Ball & Brown, 1968; Fama et al., 1969; Brown & Warner, 1980, 1985; McWilliams & Siegel, 1997). Examples of such events, to mention a few, include announcements about stock splits (Fama et al., 1969), mergers and acquisitions (MacKinlay, 1997), and corporate bankruptcies (Jayanti & Jayanti, 2011). Other marketing-related events that have been studied in prior literature include news about launches / bad publicity / recalls / modifications of products (de Mortanges & Rad, 1998), sponsorship announcements (Tsiotsou & Lalountas, 2005), product placement in films (Wiles & Danielova, 2009), and "appointment of a new CMO [...] or an announcement made by a competitor or a regulatory body that can impact the focal firm's value (e.g., an FDA drug approval)" (Sorescu et al., 2017, p. 186). Some useful sources of information about events include "daily financial press, legal publications, professional databases, company press releases/conferences, publications by stock exchange authorities, and news agency stories" (Delattre, 2007, p. 59).

2.2.2 Event date identification: Following the identification of an appropriate event, the next step involves selecting the date when the event occurred. The event date is an important feature of the ESM, as it forms the basis for evaluating the impact of the observed event on firm value/returns (Brown & Warner, 1985; MacKinlay, 1997). The event date allows researchers to compare firm returns before an event with returns subsequent to the news reaching the market, in order to measure the abnormal returns earned due to the analysed event (Armitage, 1995; Binder, 1998). Abnormal returns refer to the actual ex-post return of a security (stock) over the event window minus the normal return of the firm over the event window (MacKinlay, 1997). Thus, it is extremely important to ensure that the precise date of the analysed event is identified to avoid the flawed estimation of the associated abnormal returns. It is also not unusual for some events to ostensibly exhibit multiple dates, such as where "an executive conveys relevant information in an interview reported in the business press or at a trade show" compared to when the firm formally "issues a press release through services such as Dow Jones Newswires" (Sorescu et al., 2017). The presence of such leakages, as McWilliams & Siegel (1997, p. 634) observe, makes it "difficult to determine when traders became aware of the new information." To overcome this problem, it is often advised that users of the ESM should use the first date when information about the analysed event reached the market (Fama et al., 1969; McWilliams & Siegel, 1997; Sorescu et al., 2017).

2.2.3 Data/sample selection: When selecting the data and sample for ESM analysis, it is important to ensure that the data covers the entire event timeline (i.e. the estimation window, event window, and post-event window). The figure below provides an illustration of an event timeline.

***Figure 1*:** Illustration of an event timeline (adapted from De Jong, 2007)

Researchers can select the sample based on a range of criteria, such as data availability (Brown & Warner, 1980) and membership of a specific industry (MacKinlay, 1997). Lubatkin & Shrieves (1986) call for judicious selection of the sample to ensure no other events fell within the event timeline under consideration whilst cautioning that this could decrease the sample size. When a researcher is confronted by the challenge of inadequate sample size subsequent to cleaning the data, they can avoid this problem by using daily returns (Brown & Warner,

1985) or weekly returns (MacKinlay, 1997), instead of monthly returns (see also Brown & Warner, 1980; Lubatkin & Shrieves, 1986).

2.2.4 Event window: Depending on the sample size and the length of the event timeline, the event window may comprise a few days, weeks or months before and after the event date. The event window is an important feature of the ESM, as it permits researchers to measure the impact of the analysed event on firm returns. Whilst there exists no fixed number of days/weeks/months that should form the length of an event window, it should be kept relatively short to avoid the impact of unrelated events on the post-event returns (Armitage, 1995; McWilliams & Siegel, 1997; Delattre, 2007). Accordingly, it is important for researchers to use good judgement in selecting a suitable event window.

2.2.5 Measuring abnormal returns: Abnormal returns represent the earnings that investors make over and above their otherwise normal returns in the absence of the analysed event (Lubatkin & Shrieves, 1986; Boehmer et al., 1991). The analysis of abnormal returns (or 'unexpected returns', as per Lubatkin & Shrieves, 1986) may be performed based on the daily earnings or aggregated earnings realised during the selected event window (McWilliams & Siegel, 1997). The aggregated earnings approach is particularly useful where researchers wish to estimate the abnormal returns for multiple securities (stocks) over time or where a multiple-period event window is analysed (MacKinlay, 1997). It is not the intention of the present article to go into details about the modelling of abnormal returns, as this has been adequately covered in various studies (see, for instance, Armitage, 1995; MacKinlay, 1997; McWilliams & Siegel, 1997; Binder, 1998). The following section discusses the application of the ESM in prior marketing literature.

2.3 Use of the ESM in Prior Marketing Literature

Despite the huge potential of the ESM in analysing the impact of corporate events and news releases on firm performance, this technique is still considerably underexploited by researchers outside the accounting and finance realms. Nonetheless, there have been a few encouraging efforts of marketing studies using the ESM in the past. A select number of these studies are reviewed below. The reviewed articles are restricted to those focusing on B2B marketing research that have been published in high-quality journals listed in the *Australian Business Deans Council* (ABDC) and *Academic Journal Guide* (AJG) journal quality lists.

Bobinski & Ramirez (1994), using data obtained from the *Wall Street Journal* (WSJ), applied the ESM to examine stock market reactions to corporate advertising aimed at financial institutions. The authors established that financial-relations-inspired advertising led to heightened share turnover on the day preceding and during the introduction of advertisements, although no rise in stock prices was documented. Also employing WSJ data and the ESM, Hozier & Schatzberg (2000) report that termination of contract with advertising agencies resulted in decreased corporate accounting performance and share prices in the two days leading to the event. In a study looking at the value of sponsorship of motoring events to investors, Cornwell et al. (2001) examined data drawn from the CRSP, newspapers, and archival records. They found that share prices increased during the post-sponsorship announcement period, with no significant rises in prices before the event announcement. This contradicts the findings of Cornwell et al. (2005) who, using data obtained from the CRSP, LexisNexis, and Factiva databases, report evidence of stock price increases around the announcement of sponsorship of major sports leagues in the US. Furthermore, some authors have documented a neutral impact of sports sponsorships on corporate value, for instance Clark et al. (2009), whose data was obtained from the CRSP, various US stock exchanges, and sports associations. The above studies show the variety of databases used and the issues examined in prior literature, as well as the mixed nature of the results reported.

Accordingly, Swaminathan & Moorman (2009) investigated the value emanating from alliance marketing and report that the practice had a positive impact on shareholder value around the period of the 230 announcements studied. They used both the market model and the (four-factor) Fama–French model to calculate the abnormal returns. Boyd et al. (2010), on the other hand, used the market model to measure the impact of CMO appointments on firm value and report that 46% of firms had positive responses as reflected in their share prices, whilst 54% of firms exhibited negative share price reactions. Similarly, Wiles et al. (2012) utilised the market model to analyse stock market reactions to brand acquisition and disposal, and their findings suggest a positive impact on shareholder value. They further explain that they were constrained from using the Fama–French model due to the lack of Fama–French three-factor or four-factor data for the non-US listed firms included in their sample. Researchers conducting studies in non-US contexts, such as in emerging markets, may also find the market model easily applicable for measuring abnormal returns in similar ESM studies. It is also important to bear in mind that studies seeking to measure abnormal stock returns can only do so using publicly listed firms (see Fang et al., 2015).

Besides, Kalaignanam & Bahadir (2013) examined stock market reactions to corporate brand name changes and business restructuring. Their results show that the two events had the greatest positive impact on firm value during the time period of two days before and two days after the announcements of the events (i.e. $t_1 = -2$ to $t_2 = +2$). In addition, Homburg et al. (2014) studied the value relevance of corporate distribution channel expansions, where they observed significant abnormal returns occurring one day before the event announcement, as well as on the day of the announcement (i.e. $t_1 = -1$ to $t_2 = 0$). Lastly, Fang et al. (2015) analysed the impact of announcements concerning product co-development in the biotech and pharmaceutical industries and report evidence of abnormal returns in the period between two days before and one day after event announcements (i.e. $t_1 = -2$ to $t_2 = +1$). These studies show that abnormal returns may occur at any point around the analysed event, and it is thus the duty of researchers to apply good judgement in identifying an appropriate event window. This can be done by first selecting various (longer) windows (e.g. -10/15/20/25 days to +10/15/20/25 days) and then testing the significance of the selected windows with the t-test and z-test statistics (Brown & Warner, 1985). Where researchers face challenges specifying their models, they can substitute the parametric tests (t- and z-statistics) with nonparametric rank procedures for assessing the statistical significance of the observed stock price reactions (see Corrado, 1989; Cowan, 1992).

From the above discussion, we can see how various scholars have used the ESM in B2B marketing research to understand the impact of various B2B marketing activities on stock prices. Whilst these studies provide interesting findings concerning the potential benefits that managers can bring to their firms in terms of increased shareholder value, very little is known about the potential impact of B2B marketing activities for firms that are not formally listed in organised stock markets. Accordingly, and as the majority of businesses in many countries are privately owned, researchers need to consider how the ESM could be applied in the context of unlisted firms. In the absence of listed share prices for privately owned companies, an alternative approach would be to compute the market value for shares of unlisted firms. Several methods have been proposed in the literature for determining the value of shares of privately held firms (see, for instance, Kantor & Pike, 1987a, 1987b). Besides, researchers may also combine the ESM with primary data collection methods such as surveys and interviews with managers in order to understand whether and/or how the timing of major corporate announcements is predetermined. This is especially important considering the scant literature on whether managers really consider factors relating to the prevailing market value of their firms' equity (i.e. market capitalisation) before disclosing news of major corporate events.

In the following section, we report the step-by-step procedure with generic STATA commands that can be used by researchers when implementing an event study approach. We also provide a succinct overview of the procedures and relevant STATA codes in the Appendix.

3. Step-by-Step Procedure for the ESM

3.1 Step 1: Identifying the Event

The first step is to determine the event to examine and to collect the required data about firms that have been affected by the event. The other requirements include the collection of data to capture the announcement date (day 0) of the main event (e.g. announcements of dividends, announcements of earnings, and product launch events) and the stock prices of all the affected companies before and after the event (e.g. from -90 days to +90 days).

In this study, we consider Covid-19 as the main global event and explore the economic impact of this event on the major capital markets around the world. We provide actual examples in each step and consider the highest number of deaths in a day related to Covid-19 as the core event (day 0) under examination. Table 1 illustrates the six countries sampled, which have been strongly affected by Covid-19, along with overall data from Europe and the rest of the world.

Table 1: List of countries and event dates considered in our event study analysis

Country Name	***Event Date***	***Highest Number of Deaths in a Day Related to Covid-19***
United States	16/04/2020	4,920
France	04/04/2020*	2,004
Spain	03/04/2020	950
Italy	28/03/2020*	971
China	17/04/2020	1,290
United Kingdom	22/04/2020	1,172
World	16/04/2020	10,520
Europe	04/04/2020	5,139

*These dates fell on weekends; therefore, we have used the next trading day to calculate the stock market returns. The event date is when the highest number of deaths in a day was reported. The table also provides the highest number of deaths reported on the event date.

Table 2 shows that the data was collected from two different sources. Information on event dates was collected from the Our World in Data website (https://ourworldindata.org), whilst stock data was derived from the Bloomberg database. We used two databases because Our World in Data reports relevant event dates (e.g. the highest number of deaths in a day). The website is managed by the University of Oxford, which reports on Covid-19 cases. The

Bloomberg database was used to collect stock return dates, stock returns, and stock indices from all the countries.

Table 2: List of variables (datasets used for the event study)

Event date	Date of event	https://ourworldindata.org/coronavirus
Stock data	Stock return date	Bloomberg
	Stock returns	Bloomberg
	Stock index return	Bloomberg

The two datasets were collected from different sources. The Covid-19 event dates (the day with the highest number of deaths) were collected from the website Our World in Data. The stock data, including stock return dates, stock returns, and stock indices from all the countries, were collected from the Bloomberg database

After the identification of an event date for each country (i.e. the highest number of deaths in a day related to Covid-19), we selected three companies from each country to demonstrate how to apply the ESM. Table 3 below presents the names of the companies selected from each country.

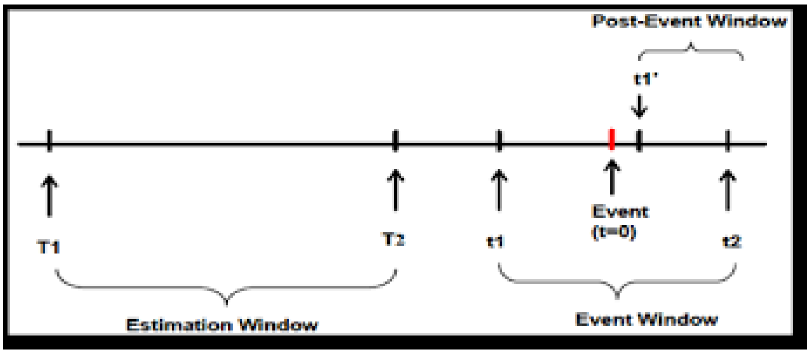
Table 3: Information about the sample countries and companies used in the event study analysis

List of Companies Selected for the Covid-19 Event Study	
United States	Amazon
	Facebook
	Apple
United Kingdom	
	BHP Group Plc
	Tesco Plc
	Unilever Plc
China	
	Bank of China Co. Limited
	Agricultural Bank of China
	Industrial and Commercial Bank of China
France	
	BNP Paribas
	L'Oréal
	Sanofi
Italy	
	Ferrari
	ENEL
	ENI
Spain	
	Banco Santander
	Iberdrola
	Industria de Diseno Textil

We selected the three companies from each country based on highest market capitalisation because these companies are highly valued listed companies in their respective stock markets. Further, the chosen countries' economies have been strongly affected by the pandemic, and the stock market data was conveniently accessible for these economies.

3.2 Step 2: Selection of Estimation, Event, and Post-Event Windows

Figure 1 illustrates the estimation window, which helps to examine the normal returns in an event study. The market model is useful in event study analysis, as it observes the abnormal returns on the event day, examines the stock returns, and compares them to the average returns (MacKinlay, 1997). The stock returns are regressed on the market returns to measure the association between the stock price and the stock index. The second step requires us to determine the period over which stock prices of the sample companies included in this event. This is called the 'event window' (shown in Figure 1).



Our event window is based on the unique event dates reported in Table 1.

3.3 Step 3: Estimation of Parameters

Our focus is now based on estimations of the main parameters that will provide us with the expected returns during the event period. For instance, estimations of expected returns through the market model require the alpha (y-intercept) and beta (slope) of the stock prices over the estimation window (e.g. for -120 to -31 days). Researchers can amend the number of days based on their requirements, and both short and long event windows are commonly used in the ESM literature (see, for example, MacKinlay, 1997). The estimation window is based on earlier days than the actual event window. It is useful to calculate the systematic risk of the stock market to help us with the regression analysis.

3.4 Step 4: Data Cleaning and Computing the Event and Estimation Windows

We expect that users will already have data with the event date, which in our analysis we called "date", and company identifier, which we called "company_id". Next, we must make sure that our estimation window is conducting analyses on accurate observations. Therefore, we form a variable, "dif", that will count the number of days from the event date (day 0).

We use the following generic STATA codes relating to the "dif" command to calculate the trading days or calendar days:

Table 4(a-i): Event study STATA code for the trading days

Code	**Explanation**
sort company_id date	This command is used to sort our data by "company_id" and "date"
by company_id: gen datenum=_n	This command creates a new column called "datenum" to number all dates (e.g. 01/01/2020 as 1, 02/01/2020 as 2, and so on). It is useful to further identify the event dates from the date column
by company_id: gen target=datenum if date==event_date *egen td=min(target), by(company_id)* *drop target*	This command generates the new column "target" to match with the event date. It identifies the target date of our event as 1 and the remaining dates as 0. The command targets the event date with "datenum" column
gen dif=datenum-td	Finally, the "dif" command calculates the number of days from the event date (i.e. the pre-event date difference in days from the actual event date and the post-event date difference in days from the actual event date)

Or

Table 4(a-ii): Event study STATA code for the calendar days

Code	**Explanation**
gen dif=date-event_date	We can apply the calendar days command only when we are using the calendar days in a month instead of trading days. This is an alternative "dif" command that is used to provide us with the number of days from the event date (i.e. the pre-event date difference in days from the actual event date and the post-event date difference in days from the actual event date)

In the next step, we identify the minimum number of observations required for the pre- and post-event dates, along with the minimum number of observations before the event window for measuring the estimation window. For example, we are using two days for the pre- and post-event dates (five days in the event window) and -30 to -60 days for the estimation window.

We apply the following STATA codes to identify the minimum number of observations required for the estimation window and the event window:

Table 4(b): Event study STATA codes for the pre- and post-event windows

Code	Explanation
by company_id: gen event_window=1 if dif>=-2 & dif<=2	This command is used to create the pre- and post-event windows. The pre-event window is -2 days and the post-event window is +2 days from the event date (0)
egen count_event_obs=count(event_window), by(company_id)	This command is used to count the total number of observations for the event window. Overall, five days are used here: -2 days (pre-event), 0 (the event day) and +2 days (post-event)
by company_id: gen estimation_window=1 if dif<-30 & dif>=-60	We also need an estimation window for the regression analysis. The estimation window is important to calculate the systematic risk of the market and help us to run the regression analysis. We develop an estimation window of -30 days (i.e. outside the pre-event window days)
egen count_est_obs=count(estimation_window), by(company_id) *replace event_window=0 if event_window==.* *replace estimation_window=0 if estimation_window==.*	This command is used to count the total number of observations for the estimation window

The method for measuring the event and estimation windows is identical. The following STATA code recognises which companies are lacking an adequate number of observations. Therefore, first, we develop a variable that equals 1 if the observation is within the specified days. Second, we construct another variable that counts the number of observations within each "company_id". Lastly, missing values get a value of '0' in our data analysis.

Table 4(c-i): Event study STATA code for determining companies with insufficient observations in the event window

Code	Explanation
tab company_id if count_event_obs<5	We use the tab command to check for any inadequate numbers of observations within the event window before performing the regression analysis. In our model, where the event window is five days, the tab command considers the number of observations to be inadequate if there are fewer than five. It is important to have a sufficient amount of data to run the regression analysis

Table 4(c-ii): Event study STATA code for determining companies with insufficient observations in the estimation window

Code	Explanation
tab company_id if count_est_obs<30	We use the tab command to check for any inadequate numbers of observations within the estimation window before performing the regression analysis. The criterion to determine inadequate numbers of observations is fewer than 30 (based on the estimation window of 30 days). It is important to have a sufficient amount of data to run the regression analysis

After using the "tab" command, we have identified a list of companies ("company_id") that do not have adequate numbers of observations within the event and estimation windows and thus lack the total number of observations required. Therefore, we will exclude these companies by using the following STATA command:

Table 4(d-i): Event study STATA code to drop any companies with insufficient observations in the event window

Code	Explanation
drop if count_event_obs < 5	This command will drop any companies with fewer than five observations within the event window

Table 4(d-ii): Event study STATA code to drop any companies with insufficient observations in the estimation window

Code	Explanation
drop if count_est_obs < 30	This command will drop any companies with fewer than 30 observations in the estimation window

3.5 Key Features of the ESM

The main goal of an event study is to examine stock price reactions to event announcements. In practice, the ESM has been applied for two main objectives. First, it has been used to measure the null hypothesis that the market efficiently integrates information (e.g. Fama et al., 1991). Second, based on the efficient market hypothesis, the ESM has been applied to measure the influence of events on firm value with respect to publicly available information. The ability to measure swift reactions in stock prices is possibly the most attractive feature of the ESM. Another advantage of the methodology is that it can be used to measure the expected value of a firm after public corporate announcements.

3.6 Regression Analysis

After cleaning the data, we carried out appropriate regression analysis. Initially, we analysed and estimated the normal performance. We computed the regressions for individual companies separately by utilising the data within the estimation window, and we measured the alpha (the intercept) and beta (the coefficient of the independent variable). Moreover, we also applied these regression equations to predict the normal performance during the event window. We used the following STATA commands for the regression analysis:

Table 4(e): Event study STATA code for the regression analysis

Code	**Explanation**
gen predicted_return=.	After cleaning our dataset, we are ready to run the regression analysis. Therefore, in the initial stage, we use this command to evaluate the predicted returns. The predicted returns (or expected returns) are useful for the calculation of the abnormal returns
egen id=group(company_id)	This command is useful if more than one event is considered for one company. In our dataset, we have considered only one event for one company. However, researchers can consider multiple events for one company and group the events by using this command
reg ret market_return if id==`i' & estimation_window==1* *predict p if id==`i' *replace predicted_return = p if id==`i' & event_window==1* *drop p}*	This regression command is applied to predict the normal performance during the event window. We also use this regression command to measure the alpha and beta. We regress the stock returns and market returns within the estimation window

3.7 Calculating Abnormal and Cumulative Abnormal Returns Around the Event Dates

In the next step, we measure the abnormal and cumulative abnormal stock returns. The daily abnormal return is calculated by subtracting the predicted normal return from the actual return for each day in the event window. Moreover, the cumulative abnormal returns are the sum of the abnormal returns from the event window.

To evaluate the event's impact, we need to examine the abnormal returns. Therefore, it is relevant to calculate the abnormal returns in an event study by calculating the difference between the actual returns and the predicted returns. Cumulative returns are basically the summation of abnormal returns in the event window, or an accumulation of abnormal returns that allows us to observe the impact of the event. We used the following STATA commands to calculate the abnormal and cumulative abnormal returns.

Table 4(f): Event study STATA code for calculating the abnormal returns and cumulative abnormal returns

Code	Explanation
sort id date *gen abnormal_return=ret-predicted_return if event_window==1* *by id: egen cumulative_abnormal_return = total(abnormal_return)*	This command is used to calculate the abnormal returns and cumulative abnormal returns. It is important to recognise any abnormal returns during the event day. Abnormal returns are calculated as the difference between the actual returns and the predicted returns. Cumulative returns are calculated by summing the abnormal returns during the event window

In the following step, we check the level of significance of the abnormal returns.

3.8 Level of Significance – Testing

We calculate the t-test statistic to confirm the following:

H0 = abnormal return for each stock = 0

TEST= ((ΣAR)/N) / (AR_SD/sqrt(N)) Equation 1

AR = abnormal return

AR_SD = abnormal return standard deviation

Our conclusion is based on the absolute value of the t-test statistic. For example, at the 5% significance level, if the absolute value of the t-test statistic is greater than 1.96, then we reject the null hypothesis.

Table 4(g): Event study STATA code for measuring the t-test results

Code	Explanation
sort id date by id: egen ar_sd = sd(abnormal_return) gen test =(1/sqrt(number of days in event window)) * (cumulative_abnormal_return /ar_sd) list company_id cumulative_abnormal_return test if dif==0	This command is used to examine the t-test results and identify the significance level. We use equation 1 to calculate the t-test statistic. We reject the null hypothesis if the results are significant

4. Findings and Discussion

We have implemented the ESM to analyse the impact of the Covid-19 pandemic by using the above-mentioned step-by-step STATA procedure. Our sample includes six countries: the US, the UK, China, France, Italy and Spain, with the three companies selected from each country shown in Table 3 (analysed in Panel A of Table 5). Moreover, we have analysed overall world data and European data using the ESM (Panel B of Table 5).

As shown in Table 5, our event date is ‘day 0’, which represents the highest number of deaths recorded in a specific day. Table 5 also shows the abnormal returns, cumulative abnormal returns, and t-test results. The results indicate that the cumulative abnormal returns were different from 0 and that the market behaved abnormally in response to the announcement of the highest number of deaths on the event date. The US and China had similar results, and the findings for all the companies in these countries were statistically significant on the event day (US – Amazon: 4.8739**, Facebook: 10.0143**, and Apple Inc.: 2.9856**, and China – Bank of China Co. Limited: 4.8605**, Agricultural Bank of China: 2.4050**, and Industrial and Commercial Bank of China: 2.0790**). The UK stock performance indicated statistically significant results for BHP Group Plc (2.5106**) and Tesco Plc (2.3053**) on day 0. France and Italy had significant results (see Sanofi: -6.5515** and ENI: 8.1881**, respectively). The significant values (**) indicate abnormal stock returns on day 0. Therefore, higher abnormal returns had a relationship with the announcement of the highest number of deaths on day 0. On the day of announcement, cumulative abnormal returns were equal to 0 in the Spanish stock market (Banco Santander: -1.208, Iberdrola: 1.047, and Industria de Diseno Textil (ITX): -0.070). These insignificant results indicate that corporate returns in the Spanish stock market were unaffected by the announcement of the highest number of deaths.

Panel B shows the combined results for Europe (-2.1665**) and the world (4.8739**). From this analysis, we can conclude that the cumulative abnormal returns were different from 0. In other words, the stock markets reacted abnormally to announcements of the highest number of deaths.

To summarise the results, the US, the UK, and China had significant results in terms of their stock returns on day 0. This indicates abnormal returns due to the highest number of deaths being observed on day 0.

Table 5: Event study analysis on the day with the highest number of deaths recorded (day 0)

Panel A – Event Study (Country-Level Analysis) – Day 0				
United States (US)	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Amazon	16/04/2020	0.0538	0.1360	4.8739**
Facebook	16/04/2020	0.0156	0.0990	10.0143**
Apple Inc.	16/04/2020	0.0190	0.0843	2.9856**
United Kingdom (UK)	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
BHP Group Plc	22/04/2020	0.0449	0.0875	2.5106**
Tesco Plc	22/04/2020	0.0341	0.0378	2.3053**
Unilever Plc	22/04/2020	0.0087	0.0523	1.8151
China	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Bank of China Co. Limited	17/04/2020	0.0049	0.0099	4.8605**
Agricultural Bank of China	17/04/2020	-0.0004	0.0026	2.4050**
Industrial and Commercial Bank of China	17/04/2020	0.0041	0.0078	2.0790**
France	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
BNP Paribas	06/04/2020	-0.0130	0.0188	1.1842
L'Oréal	06/04/2020	-0.0484	-0.0469	-1.8346
Sanofi	06/04/2020	-0.0113	-0.0783	-6.5515**
Italy	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Ferrari	30/03/2020	0.0098	0.0102	1.0600
ENEL	30/03/2020	0.0338	-0.0023	-0.0859
ENI	30/03/2020	0.0472	0.1432	8.1881**
Spain	***Event date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Banco Santander	03/04/2020	-0.015	-0.029	-1.208
Iberdrola	03/04/2020	0.024	0.016	1.047
Industria de Diseno Textil (ITX)	03/04/2020	0.005	-0.001	-0.070

Panel B – Event Study (World and European Analysis) – Day 0				
	Event Date	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
World	16/04/2020	0.0538	0.1360	4.8739**
Europe	06/04/2020	-0.0354	-0.0442	-2.1665**

Panel A considers six countries that have been significantly affected by Covid-19. Moreover, we selected three companies within each country based on highest market capitalisation in their respective stock markets. Panel B illustrates the dataset for the world and Europe. The event date represents the highest number of deaths on a particular day.

Table 6 shows the event study results for before the announcement day (day -1). Panel A shows the abnormal movements in the stock returns before the event day. The findings show significant results before the announcement day (US – Amazon: 6.7731**, Facebook: 7.5505**, and Apple Inc.: 3.1303**) and (France – BNP Paribas: -2.085**, L'Oréal: 6.8601**, and Sanofi: 3.7800**). This indicates that the cumulative abnormal returns were different from 0 and that stocks reacted abnormally before the announcement date. In China and Italy, the results are statistically significant (Agricultural Bank of China: 2.1440** and ENEL: -2.052**, respectively). The significant values (**) indicate abnormal stock returns prior to the date when the highest number of deaths owing to Covid-19 was reported, which implies that the stock markets had inside information on the trend of deaths before the event day (day 0). However, in some cases, the results are insignificant before the event date (UK – BHP Group Plc: 1.8072, Tesco Plc: 0.9992, and Unilever Plc: 1.5024 and Spain – Banco Santander: -1.8354, Iberdrola: 1.7559, and ITX: -0.9839). All the insignificant results imply that corporate returns were unaffected on day -1.

In Panel B, the findings for the aggregate 'world' show significant results (6.773**) on the pre-event date. However, there are insignificant results (-1.2821) for the European data.

The results for the pre-event day (-1) indicate that US and French companies observed abnormal returns before the event date, indicating that the markets started exhibiting abnormal reactions before the countries reached the highest number of deaths from Covid-19.

Table 6: Event study analysis on the day prior to the day with the highest number of deaths recorded (day -1)

Panel A – Event Study (Country-Level Analysis) – Day -1				
United States (US)	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Amazon	15/04/2020	0.0169	0.1960	6.7731**
Facebook	15/04/2020	0.0055	0.0797	7.5505**
Apple Inc.	15/04/2020	-0.0086	0.0824	3.1303**

United Kingdom (UK)	*Event Date*	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
BHP Group Plc	21/04/2020	-0.0460	0.0725	1.8072
Tesco Plc	21/04/2020	-0.0003	0.0182	0.9992
Unilever Plc	21/04/2020	-0.0175	0.0493	1.5024
China	*Event Date*	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
Bank of China Co. Limited	16/04/2020	0.0010	0.0066	1.7158
Agricultural Bank of China	16/04/2020	0.0015	0.0029	2.1440**
Industrial and Commercial Bank of China	16/04/2020	-0.0020	0.0062	1.6672
France	*Event Date*	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
BNP Paribas	03/04/2020	-0.0301	-0.0325	-2.085**
L'Oréal	03/04/2020	0.0050	0.0342	6.8601**
Sanofi	03/04/2020	0.0352	0.0577	3.7800**
Italy	*Event Date*	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
Ferrari	27/03/2020	0.0053	-0.0001	-0.0102
ENEL	27/03/2020	0.0062	-0.0232	-2.052**
ENI	27/03/2020	-0.0279	0.0008	0.0296
Spain	*Event Date*	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
Banco Santander	02/04/2020	0.0194	-0.0360	-1.8354
Iberdrola	02/04/2020	-0.0064	0.0212	1.7559
Industria de Diseno Textil (ITX)	02/04/2020	-0.0263	-0.0182	-0.9839

Panel B – Event Study (World and European Analysis) – Day -1

	Event Date	*Abnormal Return*	*Cumulative Abnormal Return*	*t-test*
World	15/04/2020	0.0169	0.1960	6.773**
Europe	03/04/2020	0.0081	-0.0160	-1.2821

Panel A considers six countries that have been significantly affected by Covid-19. Moreover, we selected three companies within each country based on highest market capitalisation in their respective stock markets. Panel B illustrates the dataset for the world and Europe. The event date represents the highest number of deaths on a particular day.

Table 7 shows the results relating to the impact of the event after the announcement day (day +1). In Panel A, we can see that France (BNP Paribas: 3.2365**, L'Oréal: -2.4330**, and Sanofi: -7.4528**) and Spain (Banco Santander: 2.5352**, Iberdrola: -6.6132**, and ITX: 4.0920**) had significant abnormal returns after the announcement day (day +1). This indicates that the cumulative abnormal returns were different from zero and that stocks reacted abnormally after the announcement date. The abnormal stock returns for Amazon (US) (2.4284**), Facebook (US) (6.1185**), Tesco Plc (UK) (2.2085**), Industrial and

Commercial Bank of China (China) (-2.3674**), and ENI (Italy) (13.0963**) were also statistically significant for day +1. All the significant (**) results indicate that stock prices continued to react abnormally on the day after (day +1) the highest number of deaths was announced (day 0).

Panel B shows that the stock returns for the world (2.4284**) and Europe (-2.1922**) were statistically significant on the post-event day (day +1). It shows that the cumulative abnormal returns were different from 0. Further, the US and Spain continued to experience abnormal returns on the post-event day (day +1).

Table 7: Event study analysis on the day after the day with the highest number of deaths recorded (day +1).

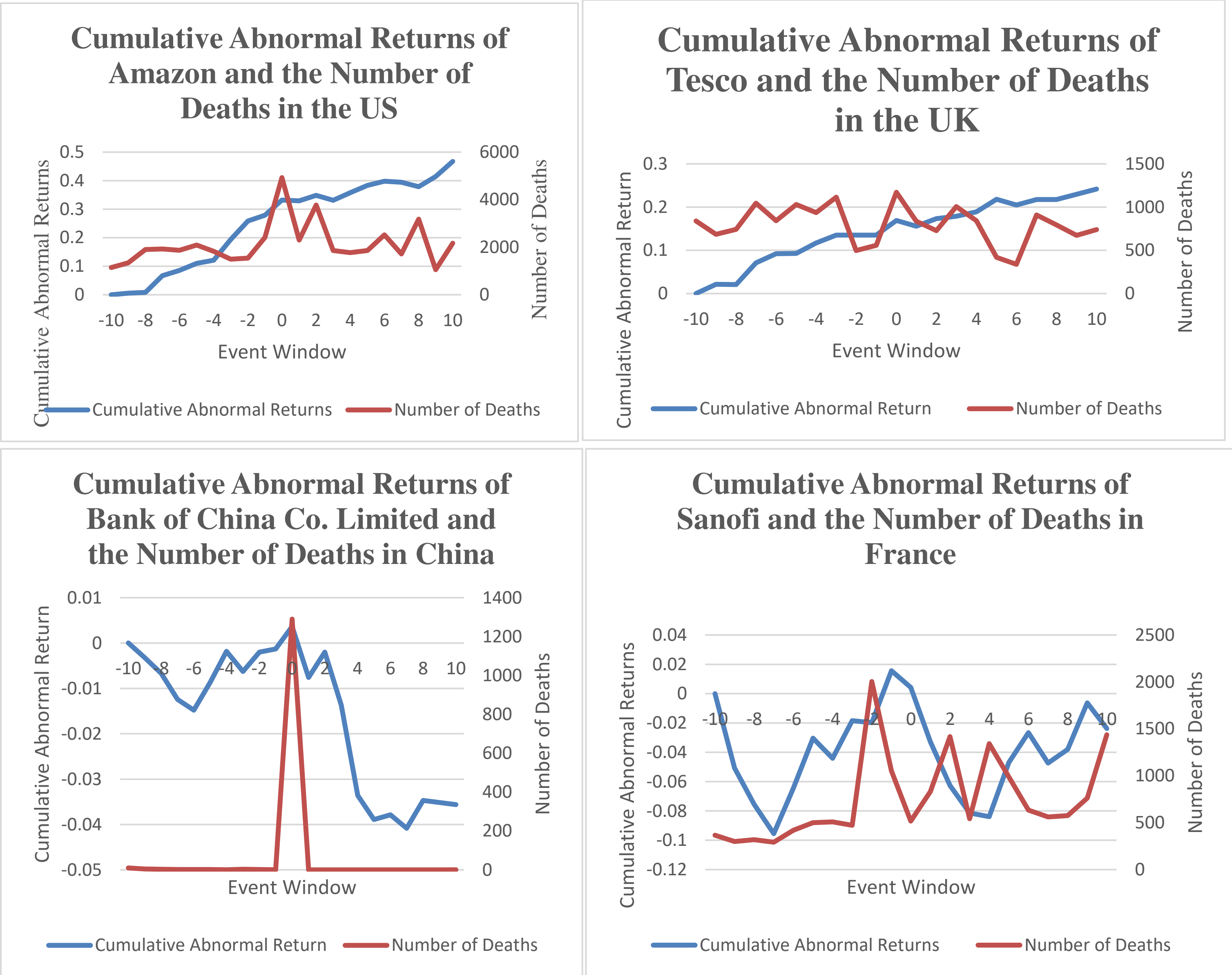
Panel A – Event Study (Country-Level Analysis) – Day +1				
United States (US)	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Amazon	17/04/2020	-0.0066	0.0627	2.4284**
Facebook	17/04/2020	0.0337	0.0619	6.1185**
Apple Inc.	17/04/2020	-0.0039	0.0120	1.1864
United Kingdom (UK)	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
BHP Group Plc	23/04/2020	0.0534	0.0646	1.6089
Tesco Plc	23/04/2020	-0.0128	0.0411	2.2085**
Unilever Plc	23/04/2020	-0.0050	-0.0066	-0.6427
China	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Bank of China Co. Limited	20/04/2020	-0.0109	-0.0158	-1.7381
Agricultural Bank of China	20/04/2020	-0.0078	-0.0060	-1.3265
Industrial and Commercial Bank of China	20/04/2020	-0.0067	-0.0079	-2.3674**
France	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
BNP Paribas	07/04/2020	0.0232	0.0641	3.2365**
L'Oréal	07/04/2020	-0.0026	-0.0510	-2.4330**
Sanofi	07/04/2020	-0.0337	-0.0831	-7.4528**
Italy	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Ferrari	31/03/2020	0.0094	-0.0128	-0.9044
ENEL	31/03/2020	-0.0171	-0.0022	-0.0991
ENI	31/03/2020	0.0673	0.1995	13.0963**
Spain	***Event Date***	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
Banco Santander	06/04/2020	0.0696	0.0863	2.5352**
Iberdrola	06/04/2020	-0.0492	-0.1034	-6.6132**
Industria de Diseno Textil (ITX)	06/04/2020	0.0265	0.0601	4.0920**

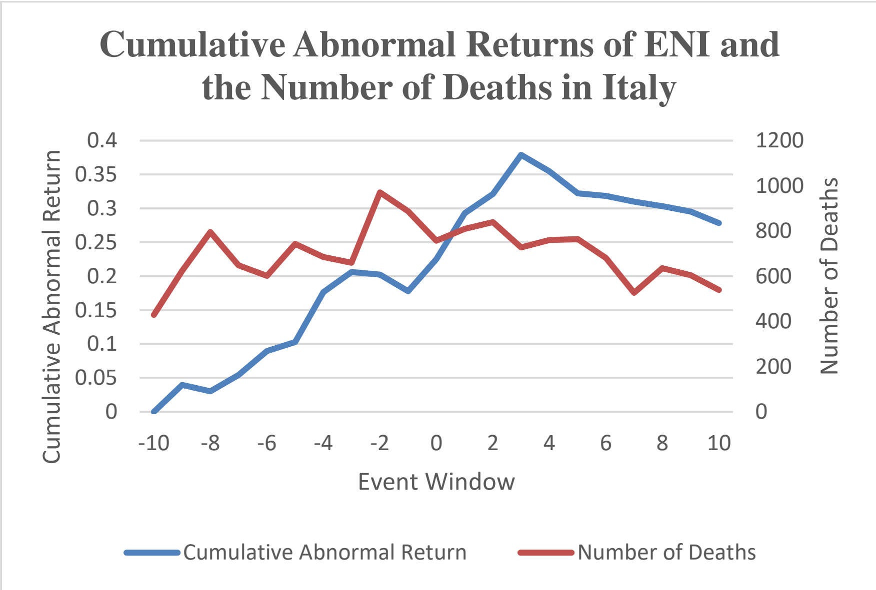
Panel B – Event Study (World and European Analysis) – Day +1				
	Event Date	***Abnormal Return***	***Cumulative Abnormal Return***	***t-test***
World	17/04/2020	-0.0066	0.0627	2.4284**
Europe	07/04/2020	0.0085	-0.0423	-2.1922**

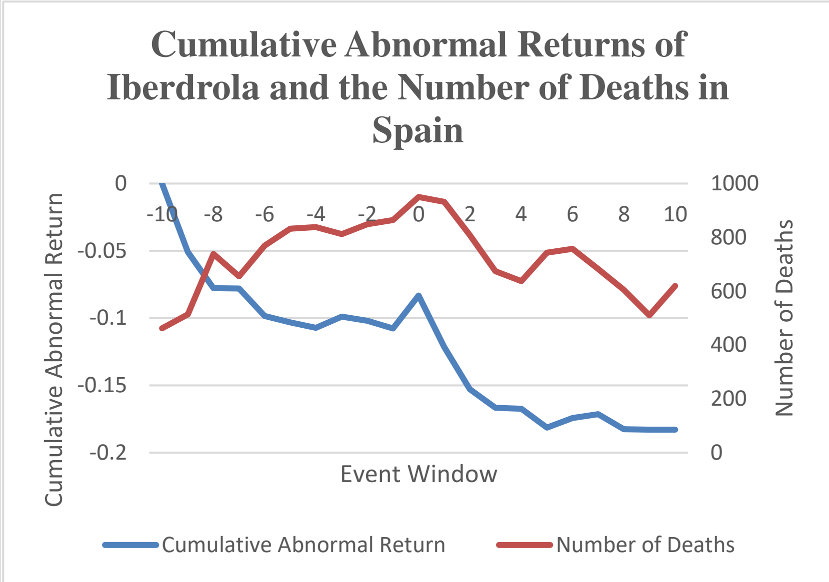
Panel A considers six countries that have been significantly affected by Covid-19. Moreover, we selected three companies within each country based on highest market capitalisation in their respective stock markets. Panel B illustrates the dataset for the world and Europe. The event date represents the highest number of deaths on a particular day.

The following figures present the number of deaths alongside the cumulative abnormal returns for an example company in each country. The diagrams demonstrate that, for the US, the UK, France, and Italy, the higher the number of deaths, the greater the cumulative abnormal returns. However, the opposite trend was observed for China and Spain.

Figure 2: Graphical illustrations of the number of deaths alongside the cumulative abnormal returns in the sample countries







Note: all the above figures report the number of deaths and abnormal returns for sample countries

5. Conclusion

The ESM is a commonly used methodological approach in the accounting and finance literature. Researchers in the multi-disciplinary fields of marketing and management have not adequately utilised this methodological approach to assess the impact of major marketing-related events on corporate stock returns.

This paper extends previous methodological papers published in the *Industrial Marketing Management* journal. We aimed to use Covid-19 as an example of a major event, and we investigated the impact of Covid-19 (highest death rate in a day) on stock returns in six major capital markets around the world. We have reported the step-by-step procedure that can be utilised by researchers to understand the pre-announcement and post-announcement impact of a major external shock. The ESM can also be used to model investment behaviour and sentiments surrounding an event date. Pre-announcement and post-announcement stock returns are calculated to make judgements about the economic significance of an event. We have also provided STATA commands that can be used by non-technical users to understand and apply the ESM in marketing research.

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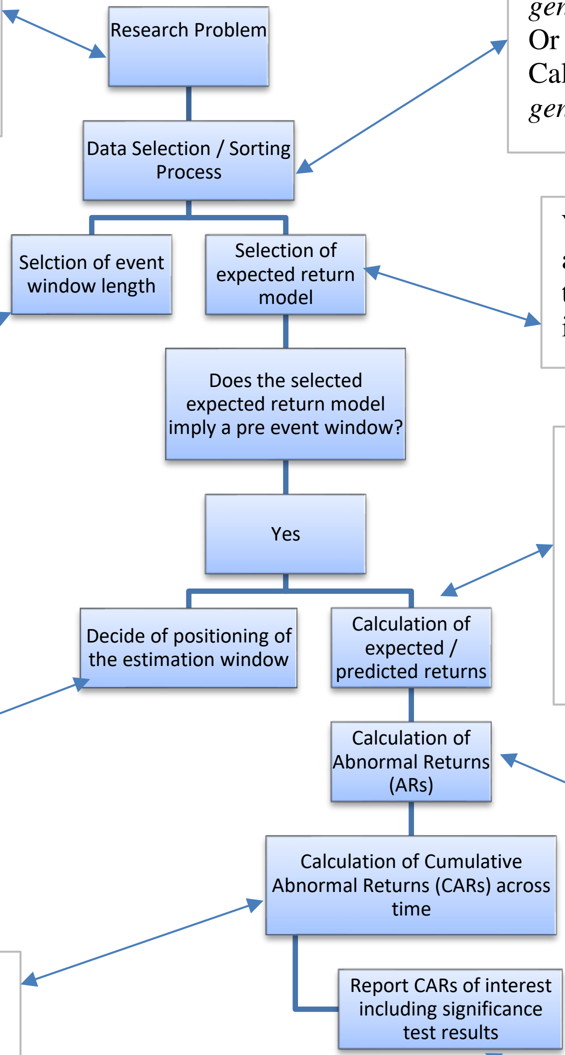
Appendix: Mapping of Event Study Methodology

In this study we considered COVID-19 as a main global event and explored the economic impact of this event on major capital markets around the world.

Trading Days STATA Commands:
sort company_id date
by company_id: gen datenum=_n
by company_id: gen target=datenum if date==event_date
egen td=min(target), by(company_id)drop target
gen dif=datenum-td
Or
Calender Days STATA Command:
gen dif=date-event_date



We considered 2 days pre- and post-event window along with event day 0.
STATA Commands are as follows:
by company_id: gen event_window=1 if dif>=-2 & dif<=2
egen count_event_obs=count(event_window), by(company_id)

We used "Market Model" because stock returns are regressed on the market returns to measure the association between the stock price and stock index.

We selected the Estimation Window and STATA commands are as follows:
by company_id: gen estimation_window=1 if dif<-30 & dif>=-60
egen count_est_obs=count(estimation_window), by(company_id)
replace event_window=0 if event_window==.
replace estimation_window=0 if estimation_window==.

We calculated the expected returns or predicted returns by using the following commands:
gen predicted_return=.
egen id=group(company_id)
reg ret market_return if id==`i' & estimation_window==1
predict p if id==`i'replace predicted_return = p if id==`i' & event_window==1 drop p}

We used the following STATA commands for calculation of abnormal returns:
sort id date
gen abnormal_return=ret-predicted_return if event_window==1

We used the following STATA commands for calculation of cumulative abnormal returns:
by id: egen cumulative_abnormal_return = total(abnormal_return)

We applied the t-test by considering the following STATA command:
sort id date
by id: egen ar_sd = sd(abnormal_return)
gen test =(1/sqrt(number of days in event window)) * (cumulative_abnormal_return /ar_sd)
list company_id cumulative_abnormal_return test if dif==0