The Impact of COVID-19 on the European Stock Market: A multiple-country Event-Study Approach

ERASMUS UNIVERSITY ROTTERDAM

Bachelor Economics and Business Economics

Major Financial Economics

May 3, 2020

Abstract

This research analyses the impact of COVID-19 on European national market index returns. An event-study is employed on four COVID-19 related events and 27 European countries. The hypothesis that COVID-19 has a negative relation to national market index returns is plausible for the first and third event. For the second and fourth event the results are more ambiguous. Overall COVID-19 seems to impact European national market index returns negatively.

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1 Introduction

The novel coronavirus surprised the whole world with a global economic paralysis as a consequence. The World Health Organization (WHO) declared the 'Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2 or COVID-19)' a pandemic on the 11th of March 2020. As of the 15th of April 2020 nearly 2 million infections are reported in 213 countries, and due to under-reporting in a more or less degree in every country affected, this figure is believed to be much higher (Rome, 2020). Baldwin & di Mauro (2020) argues that the flow of labour to businesses reduced directly and massively due to COVID-19 itself and the policies to contain the disease. These obligatory and voluntary social restrictions have led to significant economic decline (Baker et al., 2020). Moreover, the stock market reflects the uncertainties surrounding the novel coronavirus showing more volatility.

COVID-19 originated in Wuhan (China) and was first discovered in December 2019 when a mass pneumonia case occurred. The Chinese Medical Association (CMA) (2020) found that the virus is simultaneously similar and completely different to SARS-CoV and the Middle East Respiratory Syndrome (MERS-CoV). COVID-19 is also a coronavirus that causes respiratory infections and is transmitted through small droplets from nose or mouth, like the other two infectious diseases. However, it appears to be less deadly, but far more contagious via human-to-human transmission (WHO, 2020). The current approximate fatality rate is 3.4%, according to WHO Director-General Dr Tedros Adhanom Ghebreyesus. An important difference between the novel coronavirus and SARS is its direct impact on Europe. The 2003 SARS outbreak mainly took place in Asia where COVID-19 is also infecting people in Europe, with Italy as leading country in total deaths followed by Spain and France (Bloomberg, 2020).

Although the scale of a pandemic leaves much uncertainty on the economic impact of COVID-19, previous literature on similar infectious disease outbreaks provides some evidence. Chen et al. (2007) found negative abnormal returns in the Taiwanese hotel stock performance during the SARS outbreak in 2003 in Taiwan, as a result of a relatively strong decline in tourism and business related visits, and consumer consumption. Studying Korean stock market reactions to contagious animal disease outbreaks, Pendell & Cho (2013) found significantly negative returns for the industries affected by foot-and-mouth disease (FMD) outbreaks. According to Baker et al. (2020) no infectious disease outbreak had ever before influenced stock market returns as severely as COVID-19. Therefore, there yields academic and societal relevance in studying its economic impact. COVID-19 can be regarded as the rapid emergence of previously neglected risk, i.e. the effect of a pandemic on stock market returns (Ramelli & Wagner, 2020a).

Economic, societal and policy implications can be useful to assess future pandemics (or other infectious diseases) successfully. Moreover, the results of this paper may help investors manage their investment portfolio in similar situations. Al-Awadhi et al. (2020) found significantly negative returns on the Chinese stock market, as a result of COVID-19. These results may be different for European countries. Firstly, China already encountered the SARS outbreak and this yields the possibility of different stock market reactions (Ru et al., 2020). Secondly, cultural and societal differences can lead to different stock market development (de Jong & Semenov, 2002). Therefore, the stock market reactions in Europe is analysed, as a result of the novel coronavirus.

Research question: What is the effect of COVID-19 on European stock market performance?

In order to analyse the effect of COVID-19 on the stock market an event-study approach is used. MacKinlay (1997) provides a comprehensive framework for event-studies in economics and finance. Since multiple countries are studied, additional inferences and implications for a multiple-country event-study approach are considered in the setup of this paper. Campbell et al. (2010) conclude that national market indices are sufficient to construct powerful and well-specified tests of average stock-price effects. Daily stock price data from *Datastream* provides returns for national indexes. Only European countries with an active national market index are used (Table 10.1). This research analyses events – comparable between European countries – that might cause abnormal returns. For each European country in the dataset the ‘normal’ returns are estimated for the event window using the national market index of the country of interest, based on the historical average return on that index. Consequently, this historical average functions as the benchmark of a ‘normal’ market situation. Deviations from this average mirror a country’s relative economic wellbeing. The estimation period for establishing normal returns starts 250 trading days prior to the event date and ends 50 trading days before the event date [-250,-50]. Since COVID-19 is a global concern much information is released on the subject. Therefore, a conservative approach is taken, in regard of the estimation period. Leaving 50 days prior to the event date out of the estimation period prevents the data from being biased through possible information leakages or speculative trading. Multiple event windows are considered in analysing the total effect of an event on stock prices, a 1-day [0], 5-day [-2,2] and 11-day period [-5,5]. An individual country’s cumulative abnormal returns (CARs) are calculated as the difference between actual returns (conditional on the event taking place) of the national index and the historically expected returns, in that specific country.

Four events are studied: (1) the lockdown announcement in Wuhan (23 January 2020); (2) the first COVID-19 death in Europe (15 February 2020); (3) the patient zero per European country; (4) the announcement of an exit strategy per European country.

All four events are chosen upon the criteria that they are expected to contain information possibly leading to abnormal returns, and that they generally have the same impact across all countries studied. The first two events are general and the last two events are country-specific. The European stock market effect of COVID-19 are studied and differences across European countries in abnormal returns are investigated.

Significantly negative returns are found for European countries during event (1) and (3), in line with the negative returns found in studies on stock market impact of infectious diseases (Chen et al., 2007; Pendell & Cho, 2013). Moreover, Al Awadhi (2020) and Ramelli & Wagner (2020a) find these results for COVID-19 specifically. The abnormal returns during event (2) are not significant and those during event (4) are ambiguous. Between countries there are differences in magnitude and sign of the abnormal returns.

2 Literature review

In this section I will analyse existing literature on the effect of COVID-19, other infectious disease outbreaks, and news-driven trading on stock market returns in order to touch upon the theoretical implications of the highly uncertain situation that the novel coronavirus created. Moreover, in this review the gaps in the literature are defined in regard of the unprecedented effect of COVID-19 relative to other infectious diseases. Section 2.1 evaluates the existing literature on the stock market reaction to infectious disease outbreaks and other major events.

2.1 Stock market effects of infectious disease outbreaks and other major events

Given the fact that economic outcomes are highly uncertain, studying previous infectious disease outbreaks may provide useful theoretical support on stock market effects and implications of such diseases. Pendell & Cho (2013) research contagious animal disease outbreaks and find significantly negative abnormal returns for the affected industries by Foot-and-Mouth Disease outbreaks, using an event-study approach. Similar to Pendell & Cho (2013), Seo et al. (2012) find negative returns for food-related firms as a result of food safety events. Note that these studies contain implications on animal disease outbreaks and further research is needed to generalize these effects to human-to-human infectious disease outbreaks. Chen et al. (2007) find significantly negative abnormal returns in their event-study, for Taiwanese hotel stock returns during the SARS outbreak in 2003, which is humanly transmittable. Donadelli et al. (2017) elaborate on the underlying fundamentals of stock market behaviour during infectious disease outbreaks. They show that panic trading during infectious disease outbreaks (SARS, H1N1, Polio and Ebola) driven by news statements affects stock prices negatively.

Remuzzi & Remuzzi (2020) investigate the potential reproductive number and spread of COVID-19 in Italy and compare their results to China. They find a similar exponential growth in infected cases. Economically, it is uncertain whether the impact of COVID-19 will be similar across countries. As Ramelli & Wagner (2020a) point out, sector stock returns differ between the USA and China. Moreover, Ru et al. (2020) find evidence for different stock market reactions between countries that were affected by SARS and countries that were not. The latter show an underreaction at first, followed by significantly more negative returns than countries that encountered SARS. It is possible that countries with SARS experience are more informed about the economic consequences of infectious diseases leading to a more negative return at first hand. The whipsaw pattern that emerges in stock returns for countries without SARS experience might be the result of a rather late reaction to the crisis from such countries.

Europe had no SARS cases in 2003 (WHO, 2003). Therefore, a different stock market return pattern, however still negative, may be expected compared to China – where the SARS outbreak began in 2003. Europe did encounter the Great Influenza Pandemic of 1918-1920, which would be the upper bound in terms of deaths, according to Barro et al. (2020). Their results show substantial short-term declines in realized returns on stocks and short-term government bonds during the 1918-1920 pandemic.

Although many infectious disease outbreaks have existed, economic impact differs markedly across the variety of infectious diseases known to mankind. The fatality rate, reproduction rate and country of origin are, among others, factors that contribute to which extent the economy suffers from the outbreak. Most similar to COVID-19 is the 2003 SARS outbreak (CMA, 2020), but the reproductive number of COVID-19 is higher compared to SARS (Liu et al., 2020). I explore some major events that could provide assistance to understanding the impact of COVID-19.

Bourdeau-Brien & Kryzanowski (2017) study the impact of natural disasters on stock returns and volatilities for local US firms. Their research provides evidence for abnormal negative returns and abnormal volatilities related to major natural disasters. The effects are distributed over two-to-three months and are only felt by firms based in the disaster area. Wang & Kutan (2013) also find this area based effect for the US and Japan from the macro side, by showing that the composite stock market indices do not experience abnormal returns as a result of natural disasters. When relating these studies to COVID-19, a pandemic would imply that the area of the natural disaster is the entire world. Unfortunately, no previous literature provides evidence for the stock market effects of global natural disasters.

Current economic estimations about the impact of COVID-19 have led to comparisons to the Financial Crisis of 2008[1]. Though, the novel coronavirus is different from previous global financial crises. Pavlyshenko (2020) highlighted the amount of uncertainty surrounding the novel coronavirus. Using Bayesian regression and inference he finds that the impact of COVID-19 on US stock market returns, like other crises (the Financial Crises of 2008 and 2018), is negative. However, the volatility during the pandemic is markedly higher than with financial

[1] Lustig & Mariscal (2020) contribute an early attempt to draw comparisons between the economic effect of COVID-19 and that of the Financial Crisis of 2008. Although estimations and expectations for the COVID-19 impact have changed significantly since this essay, it still provides valuable insights to the recession like effects accompanied with both crises.

crises. This uncertainty is explained through news-induced trading during COVID-19 by Baker et al. (2020), consistent with the findings of Donadelli et al. (2017).

At first sight COVID-19 can be regarded of major impact on public, physical and psychological health. As side effects of SARS-CoV-2 – like lockdowns, curfews and other regulations to prevent the disease from spreading – affect daily trade and economy, the concerns about future economic hardship grow. What started as a health crisis can turn into a financial crisis, potentially making research to the economic effect of COVID-19 of first-order importance (Ramelli & Wagner, 2020a). Ramelli & Wagner show that corporate attention for COVID-19 increased rapidly after its first occurrence in a corporate international conference call, following the announcement of the WHO on the 22nd of January. Stock market returns are significantly negative in the USA and China. However, between these countries the sectors benefiting and losing from the infectious disease differ, implying that the stock market reaction across countries may be different. In line with Ramelli & Wagner (2020a), Alfaro et al. (2020) find that returns on firm level generally have a negative relationship with predicted increases in cumulative infections. Inferencing from US data, they conclude that all sectors in the US show negative average returns in response to the COVID-19 shock.

Firms with more COVID-19 exposure, i.e. firms producing products more conducive to virus transmission, exhibit more negative returns. The reason being that social distancing measures have a greater impact on those firms. Also, capital-intensive firms experience more negative returns opposed to labour-intensive firms. This can possibly be explained through investors perceiving that capital-intensive firms are less likely to reduce costs during the pandemic. Lastly, consistent with findings of Ramelli & Wagner (2020b) the amount of debt of a firm influences returns negatively (Alfaro et al., 2020). Controlling for firm-specific characteristics (market capitalization and market-to-book ratio) Al Awadhi et al. (2020) find significantly negative daily returns explained by total confirmed cases of COVID-19 and total deaths on the Chinese stock market, through a panel regression.

Although previous infectious diseases and pandemics can’t be compared one to one, there is vast support in the literature for negative stock market returns during these situations. Accompanied with results of contemporary research on the stock market effects of COVID-19 in countries outside of Europe, this leads to this thesis’s hypothesis:

H1: *COVID-19 negatively impacts national stock market index returns of European countries.*

In conclusion, the literature is cohesive in the sense that this pandemic is related to overall negative returns. The economic impact and stock market reaction of COVID-19 differ from financial crises, other infectious disease outbreaks, and other major events. Therefore, research on the subject and its implications is of paramount importance for future policy and understanding.

3 Data

In this section, the datasets used for analysis are described, as well as the multiple-country event-study methodology characteristics. Firstly, the stock market data and WHO event dates are assessed, along with descriptive statistics on the data. Secondly, the methodology is explicated.

3.1 *Stock price data & descriptive statistics*

From *Datastream* daily index prices of the most representative national value-weighted market indices are retrieved for 28 European countries (Table 10.1). I collect this data from 20 October 2000 until 30 April 2020. Only national market indices are considered when they; are accounted for in *Datastream*; and contain active stock price data, i.e. no missing values in the three years before the first event date. On this basis, Norway is removed from the original list of Table 10.1, leaving 27 countries to study. Also, two representative market indices for the European stock market are added to the dataset. In order to compare price indices across countries the return is calculated following Formula (3.1):

$$R_{i,t} = \frac{PI_{i,t} - PI_{i,t-1}}{PI_{i,t-1}}, \tag{3.1}$$

where $R_{i,t}$ is the national price index return, $PI_{i,t}$ is the national price index, and $PI_{i,t-1}$ is the lagged national price index. Table 3.1 provides descriptive statistics on the returns of the national market indices of European countries. For Cyprus, Portugal and Slovenia the index used was established later than 20 October 2000, explaining less observations in the data. Consistent with evidence from international stock markets found by Peiró (2010), all indices under consideration exhibit non-normal distributions (Table 10.3). Skewness and Kurtosis tests are performed.

3.2 *Event data*

3.2.1 *Key event dates*

In this analysis four events are distinguished to measure abnormal returns on the European stock market. The events are: (1) the lockdown announcement in Wuhan; (2) the first COVID-19 death in Europe; (3) the *patient zero* per European country; (4) the announcement of an exit strategy per European country. Hereby, event (1) and (2) are *general* events, i.e. for every European country this event is expected to generally have the same stock market effect (Table 3.2). Therefore, the date attributed to this event is the same for every country. Event (3) and (4) are *country-specific* in the fact that the event date is dependent of the country. Event dates for (3) and (4) are given respectively in Table 3.3 and Table 3.4. All event dates are from the WHO COVID-19 database and news updates.

Table 3.1: Descriptive statistics on the returns of national market indices of European countries

Country	**Market Index**	**Observations**	**Mean**	**Minimum**	**Maximum**
Austria	ATX	5,094	0.0002409	-0.1364861	0.0141646
Belgium	BEL20	5,094	0.0000814	-0.1421067	0.0124628
Bulgaria	SOFIX	5,094	0.0003940	-0.1886003	0.0141128
Croatia	CROBEX	5,094	0.0001927	-0.1252421	0.0119914
Cyprus	Cyprus General	4,084	-0.0004830	-0.1437988	0.0224901
Czech Republic	PX	5,094	0.0001929	-0.1494352	0.0131114
Denmark	OMXC20	5,094	0.0003146	-0.1106211	0.0123495
Estonia	OMXT	5,094	0.0004661	-0.1005982	0.0102189
Finland	OMXH	5,094	0.0000529	-0.1577836	0.0157210
France	CAC40	5,094	0.0000437	-0.1227677	0.0142645
Germany	DAX	5,094	0.0002050	-0.1223862	0.0146784
Greece	ATHEX	5,094	-0.0001865	-0.1623282	0.0182250
Hungary	BUX	5,094	0.0003945	-0.1188166	0.0145845
Iceland	OMX	5,094	0.0001327	-0.6657965	0.0139786
Ireland	ISEQ	5,094	0.0000917	-0.1303250	0.0136503
Italy	FTSE	5,094	-0.0000682	-0.1692376	0.0152469
Luxembourg	LUX	5,094	-0.0000683	-0.2595776	0.0171657
Malta	MSE	5,094	0.0000506	-0.0462644	0.0066005
Netherlands	AEX	5,094	0.0000495	-0.1075264	0.0139838
Portugal	PSI	4,164	0.0000215	-0.1035904	0.0115701
Romania	BET	5,094	0.0006397	-0.1229293	0.0145452
Slovakia	SAX16	5,094	0.0002982	-0.1376559	0.0111721
Slovenia	SBI	3,674	0.0000412	-0.3320504	0.0144849
Spain	IBEX35	5,094	0.0000253	-0.1405922	0.0145471
Sweden	OMXS30	5,094	0.0001665	-0.1057105	0.0142803
Switzerland	SMI	5,094	0.0001102	-0.0963737	0.0115550
United Kingdom	FTSE All Share	5,094	0.0000792	-0.1049141	0.0112184
Europe	EURO STOXX	5,094	0.0000438	-0.1235400	0.0132892
Europe	EURONEXT 100	5,094	0.0000583	-0.1197612	0.0131295
United States	S&P500	5,094	0.0002409	-0.1364861	0.0141646

Note. This table shows the descriptive statistics on the stock return data of European national market indices. The observations range from 20 October 2000 until 30 April 2020, with a daily frequency. From left to right the columns show country, index, number of observations, mean return, minimum return and maximum return.

Table 3.2: General event dates for event (1) and (2)

Event	Date
(1) Lockdown announcement in Wuhan	23 January 2020
(2) First COVID-19 death in Europe	15 February 2020

3.2.1.1 General event dates

The first event (1) is the announcement of the lockdown in Wuhan on the 23rd of January 2020, by the Chinese government. The WHO representative in China, Gauden Galea, mentioned in an interview in Beijing that the measure to contain the virus through a lockdown of 11 million people is unprecedented in public health history[2]. Therefore, this event may have had an impact on investors. Firstly, the growing restrictions in China affected companies outside of China with China exposure, consistent with the findings of Baker et al. (2020). For instance, firms that have production facilities in China. Secondly, the lockdown announcement may have risen fear amongst investors regarding the gravity of this economic and health concern. Moreover, a reaction in the stock market could possibly reflect an anticipation of greater consequences of COVID-19 than before this event.

As the novel coronavirus spreads beyond China, the situation becomes more prevalent to Europe. Event (2) which denotes the first COVID-19 death in Europe, could potentially have a serious impact on stock market returns in Europe. Especially, where SARS never hit Europe and Ru et al. (2020) find evidence for an initial underreaction by countries without SARS experience. The first death might have conveyed the seriousness of the situation to Europe. A Chinese tourist brought the coronavirus from Hubei province and died in France at the 15th of February 2020[3].

3.2.1.2 Country-specific event dates

In addition to the general [event dates], the country-specific event dates are assessed when analysing the stock market reaction to COVID-19 in Europe. These event dates differ per country and are extracted from the *WHO Global COVID-19 Database*[4].

For event (3), the *patient zero* per European country, the dates range from 24 January 2020 for France to 9 March 2020 for Cyprus (Table 3.3). These dates should be interpreted with precaution, however, because not all cases are documented. The importance of the *patient zero*

[2] Reuters (2020): 'Wuhan Lockdown "Unprecedented", Shows Commitment to Contain Virus'.
[3] For a documentation of the first COVID-19 death in Europe, see BBC (2020).
[4] For a download of these data, see https://covid19.who.int/?gclid=CjwKCAjwwYP2BRBGEiwAkoBpAuqGkz-aGrt7tFDGh3cryQWa_VpE5vqASRk9QpBbTFPqOtSN6yA4FyRoCW44QAvD_BwE.

event date lies in the sudden exposure a country has to the COVID-19 pandemic when their country's first case is reported. The effect is expected to be greatest when the news on the *patient zero* becomes publicly available, making the dates of event (3) most appropriate. The uncertainty following from this event may lead investors to alter their expectations towards the economic consequences of COVID-19 on the country of interest.

Table 3.3: Country-specific dates for event (3)

Event	**Country**	**Date**
patient zero	Austria	25 February 2020
	Belgium	4 February 2020
	Bulgaria	8 March 2020
	Croatia	25 February 2020
	Cyprus	9 March 2020
	Czech Republic	1 March 2020
	Denmark	27 February 2020
	Estonia	27 February 2020
	Finland	29 January 2020
	France	24 January 2020
	Germany	28 January 2020
	Greece	26 February 2020
	Hungary	4 March 2020
	Iceland	1 March 2020
	Ireland	1 March 2020
	Italy	29 January 2020
	Luxembourg	1 March 2020
	Malta	7 March 2020
	Netherlands	27 February 2020
	Portugal	2 March 2020
	Romania	26 February 2020
	Slovakia	6 March 2020
	Slovenia	4 March 2020
	Spain	31 January 2020
	Sweden	31 January 2020
	Switzerland	25 February 2020
	United Kingdom	31 January 2020

The last event (4) involves the first announcement of an exit strategy per European country. Governmental institutions will ease restrictions laid upon the country when epidemiologically acceptable. A strategic plan containing all dates and actions to gradually remove restrictive measures earlier imposed, is drafted. Starting economics as usual again may give rise to better economic expectations among investors. Consequently, stock market returns may be significantly positive. This news hits the public when the exit plan is released in the press, underlining the importance of accessibility to this news. Therefore, the dates for event (4) are based on the government announcing that it will implement an exit strategy for the specific European country. This data is from *Euractiv*, which is a news platform that reports on all individual European countries and Europe as a whole. Additionally, it provides translations of national news releases in European countries.

Unfortunately, not all European countries in this study have started yet with easing restrictions in their country, for the time writing. Moreover, not for every country the specific date of announcement is perfectly registered. The date is either not announced or ambiguous dates are announced. For these reasons Cyprus, Greece, Hungary, Iceland, Ireland, Luxembourg, Malta and Sweden are left out of the event study. Sweden does, however, need a different explanation. The Scandinavian country is renowned for going a completely different path in their battle against the novel coronavirus. In Sweden there were almost no restrictive measures, and thus, they also can’t be lifted. Sweden seems for that reason also not applicable to event (4). The first country under consideration to lift some restrictions is Austria on the 6th of April. The last country in this analysis is Denmark on the 29th of May (Table 3.4).

Table 3.4: Country-specific dates for event (4)

Event	Country	Date
Announcement of exit strategy	Austria	6 April 2020
	Belgium	24 April 2020
	Bulgaria	27 April 2020
	Croatia	23 April 2020
	Cyprus	n/a
	Czech Republic	14 April 2020
	Denmark	29 May 2020
	Estonia	6 May 2020
	Finland	4 May 2020
	France	28 April 2020
	Germany	6 May 2020
	Greece	n/a
	Hungary	n/a
	Iceland	n/a
	Ireland	n/a
	Italy	26 April 2020
	Luxembourg	n/a
	Malta	n/a
	Netherlands	6 May 2020
	Portugal	4 May 2020
	Romania	9 May 2020
	Slovakia	21 April 2020
	Slovenia	28 April 2020
	Spain	23 May 2020
	Sweden	n/a
	Switzerland	27 April 2020
	United Kingdom	10 May 2020

4 Research design

To study the effect of COVID-19 on stocks a multi-country event-study approach is used. Section 4.1 provides a framework for the calculation of abnormal returns. Section 4.2 contains the methods used to test for significance of the abnormal returns.

4.1 Abnormal returns

In order to study the impact of an event on stock market returns the abnormal returns conditional on the event taking place are analysed. The abnormal return is the difference between the actual return and the normal return calculated as in Formula (4.2):

$$AR_{i,t} = R_{i,t} - E(R_i), \tag{4.2}$$

where $AR_{i,t}$ is the abnormal return and $R_{i,t}$ is the actual return for country i on day t. The return that would be realized on an equity in normal market conditions (or equivalently: conditional on the event not taking place) is called the normal return, and is denoted as $E(R_i)$. To estimate the normal return, the historical average return is taken over the estimation period in a constant mean model (MacKinlay, 1997). This window starts 250 trading days prior to the first event date until 50 trading days before the first event date (notation: [-250,-50]). Moreover, the average return over the period 7 February 2019 until 14 November 2019 denotes the normal return. The same window, and thus return, is used for all events to avoid potential biases in the normal return estimation for events after event (1). The normal return is shown in Table 10.2.

In order to account for potential imprecision in dating the event or availability of information about it to market participants, multi-day event windows are used (Campbell et al., 2010). I examine windows of 1, 5, and 11 trading days centred on the event date (hereafter respectively: 1-day, 5-day, and 11-day window). The total effect of an event is measured through the cumulative abnormal returns (CARs) over the event window of days T_1 through T_2, as in Formula (4.3):

$$CAR_i(T_1, T_2) = \sum_{T_1}^{T_2} AR_{i,t}, \tag{4.3}$$

where $CAR_i(T_1, T_2)$ is the cumulative abnormal return and $\sum_{T_1}^{T_2} AR_{i,t}$ is the sum of the daily abnormal returns, for a country. Beside individual countries I also investigate the total average effect of the COVID-19 events on stock market returns in Europe, by analysing the cumulative average abnormal returns (CAARs) across European countries. Hence, the countries are grouped thereafter, and the CAARs are calculated using Formula (4.4):

$$CAAR(T_1, T_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(T_1, T_2), \tag{4.4}$$

where $CAAR(T_1, T_2)$ is the cumulative abnormal return over the event window of day T_1 through T_2, defined as the sum of the cumulative abnormal returns ($CAR_i(T_1, T_2)$) of the individual countries divided by the amount of countries (N).

4.2 Significance tests

To make inferences from the results the CARs and CAARs are tested on their statistical significance. Parametric and nonparametric tests are employed and will be discussed respectively.

4.2.1 Parametric tests

Regarding the parametric tests a Student t-test is utilized to test the significance of the abnormal returns. Despite daily stock market returns exhibiting non-normal distributions, the t-statistic rejects the null hypothesis of no abnormal returns at approximately the test's significance level (Berry et al., 1990). This indicates that the test is well specified and is consistent with the findings of Brown & Warner (1985). Next to the Student t-test a KP Test is considered. This test is developed by Kolari & Pynnönen (2010) and modifies the BMP t-statistic of Boehmer, Musumeci & Poulsen (1991), by accounting for cross-correlation in the abnormal returns. This correlation comes into play when event-clustering is the case. It is fairly plausible that this issue is relevant to the stock return data related to COVID-19. Moreover, event-induced volatility is accounted for in the KP t-statistic.

4.2.2 Nonparametric tests

Although parametric tests are rather robust in most cases, with large deviations from the distribution requirements for parametric tests, there is a possibility that a Student t-test can no longer be (asymptotically) approximated by a normal distribution (van der Sar, 2018). For the sake of conservatism nonparametric tests on the significance of abnormal returns – conditional on an event taking place – are explored next to the parametric test that is constructed. Brown & Warner (1980) find evidence that nonparametric tests are poorly specified, which could cause wrong inferences about the data. Berry et al. (1990) elaborate on this notion, highlighting that nonparametric tests have greater power, however, researchers should be cautious with respect to the understatement of probable Type I errors. Consequently, nonparametric tests produce too few rejections of the null hypothesis. Therefore, these tests only perform well in cases of relatively extreme abnormal returns. There is reason to believe ex ante that this might be applicable to the COVID-19 stock market effects, according to findings of extremely high volatility levels by Fernandes (2020), amongst others. In contrast to the findings of Berry et al. (1990) and Brown & Warner (1980) (1985), Campbell et al. (2010) show that nonparametric tests (the Generalized Sign Test and the Rank Test) are correctly specified. However, they admit to these tests not perfectly conforming to the nominal 5% significance level. Their suggestion to explore parametric as well as nonparametric tests, and to interpret any disagreements between the tests with caution, is pursued.

Kolari & Pynnönen (2011) propose the use of the Generalized Rank (GRANK) Test for assessing abnormal returns in the stock market. Their research shows that the GRANK Test performs better than previous nonparametric tests. The test's applicability to one-day as well as to multiple-day event windows is because of robustness to abnormal return serial correlation and event-induced volatility.

5 Results & Discussion

The results from analyses are reported individually for each event. Significance of abnormal returns and inferences of each event are discussed chronologically.

5.1 Event 1

For the first event, the lockdown announcement in Wuhan, the cumulative average abnormal returns show no convincing significant negative returns for individual countries, at the 5% significance level. Only Iceland and Slovakia exhibit significantly negative returns in the 1-day window. In the 5-day window, France, Iceland and the United Kingdom show significantly negative returns and in the 11-day window only the Czech Republic (Table 5.1; Table 10.4). These results are the same for parametric and nonparametric testing for significance. When grouping the 27 European countries, according to the t-statistic the cumulative average abnormal returns are significantly negative in all event windows, implying that the overall effect on Europe is more convincingly present (Table 5.1). These findings are consistent with the negative returns in China (Al-Awadhi et al., 2020). The differences in stock returns between China and the USA found by Ramelli & Wagner (2020a) correspond to differences between European countries found in this analysis. However, the GRANK Test only finds significant abnormal returns at the 10% level for the 5-day event window (Table 10.4). Consistent with Berry et al. (1990), this could be due to a type I error where the nonparametric tests has too few rejections of the null hypothesis. The KP Test generates the same results as the GRANK Test.

Table 5.1:Cumulative abnormal returns (Student t-test) for national market indices of European countries during the Wuhan lockdown announcement (1).

	CAAR					
	Event window length					
Country	**1 day**		**5 day**		**11 day**	
Austria	-1.064%	*(0.2191)*	-2.470%	*(0.2064)*	-2.506%	*(0.3942)*
Belgium	-0.974%	*(0.2630)*	-2.935%	*(0.1354)*	-1.503%	*(0.6113)*
Bulgaria	-0.243%	*(0.6500)*	-1.008%	*(0.4036)*	-1.081%	*(0.5516)*
Croatia	0.136%	*(0.7660)*	-1.454%	*(0.1590)*	-1.135%	*(0.4651)*
Cyprus	-0.714%	*(0.3912)*	0.137%	*(0.9418)*	-0.852%	*(0.7633)*
Czech Republic	-0.455%	*(0.4482)*	-0.023%	*(0.9864)*	-5.361%***	*(0.0085)*
Denmark	-0.178%	*(0.8377)*	-1.671%	*(0.3934)*	-0.976%	*(0.7405)*
Estonia	0.184%	*(0.5696)*	0.016%	*(0.9821)*	0.977%	*(0.3754)*
Finland	-0.468%	*(0.5754)*	-3.028%	*(0.1087)*	0.494%	*(0.8619)*
France	-0.730%	*(0.3847)*	-3.955%**	*(0.0371)*	-3.494%	*(0.2209)*
Germany	-1.021%	*(0.2463)*	-2.917%	*(0.1426)*	-2.873%	*(0.3371)*
Greece	-0.558%	*(0.6522)*	-1.209%	*(0.6655)*	-2.548%	*(0.5450)*
Hungary	0.473%	*(0.5308)*	-1.375%	*(0.4201)*	-2.762%	*(0.2817)*
Iceland	-2.065%**	*(0.0102)*	-3.626%**	*(0.0459)*	-5.294%*	*(0.0527)*
Ireland	-0.767%	*(0.4365)*	-2.143%	*(0.3353)*	-2.031%	*(0.5441)*
Italy	-0.081%	*(0.9313)*	-2.858%	*(0.1786)*	-0.763%	*(0.8114)*
Luxembourg	-1.053%	*(0.4993)*	-3.777%	*(0.2831)*	-6.518%	*(0.2183)*
Malta	-0.434%	*(0.3518)*	-0.665%	*(0.5277)*	-0.669%	*(0.6731)*
The Netherlands	-1.026%	*(0.1625)*	-2.786%*	*(0.0930)*	-2.622%	*(0.2933)*
Portugal	-0.175%	*(0.8070)*	-1.437%	*(0.3732)*	0.459%	*(0.8501)*
Romania	0.734%	*(0.3252)*	-0.560%	*(0.7395)*	-2.782%	*(0.2726)*
Slovakia	-1.595%**	*(0.0453)*	0.158%	*(0.9298)*	2.639%	*(0.3297)*
Slovenia	0.067%	*(0.8782)*	0.602%	*(0.5387)*	-0.126%	*(0.9319)*
Spain	-0.584%	*(0.4536)*	-3.084%*	*(0.0794)*	-0.385%	*(0.8842)*
Sweden	-0.967%	*(0.2785)*	-3.066%	*(0.1283)*	-0.634%	*(0.8344)*
Switzerland	-0.803%	*(0.2206)*	-1.857%	*(0.2096)*	0.129%	*(0.9537)*
The United Kingdom	-0.883%	*(0.1762)*	-3.059%**	*(0.0381)*	-3.269%	*(0.1408)*
CAAR group (27 countries)	-0.565%***	*(0.0003)*	-1.854%***	*(0.0000)*	-1.685%***	*(0.0016)*

Note. For each national market index in the data the cumulative average abnormal return is displayed in percentages (%), in column 2 to 4. These columns denote respectively the results for the 1-day window, the 5-day window, and the 11-day window. Standard deviations are in parentheses. Values significant at the 10% level are marked with *; at the 5% level with **; and at the 1% level with ***.

5.2 Event 2

The first COVID-19 induced death in Europe seems to exhibit no abnormal returns across European countries (Table 5.2). Since the event fell on a Saturday, the 1-day window is not taken into consideration. All returns were 0% at that day, due to inactivity of the stock market. For that reason I analyse only the 5- and 11-day window. Most indices had negative returns, however, only the Bulgarian national index had significantly negative returns (-3.014%)

at the 5% level in the 5-day window. France – the country where the first COVID-19 death of Europe emerged – experienced slightly negative returns, but not significant even at the 10% level. The results do not differ as the GRANK Test and KP Test are employed (Table 10.4).

The results of event (2) do not correspond with the significantly negative abnormal returns found by Al Awadhi et al. (2020) and Ramelli & Wagner (2020a). Possibly, the shock of COVID-19 bad news was already incorporated by event (1), leading to investors already anticipating event (2). Panic trading as explained by Donadelli et al. (2017) does not seem to be present in the stock market as result of event (2).

Table 5.2: Cumulative abnormal returns (Student t-test) for national market indices of European countries at time of the first COVID-19 death in Europe (2).

	CAR			
	Event window length			
National Market Index	**5 day**		**11 day**	
Austria Index Return (ATX)	-0.867%	*(0.6090)*	-0.016%	*(0.9954)*
Belgium Index Return (BEL20)	-0.641%	*(0.7094)*	-0.816%	*(0.7675)*
Bulgaria Index Return (SOFIX)	-3.014%***	*(0.0035)*	-2.757%*	*(0.0961)*
Croatia Index Return (CROBEX)	0.040%	*(0.9641)*	-0.799%	*(0.5798)*
Cyprus Index Return	1.422%	*(0.3807)*	1.138%	*(0.6620)*
Czech Republic Index Return (PX)	-0.574%	*(0.6244)*	-2.006%	*(0.2860)*
Denmark Index Return (OMXC20)	1.217%	*(0.4934)*	0.919%	*(0.7471)*
Estonia Index Return (OMXT)	-0.379%	*(0.5207)*	0.301%	*(0.7501)*
Finland Index Return (OMXH)	-1.990%	*(0.2300)*	-1.100%	*(0.6792)*
France Index Return (CAC40)	-1.005%	*(0.5530)*	-0.532%	*(0.8447)*
Germany Index Return (DAX)	-0.754%	*(0.6629)*	-0.138%	*(0.9603)*
Greece Index Return (ATHEX)	-1.036%	*(0.6773)*	-2.968%	*(0.4573)*
Hungary Index Return (BUX)	2.152%	*(0.1627)*	2.336%	*(0.3449)*
Iceland Index Return (OMX)	-0.445%	*(0.7801)*	0.752%	*(0.7684)*
Ireland Index Return (ISEQ)	-0.968%	*(0.6274)*	0.548%	*(0.8639)*
Italy Index Return (MIB)	1.229%	*(0.5102)*	0.675%	*(0.8217)*
Luxembourg Index Return (SE)	-1.921%	*(0.5447)*	-3.367%	*(0.5079)*
Malta Index Return (MSE)	1.266%	*(0.1749)*	-0.226%	*(0.8798)*
Netherlands Index Return (AEX)	-0.806%	*(0.5963)*	-0.421%	*(0.8630)*
Portugal Index Return (PSI)	2.616%*	*(0.0687)*	3.718%	*(0.1068)*
Romania Index Return (BET)	0.849%	*(0.5297)*	-0.594%	*(0.7839)*
Slovakia Index Return (SAX16)	0.133%	*(0.9354)*	-0.025%	*(0.9923)*
Slovenia Index Return (SBI)	-0.157%	*(0.8580)*	-0.213%	*(0.8798)*
Spain Index Return (IBEX35)	0.629%	*(0.6898)*	0.710%	*(0.7788)*
Sweden Index Return (OMXS30)	-0.791%	*(0.6609)*	1.065%	*(0.7127)*
Switzerland Index Return (SMI)	0.300%	*(0.8222)*	0.467%	*(0.8274)*
United Kingdom Index Return	-1.796%	*(0.1830)*	-0.587%	*(0.7862)*
CAAR Group (27 countries)	-0.196%	*(0.5341)*	-0.146%	*(0.7730)*

Note. For each national market index in the data the cumulative average abnormal return is displayed in percentages (%), in column 2 to 3. These columns denote respectively the results for the 5-day window, and the 11-day window. Standard deviations are in parentheses. Values significant at the 10% level are marked with *; at the 5% level with **; and at the 1% level with ***.

5.3 Event 3

The third event, the *patient zero* per European country, shows predominantly significantly negative returns at the 1% level (Table 5.3). The significantly negative abnormal returns are consistent with those expected based on research of Al Awadhi et al. (2020) and Ramelli & Wagner (2020a). For the countries that had its *patient zero* at a Saturday or Sunday the 1-day event window is kept blank.

The 11-day window appears to perform best in terms of significance. When accounting for that event window there are a few countries with no significant abnormal returns (5%). Those are Finland, France, Germany, Italy, Spain, Sweden and the United Kingdom. Furthermore, there is one extraordinary result. Belgium experiences significantly positive abnormal returns in all event windows, at time of its *patient zero.* These results deviate from those in the literature (Al-Awadhi et al., 2020; Stefano Ramelli & Wagner, 2020). An underreaction to the economic effects of an infectious disease outbreak proposed by Ru et al. (2020) may be explanatory to this gap. The rest of the countries do display significantly negative abnormal returns as expected.

Regarding the event window, the data suggest that there is either an anticipation to the *patient zero* beforehand, or a delay in information processed as result of the *patient zero,* consistent with event-study analysis by MacKinlay (1997). The results for event (3) are rather robust in regard to significance. The nonparametric GRANK and the parametric KP Test do not alter significance (Table 10.4).

Table 5.3: Cumulative abnormal returns (Student t-test) for national market indices of European countries at time of the patient zero in the specific country (3).

	CAR					
	Event window length					
Country	**1 day**		**5 day**		**11 day**	
Austria	-2.347%***	*(0.0049)*	-10.964%***	*(0.0000)*	-13.620%***	*(0.0000)*
Belgium	2.771%***	(0.0011)	5.099%***	(0.0079)	5.770%**	(0.0458)
Bulgaria			-8.630%***	*(0.0000)*	-19.473%***	*(0.0000)*
Croatia	-1.440%***	*(0.0011)*	-6.339%***	*(0.0000)*	-8.726%***	*(0.0000)*
Cyprus	-7.450%***	*(0.0000)*	-12.820%***	*(0.0000)*	-25.461%***	*(0.0000)*
Czech Republic			-2.002%*	*(0.0879)*	-12.330%***	*(0.0000)*
Denmark	2.556%***	*(0.0043)*	-6.115%***	*(0.0025)*	-7.794%**	*(0.0105)*
Estonia	-3.453%***	*(0.0000)*	-6.038%***	*(0.0000)*	-5.818%***	*(0.0000)*
Finland	-0.319%	*(0.7017)*	-1.262%	*(0.5024)*	1.518%	*(0.5921)*
France	0.788%	*(0.3423)*	-2.411%	*(0.1983)*	-4.851%*	*(0.0853)*
Germany	0.806%	*(0.3450)*	-2.153%	*(0.2640)*	-2.938%	*(0.3111)*
Greece	-2.828%**	*(0.0232)*	-21.379%***	*(0.0000)*	-17.301%***	*(0.0000)*
Hungary	0.013%	*(0.9860)*	2.319%	*(0.1787)*	-16.161%***	*(0.0000)*
Iceland			-5.095%***	*(0.0010)*	-17.103%***	*(0.0000)*
Ireland			-5.362%***	*(0.0071)*	-14.902%***	*(0.0000)*
Italy	0.484%	*(0.5970)*	-3.431%*	*(0.0972)*	0.821%	*(0.7921)*
Luxembourg			-9.722%***	*(0.0019)*	-21.603%***	*(0.0000)*
Malta			-4.158%***	*(0.0000)*	-9.122%***	*(0.0000)*
The Netherlands	-3.808%***	*(0.0000)*	-9.157%***	*(0.0000)*	-13.389%***	*(0.0000)*
Portugal	1.211%*	*(0.0821)*	-1.177%	*(0.4544)*	-20.458%***	*(0.0000)*
Romania	0.874%	*(0.1841)*	-10.581%***	*(0.0000)*	-4.731%**	*(0.0345)*
Slovakia	-0.133%	*(0.8715)*	-0.721%	*(0.6980)*	-6.455%**	*(0.0210)*
Slovenia	0.907%**	*(0.0296)*	-2.765%***	*(0.0033)*	-10.565%***	*(0.0000)*
Spain	-1.180%	*(0.1233)*	0.756%	*(0.6621)*	2.887%	*(0.2671)*
Sweden	-0.316%	*(0.7219)*	1.682%	*(0.4012)*	2.473%	*(0.4121)*
Switzerland	-2.250%***	*(0.0007)*	-9.069%***	*(0.0000)*	-10.634%***	*(0.0000)*
The United Kingdom	-1.182%*	*(0.0693)*	-0.483%	*(0.7421)*	-0.573%	*(0.7953)*

Note. For each national market index in the data the cumulative average abnormal return is displayed in percentages (%), in column 2 to 4. These columns denote respectively the results for the 1-day window, the 5-day window, and the 11-day window. Standard deviations are in parentheses. Values significant at the 10% level are marked with *; at the 5% level with **; and at the 1% level with ***.

5.4 Event 4

The fourth event involved the exit strategy announcement by the government per European country. In Table 5.4 abnormal returns for event (4) are given. In contrast to the other country-specific event (3), results are more ambiguous for the fourth event. If the announcement fell on a Saturday or Sunday the 1-day event window is kept blank. In the 1-day window, Austria, Croatia, Czech Republic, Estonia and Slovenia exhibit 5% significantly positive returns. For the 5-day window those showing significantly positive returns are Austria, Belgium, Bulgaria, Italy, Romania and Switzerland. The last window provides evidence for Austria, Estonia and Spain having significantly positive returns. This is in line with the negative relation between COVID-19 and stock returns (Al-Awadhi et al., 2020; Ramelli & Wagner, 2020a).

Regarding significance, it is not clear which event window performs best. In addition, there is also evidence for significantly negative returns during event (4) which is not expected. For instance, Belgium (1-day window), Finland and Portugal display positive returns which is in conflict with the existing literature. The strategy proposed by the government could be a reason for the stock returns to deviate from the hypothesis. Moreover, other influences like capital structures and government structures may alter the returns. The results from the T-test are robust in the sense that the GRANK and KP Test do not change the outcomes and significance (Table 10.4).

Table 5.4: Cumulative abnormal returns (Student t-test) for national market indices of European countries at time of the exit strategy announcement (4).

	CAR					
	Event window length					
Country	**1 day**		**5 day**		**11 day**	
Austria	4.182%***	*(0.0000)*	8.609%***	*(0.0000)*	9.501%***	*(0.0004)*
Belgium	-2.572%***	*(0.0021)*	6.763%***	*(0.0003)*	5.098%*	*(0.0724)*
Bulgaria	-0.723%	*(0.1607)*	3.237%***	*(0.0054)*	0.321%	*(0.8544)*
Croatia	1.011%**	*(0.0207)*	0.061%	*(0.9507)*	-2.617%*	*(0.0780)*
Czech Republic	1.355%**	*(0.0263)*	0.550%	*(0.6895)*	2.727%	*(0.1884)*
Denmark	0.054%	*(0.9651)*	0.349%	*(0.9005)*	0.924%	*(0.8258)*
Estonia	1.079%***	*(0.0026)*	0.924%	*(0.2537)*	3.644%***	*(0.0028)*
Finland	-3.613%***	*(0.0000)*	-3.987%**	*(0.0311)*	5.417%*	*(0.0516)*
France	1.359%	*(0.1083)*	2.416%	*(0.2060)*	-1.508%	*(0.5999)*
Germany	-1.178%	*(0.1977)*	0.371%	*(0.8573)*	-2.468%	*(0.4271)*
Italy			4.984%**	*(0.0118)*	2.892%	*(0.3621)*
The Netherlands	-0.868%	*(0.2995)*	1.457%	*(0.4408)*	-1.645%	*(0.5628)*
Portugal	-1.997%***	*(0.0051)*	-1.638%	*(0.3093)*	3.615%	*(0.1360)*
Romania			3.382%**	*(0.0341)*	1.744%	*(0.4958)*
Slovakia	0.141%	*(0.8638)*	-0.894%	*(0.6291)*	3.264%	*(0.2413)*
Slovenia	1.617%***	*(0.0007)*	2.803%***	*(0.0091)*	-0.287%	*(0.8590)*
Spain			5.499%*	*(0.0915)*	11.330%**	*(0.0302)*
Switzerland	1.299%*	*(0.0542)*	2.006%	*(0.1881)*	-3.140%	*(0.1709)*
The United Kingdom			2.286%	*(0.1670)*	0.376%	*(0.8873)*

Note. For each national market index in the data the cumulative average abnormal return is displayed in percentages (%), in column 2 to 4. These columns denote respectively the results for the 1-day window, the 5-day window, and the 11-day window. Standard deviations are in parentheses. Values significant at the 10% level are marked with *; at the 5% level with **; and at the 1% level with ***.

6 Robustness analysis

To assess the robustness of the event-study analyses in this paper, three main fields of interest can be differentiated. The estimation period, event windows and test forms are considered in checking for robustness.

In order to account for potential bias in the normal returns through the estimation period, I perform for every event two new analyses of abnormal returns with different estimation periods from the ones in the results section. Firstly, a shorter window is considered, which should reflect the most recent and accurate economic environment in the European countries. This estimation window is from 150 days prior to the first event until 30 days prior to the first event [-150,-30]. A longer estimation window is used to account for more observations, and thus, a more reliable normal return. This window starts 500 days before the first event and ends 30 days before the event. Both estimation periods do not greatly change the significance of the results as reported in this paper. This is the case for all events (1) till (4) (Table 10.4).

As for the event windows, three different windows are employed in this research. I do not observe major consistent differences between the different windows. This is consistent with event-study research by Campbell et al. (2010), MacKinlay (1997) and Boehmer et al. (1991), who point out the lack of a sound theory on how to choose an event window. For this paper, performance of event windows in terms of significance seems to differ across the different events. Hence, by using all three event windows this paper provides a rather robust and complete view of the abnormal returns in these events.

Lastly, I discuss the robustness of the different tests used. In this paper, the Student t-test, the KP Test and the GRANK Test are performed. Given the fact that these different tests do not alter the significance of the abnormal returns, it provides a fair basis to regard the results as robust towards different statistical tests.

7 Summary & Conclusion

The economic impact of COVID-19 is widely discussed at this moment in time, due to the unprecedented situation that emerged from a pandemic. With restrictive measures like curfews, lockdowns and other social distancing practices, business is ceasing. In order to cope with similar global circumstances in the future, it is relevant to study the economic effect of the novel coronavirus. This paper attempts to contribute to the literature by analysing stock market reactions of European market indices to COVID-19 related events.

The days surrounding the lockdown announcement of Wuhan (1) do not seem to exhibit relatively unusual returns. Results are consistent with the hypothesis of Ru et al. (2020) that countries without SARS experience react relatively late to infectious disease outbreaks in terms of stock returns. It can be noted that the gross majority of abnormal returns is negative and the grouped European countries in the analysis overall show negative abnormal returns that are significant.

There seems to be no convincing evidence that the first COVID-19 induced death (2), in Europe (in France), is related to negative abnormal returns. Only Bulgaria experienced significantly negative abnormal returns. The *patient zero* per European country (3) is the first event to show strong significantly negative abnormal returns. The announcement of an exit strategy exhibits ambiguous abnormal returns. Where significantly positive returns are expected, these are observed next to significantly negative returns. This can be related to the fact that exit strategies differ across countries and for that reason might have a different effect.

In regard to the economic effect that COVID-19 has on stock returns, it is hypothesized that COVID-19 is negatively related to national stock market index returns of European countries. Based on the empirical event-study analyses no incontrovertible conclusion can be drawn. The first (1) and third (3) event correspond with the hypothesis (**H1**). For the second (2) and fourth (4) event it is somewhat unclear whether this effect holds true.

The research question this thesis tries to address is: *What is the effect of COVID-19 on European stock market performance?* The results highlight the different effect of COVID-19 on stock market returns between European countries, for all events. Based on the results of this paper the effect of COVID-19 seems to be negative in the cases of event (1) and event (3). For event (2) and (4) this conclusion cannot be drawn. Concluding, the effect of COVID-19 on European stock market performance is mostly negative and in part still uncertain.

8 Limitations

Although it is widely accepted that the stock market resembles the state of the economy, blindly drawing conclusions from its appearances can be deceiving. This paper discusses the economic impact of COVID-19 in terms of stock market returns. However, for conclusions to be meaningful one should accept the premise that the stock market is well related to the ‘real’ economy. While the United States seem to be in a recession according to unemployment rates, the US stock market does not reflect this situation in its returns (NY Times, 2020). This gap between stock market and real life economy should be considered carefully in interpreting the results from this paper.

In this light, a suggestion for future research is to measure economic impact differently. Firm’s profitability and revenues can be studied in relation to COVID-19 developments. Beside different dependent variables, different methodologies might be considered. Stock market returns or other economic measures can be regressed on expected COVID-19 deaths ore infections, for instance.

National market indices contain a relatively complete mix of business industries in the country it reflects. It does not distinguish between industries. Therefore, the results in this paper do not reflect individual industries. For future research it may be helpful to study particular sectors of a country’s economy in regard to COVID-19. Implications from an industry analysis can contribute to effectively countering economic hardship as a result of situations similar to the current pandemic.

The dataset used consists of 27 out of 44 European countries. Results may be more conclusive if the analysis accounted for more European countries with an active stock market, which are not included in this research.

Concluding, there are multiple entries to the limitational boundaries of this research. Scholarly research hereafter will contribute to an already big pool of literature on the extraordinary economic implications that are the result of a pandemic.

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10 Appendix

10.1 Tables

Table 10.1: Price indices of countries in Europe from Datastream

Country	Market index	Mnemonic	Currency
Austria	ATX	ATXINDX	Euro
Belgium	BEL20	BGBEL20	Euro
Bulgaria	SOFIX	BSSOFIX	Bulgarian Lev
Croatia	CROBEX	CTCROBE	Croatian Kuna
Cyprus	Cyprus General	CYPMAPM	Euro
Czech Republic	PX	CZPXIDX	Czech Koruna
Denmark	OMXC20	DKKFXIN	Danish Krone
Estonia	OMXT	ESTALSE	Euro
Finland	OMXH	HEXINDX	Euro
France	CAC40	FRCAC40	Euro
Germany	DAX	DAXINDX	Euro
Greece	ATHEX	GRAGENL	Euro
Hungary	BUX	BUXINDX	Hungarian Forint
Iceland	OMX	ICEXALL	Icelandic Krona
Ireland	ISEQ	ISEQUIT	Euro
Italy	FTSE	FTSEMIB	Euro
Latvia	OMXR	RIGSEIN	Euro
Lithuania	OMXV	LNVILSE	Euro
Luxembourg	LUX	LUXGENI	Euro
Malta	MSE	MALTAIX	Euro
Netherlands	AEX	AMSTEOE	Euro
Norway	Oslo Exchange	OSLOASH	Norwegian Krone
Poland	Warsaw General Index	POLWIGI	Polish Zloty
Portugal	PSI	POPSIGN	Euro
Romania	BET	RMBETRL	Romanian Leu
Russia	MOEX	RMBETRL	Russian Federation Ruble
Slovakia	SAX16	SXSAX16	Euro
Slovenia	SBI	SLOETOP	Euro
Spain	IBEX35	IBEX35I	Euro
Sweden	OMXS30	SWEDOMX	Swedish Krona
Switzerland	SMI	SWISSMI	Swiss Franc
United Kingdom	FTSE All Share	FTALLSH	United Kingdom Pound
Europe	EURO STOXX	DJEURST	Euro
Europe	EURONEXT 100	EUNX100	Euro

Note. For every country – and for Europe as a continent – the name of the market index is given in the second column, the DATASREAM code is given in the third column and the currency of the market index is given in the last column.

Table 10.2: Descriptive statistics on the normal returns of national market indices of European countries

Country	**Market Index**	**Observations**	**Mean**	**Minimum**	**Maximum**
Austria	ATX	201	0.0002663	-0.0237397	0.0224378
Belgium	BEL20	201	0.0004287	-0.0313595	0.0191784
Bulgaria	SOFIX	201	-0.0001216	-0.0191872	0.0245384
Croatia	CROBEX	201	0.0005650	-0.0158301	0.0209504
Cyprus	Cyprus General	201	0.0003389	-0.0252829	0.0312398
Czech Republic	PX	201	0.0000939	-0.0205770	0.0163144
Denmark	OMXC20	201	0.0007382	-0.0276334	0.0250923
Estonia	OMXT	201	0.0001155	-0.0115143	0.0138028
Finland	OMXH	201	-0.0000384	-0.0247274	0.0200559
France	CAC40	201	0.0007817	-0.0357019	0.0230608
Germany	DAX	201	0.0007937	-0.0310704	0.0285633
Greece	ATHEX	201	0.0016059	-0.0428049	0.0609000
Hungary	BUX	201	0.0003395	-0.0173415	0.0219481
Iceland	OMX	201	0.0007155	-0.0298330	0.0238142
Ireland	ISEQ	201	0.0007220	-0.0282027	0.0373379
Italy	FTSE	201	0.0008435	-0.0287004	0.0245976
Luxembourg	LUX	201	-0.0006198	-0.0457456	0.0369999
Malta	MSE	201	0.0004046	-0.0121149	0.0192103
The Netherlands	AEX	201	0.0005428	-0.0316878	0.0172545
Portugal	PSI	201	0.0003275	-0.0212660	0.0172707
Romania	BET	201	0.0013422	-0.0244715	0.0313775
Slovakia	SAX16	201	0.0001131	-0.0413527	0.0273798
Slovenia	SBI	201	0.0002752	-0.0163908	0.0144632
Spain	IBEX35	201	0.0000695	-0.0276787	0.0190673
Sweden	OMXS30	201	0.0006609	-0.0274101	0.0193640
Switzerland	SMI	201	0.0005819	-0.0208350	0.0228205
United Kingdom	FTSE All Share	201	0.0001371	-0.0296474	0.0150555
Europe	EURO STOXX	201	0.0005971	-0.0287116	0.0201519
Europe	EURONEXT 100	201	0.0006446	-0.0327543	0.0203792
United States	S&P500	201	0.0001371	-0.0296474	0.0150555

Note. This table shows the descriptive statistics on the normal returns of European national market indices. The observations range from 7 February 2019 until 14 November 2019, with a daily frequency. From left to right the columns show country, index, number of observations, mean return, minimum return and maximum return.

Table 10.3: Results of normality test through skewness and kurtosis on European national market indices

Country	**Observations**	**Skewness**	**Kurtosis**	Chi^2
Austria	5,094	-0.338063***	13.14645***	995.83***
Belgium	5,094	-0.2651002***	12.83725***	945.77***
Bulgaria	5,094	0.1567523***	42.85802***	1620.72***
Croatia	5,094	0.2211527***	29.76868***	1443.54***
Cyprus	5,094	0.3812955***	11.56404***	751.33***
Czech Republic	5,094	-0.2532979***	17.27281***	1131.97***
Denmark	5,094	-0.1837883***	8.798913***	660.02***
Estonia	5,094	-0.024412	17.05346***	1071.48***
Finland	5,094	-0.1509001***	9.465812***	701.41***
France	5,094	-0.0313518	9.858442***	710.99***
Germany	5,094	0.0031845	9.483081***	683.50***
Greece	5,094	-0.2590081***	10.44418***	804.88***
Hungary	5,094	-0.0496359	10.6708***	766.25***
Iceland	5,094	-23.73145***	1062.025***	12146.48***
Ireland	5,094	-0.5427052***	11.43782***	1031.81***
Italy	5,094	-0.361649***	11.48578***	918.63***
Luxembourg	5,094	1.583451***	71.3359***	2990.20***
Malta	5,094	0.2871323***	1.243.551***	934.37***
Netherlands	5,094	-0.0127384	10.82003***	773.71***
Portugal	5,094	-0.2457199***	14.47608***	833.40***
Romania	5,094	-0.3341584***	13.40871***	1006.78***
Slovakia	5,094	-0.4460354***	18.94667***	1291.37***
Slovenia	3,674	7.63037***	462.0989***	5374.58***
Spain	5,094	-0.1079369***	11.31451***	813.60***
Sweden	5,094	0.0727843**	8.057793***	574.94***
Switzerland	5,094	-0.1286088***	11.35579***	820.16***
United Kingdom	5,094	-0.2437856***	11.64765***	872.40***
Europe	5,094	-0.1587902***	9.742869***	723.27***
Europe	5,094	-0.1020161***	10.48743***	761.20***
United States	5,094	-0.2437856***	11.64765***	872.40***

Note. This table shows the results of a skewness and kurtosis normality test on European national market indices. For every country the number of observations in the sample are displayed in the second column. In the third column the value of skewness is given, and in the fourth column the value of kurtosis. The combined test statistic for normality based on skewness and kurtosis can be found in the fifth column. Values significant at the 10% level are marked with *; at the 5% level with **; and at the 1% level with ***.

Table 10.4: Significance of alternative results from different tests and estimation windows

Event	Alternative methods	Different abnormal returns with respect to the T-test
Event (1)	KP Test	Significance for individual countries is the same as with the T-test. The grouped significance of the 27 countries is less strong. Only in the 5-day window the grouped countries exhibit significantly negative returns.
	GRANK Test	Significance for individual countries is the same as with the T-test. The grouped significance of the 27 countries is less strong. Only in the 5-day window the grouped countries exhibit significantly negative returns.
	Estimation window [-150,-30]	Only Belgium and Finland experience a change in significance. In the 5-day window their abnormal returns become significant at the 10% level.
	Estimation window [-500,-30]	There are no changes in which countries exhibit significant abnormal returns, but the abnormal returns are less significant.
Event (2)	KP Test	The KP Test does not change significance for any country or for the grouped countries compared to the T-test
	GRANK Test	The KP Test does not change significance for any country or for the grouped countries compared to the T-test
	Estimation window [-150,-30]	There are no changes in significance
	Estimation window [-500,-30]	Bulgaria becomes insignificant at any level in the 11-day window and Portugal becomes 10% significant at the 11-day window.
Event (3)	KP Test	The KP Test does not change significance for any country compared to the T-test
	GRANK Test	The KP Test does not change significance for any country compared to the T-test
	Estimation window [-150,-30]	Slovenia becomes less significant in the 1-day window. Slovakia becomes more significant in the 11-day window. Italy loses significance in the 5-day window and France and Belgium both in the 11-day window.
	Estimation window [-500,-30]	Austria and the UK become less significant in the 1-day window. Czech Republic and Italy become less significant in the 5-day window. France and Romania become less significant in the 11-day window. Slovenia becomes less significant in the 1-day as well as the 5-day window.
Event (4)	KP Test	The KP Test does not change significance for any country compared to the T-test
	GRANK Test	The KP Test does not change significance for any country compared to the T-test
	Estimation window [-150,-30]	In the 1-day window Estonia, Portugal, Slovenia and Switzerland become less significant. In the 5-day window Italy, Romania, Slovenia and Spain become less significant. Estonia and Spain become less significant in the 11-day window. Belgium and Finland become less significant in all windows.
	Estimation window [-500,-30]	In the 1-day window Belgium, Portugal and Slovenia become less significant. In the 5-day window Bulgaria, Finland, Italy, Romania, Slovenia and Switzerland become less significant. In the 11-day window Finland becomes less significant. Croatia and Estonia lose all significance in the 1-day and 11-day window.

Note. For robustness the GRANK and KP Test are employed and their results are displayed. Also, different the results of different estimation windows are given. In column 1 the event is noted, in column 2 the alternative method and column 3 summarizes the differences in significance found in the data.