Erasmus School of Economics

Master Thesis

The response of European Stock Markets to the first and the second wave of the Covid-19 pandemic.

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Abstract

The aim of this study is to investigate the response of the European Stock markets to the first and the second wave of the Covid-19 pandemic. There is a large amount of literature examining the response of stock markets. However, by the time delivering this paper, there is a gap in the existing literature regarding the response of the Stock exchanges to policy evaluations and sectoral variation. This paper examines the effect of daily growth in total confirmed cases and deaths on stock market returns. In addition, the impact of a stringency policy index and sectoral analysis is extensively scrutinized. Using panel data analysis during the two waves of the pandemic in a total sample of 10 countries that include over 383.000 daily observations, I illustrate the expected different stock reactions between the two periods, the effect of governmental measures and finally a rigorous analysis of 10 different sectors.

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1 Introduction

At the time of delivering my thesis -07.02.2022- the World Health Organization (WHO) reports 394.381.395 confirmed cases of COVID-19 including 5.735.179 deaths (WHO, 2021). The data reveal that the largest number of confirmed cases are reported in America and Europe. However, this dramatic loss in human lives is among other several harmful consequences of the pandemic.

It was during the first days of 2020 when the Chinese authorities announced that an increasing amount of people was being treated for health-related issues (The New York Times, 2021). A new virus that seemed to cause an illness very similar to pneumonia had been detected. However, there was no evidence of a human transmission of the virus even though dozens of people in Asia had been infected. On January 11th, a 61-year-old man was the first victim of the Corona virus disease. It was reported that he had visited the Wuhan Huanan Seafood Wholesale Market. Nine days after the first death in China, the first cases of coronavirus were detected in Thailand, Japan, and South Korea while on the 21st of January the first patient with the symptoms of coronavirus was reported in USA.

In response to the rapidly increasing number of new cases, the Chinese authorities decided to undertake draconian measures to prevent the spread of the virus. The whole city of Wuhan, where most of the cases had been reported, was decided to cut off from the rest of the country. Travel restrictions that included the cancellation of flights, trains and other means of transport were adopted. It was on the 30th of January, nearly after 10.000 confirmed cases worldwide, when the World Health Organization (WHO) declared a global health emergency (The New York Times, 2021).

In Europe, the first confirmed cases of the coronavirus disease were officially detected on the 24th of January 2020 (European Centre for Disease Prevention and Control, 2020). A plea for non-pharmaceutical measures aiming to mitigate the spread of the coronavirus was published by the ECDC. National governments were called to take urgent measures, apply social distancing rules, avoid mass gatherings, apply travel restrictions, and introduce flexible working schedules. However, health related efforts to slow down the economic sequences of the pandemic seem to have failed. Following the rapid increase of total confirmed cases and deaths the WHO stressed out the devastating impact of Covid-19 on the economy and society. Germany, the largest economy of the Union entered a recession period. The country's economy contracted by 2,2% during the period January to March -compared to previous year (The New York Times, 2021).

The effect of the pandemic on the economic activity of the EU is reflected on the published growth GDP rates. It is reported that the decrease in GDP, compared to the previous year, during the 1st quarter of 2020 is 2,6%, 13,9% in the 2nd quarter, 4,2% in the 3rd quarter and 4,8% in the 4th

quarter (Eurostat, 2021). The increasing number of people and enterprises facing economic damages underscored the necessity of an urgent strategic planning to tackle the pandemic. The response of the European Union to tackle the effect of the pandemic was unprecedented. On the 21st of July 2020, the European authorities announced a €750 billion recovery plan "Next Generation EU" (Council of the European Union, 2021). The funds were directed for the support of local governments, businesses, and workers. In the long term, and till the end of 2027 a total of €2.3643 trillion will be directed to support the EU's recovery from the impact of Covid-19.

The effects of Covid-19 and its nexus with the global markets is clear. Among others, the WHO stresses out the devastating impact of Covid-19 on the economy. However, I was intrigued to investigate the following paradox: Despite the aforementioned negative impact of Covid-19 on the European economy, stock markets seem to perform unexpectedly well. The huge decline in economic activity across the countries of the EU does not appear to affect the performance of stock exchanges. Following a decline from January 2020 to March 2020, all the major European Stock exchanges seem to recover (Statista, 2021). The announced results for the year 2020 of Euronext, the largest European stock exchange which includes Amsterdam, Brussels, Dublin, Lisbon, Oslo and Paris, confirm the positive trend in the major European stock exchanges. Both the revenue and the EBITDA are increased by 30,2% compared to the last fiscal year (Euronext, 2021). Nasdaq Nordic, which includes the stock exchanges of Finland, Iceland, Sweden, and Denmark, also reports an increase of 31% over the last fiscal year in share trading which is translated into to a daily average of 3.723bn EUR (Mondovisione, 2021).

There is a large amount of literature regarding the effect of the pandemic on the economy and more specifically on stock prices. However, there is further space on the existing literature as at the time of writing the thesis there are no papers that investigate the response of the stock markets -for the countries of interest- to Covid-19 "measured in daily cases and deaths" while they also examine the implementation of a policy "lockdown" during the first and the second wave of the pandemic -in addition with a rigorous sectoral analysis. The importance of this study is dual. First, it illustrates the way stock markets reacted to the daily growth of Covid-19 cases and deaths while at the same time examines the effectiveness of the policies to tackle the pandemic and the impact these measures had on the stock exchanges. However, the valuation of the policies among the countries only applies to the level of stock exchanges. I only evaluate the impact of the lockdown on the performance of the stock markets and not on the governmental response as an attempt to prevent Covid-19 transmission. Second, the results illuminate the response of different sectors among the countries of the sample. Thus, it improves the knowledge of those engaged in the Stock markets and will help them understand and predict the future fluctuation of the stock prices. With respect to that and outlining this new reality, I observe an involving change in a globalised world. Starting from the first confirmed case in China to the declaration of the pandemic and from the

adoption of strict governmental rules to recovery plans during the summer of 2020, I am challenged to investigate the way all these events are reflected on the European stock markets. Therefore, the research question is structured as follows:

What is the response of the European stock markets to the outbreak of Covid-19 during the first and the second wave of the pandemic?

Following the research questions, a rich amount of stock data is used to investigate the response of the European stock markets to the outbreak of the pandemic during the first and the second wave. The goal of this paper is to analyse the way European stock markets performed. As already mentioned, it contributes to the current literature as -at the time of delivering the thesis- it is the first paper that provides a diligent analysis of two pan-European stock exchanges, namely Euronext and Nasdaq Nordic. The majority of the current literature provides a country level analysis. In addition, this paper deviates significantly from the existing literature as the selected time frame is much extended. The actual results of the paper will provide a detailed analysis which can help investors predict stock market reactions to similar unexpected phenomena.

The rest of the thesis is organized as follows. Section 2 presents the relevant literature and the formulation of the research hypotheses. Section 3 presents the methodology and the data used. Section 4 analyses the results and Section 5 discuss the conclusion and the limitations of the paper.

2 Literature Review and Hypotheses

2.1 Background and Literature Review

According to Al-Awadhi et al. (2020), stock markets respond to several considerable events. Among these events are major natural disasters, sport news, environmental and political events, all of which seem to directly impact the performance of stock exchanges, which is translated into stock market returns (Hendricks et al., 2019; Mirman & Sharma, 2010; Alsaifi et al., 2020; Kollias et al., 2012; Asteriou & Siriopoulos, 2003). The effect of the 2011 Eearthquake in Japan is investigated by Hendricks et al. (2019). Consequently, it appeared that the problems in supply chain as a result of the earthquake were reflected in the shareholders' value. Japanese firms seemed to experience a significant decrease of 9% on average on their shareholder value. The response of stock markets to the announcement of the winning country that will hold the Olympic Games is among one of the sport announcements that is examined by Mirman & Sharma (2010). An insignificant positive stock market reaction to the announcement of the summer Olympic Games and a significant negative reaction to the announcement of the Winter Olympic Games for the host country is reported. At the same time, stock markets tend to react to the announcement of environmental related disclosures. Alsaifi et al. (2020) investigate the way investors in UK

perceive and react to the disclosure of carbon dioxide emissions. As stated, that investors respond negatively, except for the period 2007-2008, to the voluntary carbon disclosure announcement. In addition, another study conducted by Kollias et al. (2012) suggests that the increased media coverage during the catastrophic environmental crisis in the Gulf of Mexico had a negative effect on the stocks prices for the firms involved. This is attributed to the negative public opinion in combination with the "investors' sentiment". Finally, political uncertainty is also related to the response of stock markets. Asteriou & Siriopoulos (2003) investigate the way political and social instability affect the stock market development in Greece. The results reinforced their expectations; that higher uncertainty in the political sphere negatively influences the stock market development.

Related literature addresses the response of stock markets during health crises. Among the most important health crises that have been subject to academic investigation are the Ebola virus disease (EVD) and the severe acute respiratory syndrome (SARS). The Ebola virus disease was first detected in 1976. However, during the years 2014 to 2016, Central and West African countries experienced a severe outbreak with a total of 28,.000 confirmed cases. Despite the fact the EVD mainly was detected in African countries and was not spread across other continents its implications were observed across the US stock market. Ichev & Marinč (2018) investigate the effect of the Ebola outbreak to the stock prices of the firms listed in the US. The authors suggest that the Ebola outbreak in conjunction with the intense media coverage affected the stock prices. More specifically, the results indicate that anxiety and fear related to the Ebola disease affected investors' perceived risk for the firms that operated there. Similar was the response of stock markets to the severe acute respiratory syndrome (SARS). Like Covid-19, SARS is a respiratory illness that was first reported in Asia in 2003. At a later stage it spread across Europe and America. An empirical investigation was carried by Chen et al. (2007) aiming to investigate the effect of SARS to the Taiwanese tourism industry. The results suggest a huge decline of approximately 29% in the hotel stock performance of Taiwanese firms. Following the literature related to the response of stock markets to several considerable events, a large amount of literature that investigates the response of stock markets during the new SARS Covid-19 pandemic was encountered.

The large amount of literature related to Covid-19 and stock Market returns is underlined in many scholars (Al-Awadhi et al., 2020; Yousfi et al. 2021; Bash, A. 2020). Following this approach, and at a first stage I investigated the related academic literature that measures the Covid-19 pandemic in daily confirmed cases and deaths. Consequently, the way that daily confirmed cases and deaths affected the stock market returns. However, as stated by Khanthavit (2021), the academic literature with respect to stock market returns is contradicting. Several papers find evidence of a negative and significant effects of Covid-19 on stock market returns. The results are stronger when daily confirmed cases and deaths increase. However, other scholars find evidence of a

positive and significant effect of the daily confirmed cases and deaths on stock market returns (Alam et al., 2020). Al-Awadhi et al. (2020) study the effect of Covid-19 on stock prices. The authors focus on China and analyse the direct impact of the disease on stock market returns. In addition, they proceed to a sector level analysis. A panel regression analysis is used while the effect of the pandemic is approached by two main variables: the daily confirmed cases and the daily deaths due to Covid-19. The results indicate a negative relation between the number of daily cases and deaths and the stock market returns in China. Regarding the sectoral analysis the results reveal that the following sectors: "information technology", and "medicine manufacturing" performed better while "transportation" and "beverages" "performed significantly worse than the market during the COVID-19 outbreak".

A unique approach is adopted by Yousfi et al. (2021). In their paper, the authors proceed to a comparative analysis of the first and second wave of the pandemic. They declare their paper as the first comparative approach between the first and the second wave for the US stock market. However, they use daily data from the S&P 500 index. The selected time frame is from the 5th of January 2011 to 21st of September 2020. As independent variables they use both the global cumulative cases and deaths. The authors stress the significant drop for both the US economy (S&P 500 index) during the Covid-19 period. High uncertainty as measured by the "implied volatility index (VIX) and US Economic Policy Uncertainty Index (EPU)", is detected during the beginning of the pandemic, which concurs with the increased number of global daily cases and deaths. Consequently, high uncertainty seems to be correlated with an increase in the number of daily cases and deaths. This implies serious sequences for the US stock market during the first and the second wave of the pandemic.

The impact of Covid-19 and its relationship with stock market returns is also subject to further academic literature. Liu et al. (2020) includes in his analysis the effect of crude oil. Investigating the US stock market and using data covering the period of the first wave (January – May 2020) the authors analyse this nexus. Covid-19 is measured by the number of daily confirmed cases, while crude oil prices and the S&P 500 index are included in the model. Aiming to structure their argumentation, the authors initially seem to expect that the outbreak of a global pandemic will affect negatively both the crude oil prices and the stock market returns. This is explained by the fact that the lower demand will lead to a decrease in the prices of crude oil. In addition, investors -based on the theory of real options- will defer their investment plans aiming to reduce uncertainty. However, the results obtained seem to contradict their initial expectations. Higher daily cases seem to lead to higher returns both in the crude oil and the stock market. Following this result, the authors stress that Covid-19 did not vandalize the economic performance at least in the US for this specific time frame. Another attempt to investigate the relationship between exchange rates, oil prices and the Covid-19 pandemic is made by Devpura (2021). The author

notes that the highest volatility for the EUR/USD rate -measured by the standard deviation- is observed during the Covid-19 pandemic. Oil price seems though to have higher values during the pre-covid period. However, the results suggest a very limited effect of oil price to the EUR/USD rate.

With respect to governmental interventions, several scholars argue that strict lockdown policies negatively affect the stock market performance (Davis et al., 2021; Bannigidadmath et al., 2021). Davis et al. (2021) examine to what extent a policy against the Covid-19 pandemic affects the stock prices. The Oxford "Stringency" Index is used to capture the intensity of governmental actions to tackle the pandemic. The estimated results indicate that the countries which adopted stricter measures face larger drops in their stock prices. Bannigidadmath et al. (2021) investigate the reaction of the stock market to the policies adopted across different countries. The authors use a sample of 25 countries to investigate this relationship. Aiming to capture the governmental policies, the authors include the following variables: "country lockdown, the stimulus package, travel ban, and monetary policy" which correspond to different forms of governmental interventions. Also in this case, a strong heterogeneity among countries is detected. For approximately one third of the total sample there is no evidence of stock market response to these policies. However, for the countries affected the relationship between stock market and governmental policies is negative. Overall, the authors stress the negative effects of governmental policies.

Nevertheless, the importance of mild governmental policies is stressed by several academic papers (Alam et al., 2020; Narayan et al., 2021; Baker et al., 2020). In the research conducted by Alam et al. (2020) the reaction of the Indian stock exchange is investigated during the first lockdown period. The authors use data of firms listed on stock exchange for a period of 35 days to capture the response of the market on the imposed lockdown. The results indicate the positive response of the stock market after the announcement of the lockdown. According to the authors the main reason of this reaction is the anticipated belief that a lockdown will constrain the spreading of the virus. As a result, the authors find evidence of a positive effect of the lockdown on stock prices. The findings by Narayan et al. (2021) also confirm the positive effect of the measures against corona virus on the performance of stock exchanges. As measures against the pandemic are selected the date of the lockdown for every country, the travel bans and other stimulus packages. The authors focus on the stock market returns of the G7 countries and assume that the different responses amongst countries will lead to different effect on the stock prices. The estimated results suggest that for five out of seven countries the effect of lockdown improved stock returns, although there is no evidence for Germany and Italy. Baker et al. (2020) investigate the effect of Covid-19 on the U.S. stock market until the last week of April 2020 by proceeding to a comparative analysis of the fluctuation of the US stock exchange since 1900. The writers support

the idea that the fluctuation on the US stock exchange from 1900 until the early 2020's has not been caused by any infectious diseases, pandemics or governmental measures to tackle them. However, during the first wave of Covid-19 the US stock market has faced several shocks -both upward and downward-. The restrictions imposed to confront the pandemic seem to be more aggressive than previous diseases. Nevertheless, the writers point out that the solution of lockdown or other restrictions were not considered during the 1818 Spanish Flu or during the 1957-58 influenza pandemic. In contrast, during these crises the government focused on the development of a vaccine and the in-house treatment of those infected. These diseases that seem to be much less fatal than Covid-19 had a lower impact on the US economy. As a result, the writers emphasize the necessity of less aggressive policies -than those implemented by the US government- should be adopted to tackle both the health and economic crisis of Covid-19.

2.2 Efficient Market Hypothesis

At this point it must be mentioned that the analysis of the Efficient Market Hypothesis is of great importance for the formulation of the research hypotheses. There are several theories which attempt to describe the determinants of stock markets. The efficient market hypothesis (EMH) suggests that the stock markets "fully reflect" all the available information (Malkiel & Fama, 1970). In their paper, the authors identify three different categories based on the available information "strong form, semi-strong form and weak form". The strong forms suggests that the investors have a monopolistic access to information, while the other two rely on more publicly available information. Based on this theory, all the available information is being reflected on the market performance that is characterized as efficient. An attempt to link the theory of efficient market hypothesis during the Covid-19 pandemic is conducted by Vasileiou et al. (2020). The authors investigate the effect of Covid-19 on stock prices. The estimated results suggest that before the first announcement of the WHO regarding Covid-19 the markets were performing roughly in line with the theory about EMH. All the available information and news related to Covid-19 did not trigger any response of the investors. It was only after the declaration of a global pandemic that stock markets faced a huge decline. Nevertheless, the announcement of financial reliefs programs and the governmental measures to tackle the pandemic lead the stock exchanges to a significant period of growth.

The following background will illuminate and analyse the implications of the EMH in the case of the Covid-19 pandemic. On November 9th Pfizer and BioNTech announced that the results from phase 3 of clinical trials suggest that their vaccine had more than 90% efficacy rate (The New York Times, 2021). The New York Times highlights the importance of this development by stressing that the results "far surpassed expectations". However, the announcement of the vaccine preceded by a period of 11 months, when BionTech initiated its work on the development of the vaccine.

On July 27, following the successful phase 1 trials, the two companies announced the launch of late-stage vaccine trials in a total of 30.000 volunteers. The New York Times captures the expectations in the following sentence "through the summer and into the fall, the world focused more and more of its attention on the Pfizer-BioNTech trial". The US president pledged the development of the vaccine by mentioning that "We are going to have a vaccine very soon. Maybe even before a very special day" – referring to the development of the vaccine before the Election Day -November 3, 2020- (Westcott - CNN, 2020). However, on December 11, the vaccine "granted an emergency use" by the Food and Drug Administration in the USA ten days later by the European Union. Consequently, it is expected that in line with the EMH, the expectations of the vaccine will be reflected on the stock market returns during the second wave of the pandemic.

2.3 Development of the hypotheses

As mentioned before, the effect of Covid-19 on stock market returns differentiates among countries, sectors, and time periods. Based on the existing literature there is a direct effect of several considerable events and more specifically severe health crises to stock market returns. Several scholars have been conducted to investigate this relationship (Al-Awadhi et al., 2020; Yousfi et al. 2021; Bash, A. 2020). The majority of the existing literature suggests a negative effect between stock market returns and Covid-19 -measured in total confirmed cases/deaths. However, while Covid-19 persists, its effect will differ across countries and time periods. Developing the hypotheses based on the existing literature, it is expected a negative relation between Covid-19 and stock market returns. Consequently, aiming to investigate the way all the countries of interest responded to the outbreak of the pandemic during the two waves the following hypotheses are developed.

Hypothesis 1a: Higher daily cases lead to a decrease in stock returns during the first wave of the pandemic.

Hypothesis 1b: Higher daily cases lead to a decrease in stock returns during the second wave of the pandemic.

Hypothesis 1c: Higher daily deaths lead to a decrease in stock returns during the first wave of the pandemic.

Hypothesis 1d: Higher daily deaths lead to a decrease in stock returns during the second wave of the pandemic.

How are these effects triggered by governmental interventions?

In fact, the existing literature suggests a significant effect of governmental policies, on stock market returns (Davis et al., 2021; Bannigidadmath et al., 2021; Alam et al., 2020; Narayan et al.,

2021; Baker et al., 2020). Following the same approach as before and aiming to examine the way governmental policies affected the stock market returns during the Covid-19 pandemic I searched for literature that examines the lockdown intensity. As stated by Khanthavit, (2021), certain countries and sectors seem to face an increase in the stock market returns during the lockdown period and a decrease in the period after the shift of lockdown measures. Based on that, we observe a direct relation of governmental measures and stock market returns. However, we expect a differentiation among countries, sectors, and time periods. The significant effect of governmental policies to tackle the effects of the pandemic is observed in the academic literature as described above.

Davis et al. (2021) argue that countries which adopted strict lockdown policies faced larger drops in the stock market prices during the first wave. As a result, it is expected that the decrease in economic activity which incurred by strict political guidelines will have a huge impact on the economic performance of these countries. Consequently, the stagnant economic activity is illustrated on the performance of the Stock Exchanges measured by their daily returns. Based on current literature, the theory of EMH suggests that information related to Covid-19 will be reflected in stock prices. Following the same approach, it is expected that uncertainty will have a direct effect on investors decisions.

With respect to the first wave and given the fact that there were no expectations of a vaccine development, investors will take their decisions based on governmental interventions. Consequently, during the first wave of the pandemic countries which adopted strict policies will face a decrease in their stock market returns. Investors will base their decisions on current available information as it is described by Vasileiou et al. (2020) and the theory of efficient market hypothesis. The increase in total confirmed cases and deaths during the first wave of the pandemic -in combination with strong governmental interventions in some countries- is expected to lead investors to risk aversion and consequently to a decrease in stock market returns.

However, during the second wave of the pandemic the available information has dramatically changed. As described, in line with the theory of EMH investors will take their decisions based on the current available information and this will be directly reflected in stock prices. During the second wave, it is expected that stock returns will increase after the announcement of the vaccine. In line with that, it is expected that countries which adopted stricter lockdown policies during the second wave of the pandemic will have a positive impact in their stock market returns. This will be driven by the expectations of a vaccine development in combination with the adoption of governmental measures. Consequently, the following hypotheses are formulated to test these governmental interventions.

Hypothesis 2a: Stricter lockdown policies lead to a decrease in stock returns during the first wave of the pandemic.

Hypothesis 2b: Stricter lockdown policies lead to an increase in stock returns during the second wave of the pandemic.

How are these effects separated by sector?

As discussed, I argue that different sectors are exposed to different types and levels of demand. As a result, several sectors will be heavily affected by the pandemic while others will thrive in the fast-changing environment. From a global perspective, travel, tourism, automobiles, and oil seem to be negatively affected while e-commerce, and the healthcare industry will benefit from these dramatic changes (S&P Global Market Intelligence, 2020). Al-Awadhi et al. (2020) argue about the negative effects of the pandemic on transportation and beverages while Chen et al. (2007) stress the huge decline in tourism industry. In contrast, it is argued that information technology and medicine manufacturing performed better than the market. Based on the current literature, it is expected that the pharmaceutical sector will be strengthened -in terms of stock market returns- during the two waves of the pandemic. Consequently, the following hypotheses are formulated to investigate the response of the industries during the two waves of the pandemic.

Hypothesis 3a: Higher daily cases lead to an increase in stock market returns for the pharmaceutical sector during the first wave of the pandemic.

Hypothesis 3b: Higher daily deaths lead to an increase in stock market returns for the pharmaceutical sector during the first wave of the pandemic.

Hypothesis 3c: Higher daily cases lead to an increase in stock market returns for the pharmaceutical sector during the second wave of the pandemic.

Hypothesis 3d: Higher daily deaths lead to an increase in stock market returns for the pharmaceutical sector during the second wave of the pandemic.

3. Methodology and Data

The following table categorizes the most important events in relation to Covid-19 and the dates that they occurred. Governmental actions to tackle the negative effects of the pandemic are observed during the first wave of the pandemic. However, during the second wave of the pandemic, the clinical trials and the vaccine development are selected as the most important factors. Since I aim to investigate the response of the selected stock exchanges to the outbreak of the pandemic, I searched for firm level data that cover the periods of interest. The data are derived

from Eikon – Datastream which provides access to a large amount of financial information available in a daily basis. This paper uses firms as the unit of analysis.

Table 1: List of considerable events

Considerable Events	**Date**
First confirmed case of Covid-19 in Europe	24-Feb-2020
Declaration of the pandemic by WHO	11-Mar-2020
National lockdowns	20-Mar-2020
Stimulus package	21-Jul-2020
Phase II of clinical trials – 30.000 volunteers	27-Jul-2020
Phase III of clinical trials – 90% efficacy rate	9-Nov-2020
Emergency used granted by FDA	11-Dec-2020

3.1 Panel Models

Following the literature on the effect of covid-19 on stock prices, several estimation techniques are applied. Alam et al. (2020) use an event study to examine the response of the Indian stock exchange to the outbreak of the pandemic while Al-Awadhi et al. (2020) use panel data regressions to examine the impact of Covid-19 on stock market returns.

I argue that, aiming to investigate the way stock exchanges responded to the outbreak of the pandemic during the two waves, panel data technique is appropriate to use. Consequently, firm level data that cover the two periods of interest are used. Panel data analysis exploits variation both on every unit in the analysis and over time. Firm level data are used that cover the two periods of the Covid-19 pandemic. This allows to control for firm level heterogeneity. In addition, aiming to control for unobserved time shocks, day fixed effects are included in the model.Returning to the research question, the aim of this paper is to investigate the unique effect of Covid-19 on stock market returns and not to analyze the determinants of stock market returns during that period. Fixed effects are preferred over random effects given the fact that the aim of this paper is to investigate the way time variant characteristics affect the dependent variable. Accordingly, fixed effects will allow the estimation of the direct effect of the selected time variant variables on stock market returns. In addition, a Hausman test is applied to determine whether fixed or random effects estimation is more suited. Following the specific characteristics of the research question, the Hausman test is applied separately for Covid-19 Cases and Covid-19

Deaths during the first and the second wave of the pandemic. In all four estimations the results are significant at 1% significance level, meaning that the H_0 is not supported. As a result, fixed effects is the preferred estimation technique over random effects in this analysis. Robust standard errors are also included in the model to fix the potential problem of heteroscedasticity.

The following model is developed to test hypothesis 1:

(i) $$Ri,t = \alpha 0 + \beta 1 \text{ Covid-19 Cases} + \beta 2 \text{Micro determinants} + \beta 3 \text{Macro determinants} + \varepsilon i,t$$

(ii) $$Ri,t = \alpha 0 + \beta 1 \text{ Covid-19 Deaths} + \beta 2 \text{Micro determinants} + \beta 3 \text{Macro determinants} + \varepsilon i,t$$

Where R represents the stock market returns of firm i on day t, Confirmed Covid-19 Cases represents the daily growth in total confirmed cases per million, Confirmed Covid-19 Deaths the daily growth in total confirmed deaths per million, micro economic determinants include the market capitalization and price to book value while macroeconomic determinants include the oil prices and the exchange rate (EUR/USD).

3.2 Difference in differences

In order to test the effect of governmental interventions on stock market returns and answer hypothesis 2, I use the difference in differences (DiD) technique. Goodman-Bacon and Marcus (2020) argue about the importance of DiD for a given policy and clearly mention that "a (DiD) design compares changes in COVID-related outcomes before and after a given policy takes effect in one area, to changes in the same outcomes in another area that did not introduce the policy". The DiD method will allow the investigation and the comparison of the outcomes between the control and the treatment group before and after an intervention. More specifically, in this case, the DiD method will capture the differences on stock market returns among the countries that imposed a strict lockdown. In addition, this effect is extended to two different periods, the first and second wave of infections. More specifically, this estimation technique requires two different groups, the control, and the treatment group. However, the effect is observed only in one (treatment group) while it is examined the period before and after the effect-strict lockdown. As a result, the DiD analysis will estimate the causal effect of adopting strong governmental measures on stock market returns. Robust standard errors to control for heteroscedasticity are included.

The following model is developed to test the hypothesis 2:

$$R_{it} = \beta_0 + \beta_1 \text{Lockdown}_i + \beta_2 \text{Country}_t + \beta_3(\text{Lockdown}_i * \text{Country}_t) + \beta 4 \text{Micro determinants} + \beta 5 \text{Macro determinants} + \mu_{it}$$

Where R represents the stock market returns of firm i on day t, lockdown is a dummy which indicates if the country has implemented a strict lockdown policy or not, Country indicates the treatment group and μ_{it} is the error term. In addition, firm fixed effects are included to control for firm level heterogeneity.

3.3 Data and variables

The selected time frame is the same for all countries of interest. This paper will investigate the response of the European Stock Exchanges during the first and the second wave of the pandemic. I define the period from March 1st to June 30th as the first wave and the period from September 1st to December 31st as the second wave of the pandemic. Based on the following segmentation, the generation of the two dummies was crucial for the further analysis. Consequently, the variable "first wave" takes the value 1 for all the observations from March 1st to June 30th and the value 0 otherwise. The variable "second wave" takes the value 1 for all the observations from September 1st to December 31st and zero otherwise. In addition, I proceed to a standardization of all the variables used in the model, aiming to achieve an equal range among the variables. Since the dataset consists variables of different scales the standardization will help to compare the values across the different variables.

Dependent variable: Eikon provides access to the close price of every firm listed on the stock market of interest. In addition, firm level data are available in a daily basis. However, since there are no data available for the stock market returns, I proceeded to a calculation of the returns using the formula described below:

$$\frac{Share\ Price\ "end"\ -\ Share\ Price\ "begin"}{Share\ price\ "begin"}$$

As a result, the following two dependent variables have been generated "return first wave" and "return second wave".

Independent variables:

Daily growth in total confirmed cases per million (Covid-19 Cases 1/2): Standardized variables that represent the daily growth in total confirmed cases during the first or the second wave of the pandemic. The data are retrieved from "Our World in Data" and include the daily confirmed cases per million for the countries of interest. It is stressed though that "the true number of infections may be far higher than the number of confirmed cases". Following the literature and the academic work of Al-Awadhi et al. (2020), I proceed to a further calculation aiming to capture the daily growth in total confirmed cases. The formula used is presented below:

$$\frac{Daily\ growth\ in\ total\ confirmed\ cases\ per\ million\ "end"\ -\ Daily\ growth\ in\ total\ confirmed\ cases\ per\ million\ "begin"}{Daily\ growth\ in\ total\ confirmed\ cases\ per\ million\ "begin"}$$

Daily growth in total confirmed deaths per million (Covid-19 Deaths 1/2): Standardized variables that represent the daily growth in total confirmed deaths during the first or the second wave of the pandemic. The data are retrieved from "Our World in Data" and include the daily confirmed deaths per million for the countries of interest. It is stressed though "that the number of confirmed deaths may not be an accurate count of the true total number of deaths from COVID-19". Following the literature, I proceed to a further calculation aiming to capture the daily growth in total confirmed deaths. The formula used is presented below:

$$\frac{Daily\ growth\ in\ total\ confirmed\ deaths\ per\ million\ "end"\ -\ Daily\ growth\ in\ total\ confirmed\ deaths\ per\ million\ "begin"}{Daily\ growth\ in\ total\ confirmed\ deaths\ per\ million\ "begin"}$$

Market capitalization (Market Capitalization 1/2): The market capitalization is derived from Eikon – Datastream and represents the value of the firm based on its shares. Market capitalization is available in a daily basis and can be used as a proxy for investors' decision to trade or not in this public share. Datastream defines market capitalization as "*the share price multiplied by the number of ordinary shares in issue*." Following the literature, I calculate the log value of Market capitalization. Al-Awadhi et al. (2020) include in their analysis the natural logarithm of daily market capitalization aiming to examine the effect of the pandemic on stock market returns.

Price to book value (Price to book value 1/2): The price to book value is derived from Eikon – Datastream and represents the "*share price divided by the book value per share*". The daily market to book value is used by Al-Awadhi et al. (2020) as one of the determinants of stock market returns during the Covid-19 pandemic.

Sector: The sectors of each listed firm are derived from Eikon – Datastream. In total there are 10 different sectors which represent the area of activity for the firms listed in the selected stock exchanges. Based on the academic literature, the sectoral analysis is dominant in many papers which examine the response of stock markets to the outbreak of the pandemic.

Stringency index: The intensity of lockdown is captured using The Oxford "Stringency" Index. In a scale from 1 to 100 is reflected the level of governmental actions to prevent the spread of the virus in a daily basis (OxCGRT, 2021). During the first wave of the pandemic, a value of 70 is considered as "hard" (Davis, 2021). However, during the second wave it is observed that most of the countries adopted, on average, less strict governmental actions. Thus, aiming to capture more variation and retrieve more meaningful results, the definition of a strict lockdown is adjusted to values higher than 60. This severity of governmental actions and the impact on stock market returns has been subject to various academic papers as already presented in the academic

literature (Davis et al., 2021; Bannigidadmath et al., 2021; Alam et al., 2020; Narayan et al., 2021; Baker et al., 2020).

Crude Oil (Crude Oil 1/2): The crude oil price is derived from Business Insider and represents the close price of the West Texas Intermediate (WTI) a trade classification of crude oil. Data of crude oil are available in daily basis and cover the whole period of interest. The effect of oil prices on stock market returns has been examined by several academics (Prabheesh et al., 2020; Arouri et al., 2011). It appears that oil prices are used not only as a measure to capture the global production activity but also as a financial asset that influence stock markets (Venditti 2020). Based on a publication by the European Central Bank it appears that stock markets respond to changes in oil prices (ECB, 2004). The analysis provides evidence that an increase in oil price is perceived by the investors as a sign of a decrease in economic growth. This seems to negatively affect the expectations of future earnings for the companies, thus resulting to a decrease in their stock prices. Nevertheless, during the turbulent period of 2020 it appears that the price per barrel reached a low of $36.98 on April 20 as a result of the imposed lockdowns and the consequential low oil demand (Rubbaniy et al. 2020). In their study the authors characterize crude oil prices as a determinant of stock market returns and find evidence of a direct effect during the two waves of the Covid-19 pandemic. Thus, it is highlighted the necessity of including the close price of crude oil in the current study as a control variable and a determinant of stock market returns.

Exchange rate (Exchange rate 1/2): The exchange rate is derived from Nasdaq and represents the ratio of EUR to USD. Data of exchange rate are available in daily basis and cover the whole period of interest. Based on the current literature it appears that national lockdowns and other measures aiming to halt the pandemic affected the international trade. Consequently, exchange rates got affected significantly (Rubbaniy et al. 2020). The authors find evidence of a negative effect of the volatility in exchange rates on stock market returns.

3.4 Descriptive statistics

The following table presents the descriptive statistics of the variables used in the model. As expected, all the variables are standardized indicating a mean of zero and a standard deviation of 1. It is interesting to note that the median is negative for almost all the variables across the two waves of the pandemic. With respect to firm level data the negative means describe the overall negative trend for the firms listed in the stock exchanges. The same applies to the explanatory variables indicating an overall decrease in the growth of Covid-19 cases and deaths. With respect to macroeconomic determinants, the negative medians also describe this decrease in their prices during the selected time frames. In addition, the correlation matrices suggest that the variables do not suffer from multicollinearity and thus could be used in the estimation models. Note that return is the standardized variable of the daily stock returns during the first wave; Covid-19 Cases

is the standardized variable of the daily growth in total confirmed cases per million during the first or the second wave; Covid-19 Deaths is the standardized variable of the daily growth in total confirmed deaths per million during the first or the second wave; Market Capitalization is the standardized variable of the natural logarithm of daily market capitalization during the first or the second wave; Price to book value is the standardized variable of the daily price to book value during the first or the second wave; Crude oil is the standardized variable for the closing price of Texas crude oil during the first or the second wave; Exchange rate is the standardized variable of the daily ratio of dollar to euro during the first or the second wave.

Table 2

Summary statistics - First wave.

	Mean	Median	SD	Max	Min
Return first wave	0	-0.00	1	107	-30.2
Covid-19 Cases	0	-0.15	1	12.1	-1.90
Covid-19 Deaths	0	-0.10	1	15.3	-2.01
Market Capitalization	0	0.01	1	2.73	-3.38
Price to book value	0	-0.34	1	4.66	-2.86
Crude oil	0	-0.66	1	2.55	-0.6
Exchange rate	0	-0.33	1	1.94	-1.71

Table 3

Summary statistics - Second wave.

	Mean	Median	SD	Max	Min
Return second wave	0	-0.04	1	96.6	-41.9
Covid-19 Cases	0	-0.05	1	15.1	-2.10
Covid-19 Deaths	0	-0.09	1	16.9	-7.48
Market Capitalization	0	0.02	1	2.63	-3.15
Price to book value	0	-0.37	1	4.20	-2.21
Crude oil	0	-0.71	1	1.76	-0.71
Exchange rate	0	-0.30	1	2.12	-1.44

Table 4

Correlation matrix 1a – First wave

	(1)	(2)	(3)	(4)	(5)	(6)
Return first wave	1					
Covid-19 Cases	0.02	1				
Market Capitalization	0.00	-0.02	1			
Price to book value	0.02	-0.00	0.30	1		
Crude oil	-0.00	0.11	0.02	0.46	1	
Exchange rate	-0.12	0.09	0.02	0.03	0.74	1

Table 5

Correlation matrix 1b – First wave

	(1)	(2)	(3)	(4)	(5)	(6)
Return first wave	1					
Covid-19 Deaths	0.01	1				
Market Capitalization	0.00	-0.01	1			
Price to book value	0.023	-0.01	0.30	1		
Crude oil	-0.01	0.02	0.02	0.47	1	
Exchange rate	-0.12	0.02	0.02	0.03	0.74	1

Table 6

Correlation matrix 2a – Second wave

	(1)	(2)	(3)	(4)	(5)	(6)
Return second wave	1					
Covid-19 Cases	-0.02	1				
Market Capitalization	-0.00	-0.03	1			
Price to book value	0.03	-0.02	0.32	1		
Crude oil	0.05	0.00	0.02	0.52	1	
Exchange rate	0.01	0.01	0.02	0.03	0.89	1

Table 7

Correlation matrix 2b – Second wave

	(1)	(2)	(3)	(4)	(5)	(6)
Return second wave	1					
Covid-19 Deaths	-0.00	1				
Market Capitalization	-0.00	-0.04	1			
Price to book value	0.03	-0.02	0.32	1		
Crude oil	0.05	0.03	0.02	0.52	1	
Exchange rate	0.01	0.02	0.02	0.03	0.89	1

4 Results

The current section describes the main results of the analysis. The order follows the research hypotheses as they have been previously formulated.

4.1 The effect of daily cases and deaths.

Tables 8 to 11 represent the coefficients derived from the panel data regressions. The results include all the firms listed on the selected Stock Exchanges and cover the period of the first and the second wave of the pandemic.

4.1.1 First wave of the pandemic

Aiming to test hypothesis 1 the following models are deployed. The effect of covid on stock market returns is investigated during the two waves of the pandemic. To do so I use a panel fixed effects estimation technique.

Table 8 shows the correlation between Covid-19 cases and stock market returns during the first wave. Based on the results derived, the daily growth in total confirmed cases per million is not associated with the stock market returns. The insignificant results on the effect of Covid-19 cases are confirmed even when the explanatory and control variables are added to the model. Hence, hypothesis 1a is rejected. This can be caused by the fact that 10 different countries are included in the model. Different countries faced different levels of influence on their stock markets. In addition, the extended period of the first wave might differentiate across countries. While in country x the wave persists in country y it might be partially controlled. The fixed time period definition did not allow to control for the differentiation across countries and intensity of the wave. Nevertheless, despite the insignificant effect of Covid-19 cases the positive sign is observed. It is interesting to note that this is in line with the findings of Liu et al. (2020). The authors found evidence of a positive effect of Covid-19 measured by daily cases on stock prices. Based on their

Table 8

Panel regression: Daily growth in total confirmed cases first wave

	(1)	(2)	(3)	(4)	(5)
Dependent variable: Stock market returns					
α0	0.62***	0.370***	0.354***	-1.875***	-2.402*
	(0.034)	(0.046)	(0.043)	(0.205)	(1.450)
Covid-19 Cases	0.005	0.007	0.007	0.008	0.008
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Market Capitalization		4.247***	4.204***	4.161***	4.161***
		(0.462)	(0.483)	(0.483)	(0.483)
Price to book value			0.021	0.026	0.026
			(0.022)	(0.023)	(0.022)
Crude oil				0.874***	1.021**
				(0.092)	(0.416)
Exchange rate					0.217
					(0.562)
Observations	120,086	120,086	120,086	120,086	120,086
Number of Countries	10	10	10	10	10
R^2	0.0005	0.0144	0.0145	0.0224	0.0511
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes
Day Fixed effects	Yes	Yes	Yes	Yes	Yes

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

findings the authors argued about the non-damageable impact of Covid-19 on the performance of the S&P 500 stock index.

Table 9 displays the results of the effect of Covid-19 on stock prices using as independent variable deaths related to Covid-19. The results indicate a positive relationship between the Covid-19 deaths and stock market returns during the first wave of the pandemic. The consistency of the results is also confirmed when the explanatory and control variables are included in the model. Hence, hypothesis 1c is also rejected. A similar reasoning with the effect of daily Covid-19 cases applies to the daily growth in total confirmed deaths per million as shown in columns 6-10 of Table 9.

Table 9

Panel regression: Daily growth in total confirmed deaths first wave

	(6)	(7)	(8)	(9)	(10)
Dependent variable: Stock market returns					
α0	0.500***	0.325***	0.310***	-1.024***	-1.762
	(0.056)	(0.062)	(0.027)	(0.053)	(0.051)
Covid-19 Deaths	0.009*	0.011**	0.011**	0.011**	0.011**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Market Capitalization		4.860***	4.820***	4.762***	4.762***
		(0.623)	(0.650)	(0.652)	(0.652)
Price to book value			0.019	0.024	0.024
			(0.025)	(0.025)	(0.025)
Crude oil				0.524***	0.729
				(0.141)	(0.473)
Exchange rate					0.304
					(0.597)
Observations	100,919	100,919	100,919	100,919	100,919
Number of Countries	10	10	10	10	10
R^2	0.0005	0.0146	0.0146	0.0184	0.0349
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes
Day Fixed effects	Yes	Yes	Yes	Yes	Yes

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

With respect to the analysis of the control variables it appears that their results as displayed in Table 8 and 9 are relatively similar. The variable Market Capitalization has a positive relationship with stock market returns. The results suggest that on average higher market capitalization for a firm leads to higher stock returns for the firm. In addition, the positive relationship between the stock market returns and the crude oil price is detected during the first wave of the pandemic. It does not apply the same for the price to book ratio and exchange rate. It appears that the results are not significant.

4.1.2 Second wave of the pandemic

In comparison to the first wave of the pandemic, the second wave suggests different results with respect to the explanatory variables as can be seen in Tables 10 and 11. Higher daily growth in

total confirmed cases per million leads to a decrease in stock market returns. The results are consistent even when the explanatory and control variables are included in the model. In addition, the effect is significant at 1% significance level. Hence, hypothesis 1b is not rejected.

Table 10

Panel regression: Daily growth in total confirmed cases second wave

	(1)	(2)	(3)	(4)	(5)
Dependent variable: Stock market returns					
α0	0.212***	0.439***	0.393***	2.479***	3.711***
	(0.040)	(0.044)	(0.049)	(0.243)	(0.898)
Covid-19 Cases	-0.014***	-0.015***	-0.015***	-0.015***	-0.015***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Market Capitalization		4.632***	4.567***	4.567***	4.567***
		(0.420)	(0.426)	(0.426)	(0.426)
Price to book value			0.061**	0.061**	0.061**
			(0.026)	(0.026)	(0.026)
Crude oil				-1.520***	-2.376***
				(0.146)	(0.618)
Exchange rate					0.141
					(0.093)
Observations	120,281	120,281	120,281	120,281	120,281
Number of Countries	10	10	10	10	10
R^2	0.0006	0.0198	0.0199	0.0213	0.0226
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes
Day Fixed effects	Yes	Yes	Yes	Yes	Yes

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 11

Panel regression: Daily growth in total confirmed deaths second wave

	(6)	(7)	(8)	(9)	(10)
Dependent variable: Stock market returns					
α0	0.273***	0.808***	0.763***	3.056***	3.597***
	(0.000)	(0.072)	(0.044)	(0.273)	(0.134)
Covid-19 Deaths	0.002	-0.001	-0.005	-0.005	-0.006
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
Market Capitalization		4.990***	4.927***	4.927***	4.927***
		(0.454)	(0.461)	(0.461)	(0.461)
Price to book value			0.059*	0.059*	0.059*
			(0.031)	(0.031)	(0.031)
Crude oil				-1.671***	-2.046***
				(0.155)	(0.650)
Exchange rate					0.061
					(0.098)
Observations	98,320	98,320	98,320	98,320	98,320
Number of Countries	10	10	10	10	10
R^2	0.0000	0.0191	0.0192	0.0216	0.0225
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes
Day Fixed effects	Yes	Yes	Yes	Yes	Yes

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

As can be seen from Tables 10 and 11, all the explanatory and control variables differ from the results of the first wave of the pandemic. It appears the results are significant. At this point, the importance of the daily growth in total confirmed deaths needs to be stressed as shown in Table 11 columns 6-10. The results are not significant for the effect of daily deaths on stock market returns. Thus, hypothesis 1d is rejected. It is suggested that investors are not affected by the daily growth in confirmed deaths. This is explained by the fact that the announcement of the vaccine has a positive impact on the stock market returns. Consequently, investors do not seem to be affected by the number of daily deaths since the expectations of a vaccine overcome the risk of a long period of instability due to the Covid-19 pandemic.

4.2 Governmental response and stock market returns.

Aiming to test hypothesis 2 the following models are deployed. The effect of governmental actions on stock market returns is investigated during the two waves of the pandemic. To do so I use a difference in differences estimation technique. Table 12 displays the results of imposing a strict lockdown on stock market returns during the first and the second of the pandemic.

4.2.1 First wave of the pandemic

Following the same approach between the two waves, I analyse this specific effect of governmental actions. As in the case of daily cases/deaths and stock market returns, the results suggest that the two waves differ significantly. More specifically, it appears that during the first wave of the pandemic countries that adopted stricter policies -based on the Oxford stringency index- faced a decrease in their stock market returns. The effect is significant at 1% significance level. The negative effect of strict lockdown policies during the first wave of the pandemic is in line with the analysed literature and according to the expectations. Hence, hypothesis 2a is not rejected. It is suggested that countries that adopted stricter measures faced larger drops in their stock prices during the first wave of the pandemic. The results can be explained by the fact that the decrease in economic activity, which incurred by strict political measures, had a large impact on the economic performance of these countries. Consequently, the stagnant economic activity is illustrated on the performance of the stock exchanges measured in their daily returns. With respect to the control variables that are included in the model it appears that all are significant at 1% significance level. The variable Market Capitalization has a positive relationship with stock market returns. However, a negative relationship between the stock market returns and the crude oil price is detected. The same applies for the price to book ratio. Exchange rate is also negatively correlated with stock market returns.

4.2.2 Second wave of the pandemic

The second wave suggests similar results with the first wave of the pandemic. Based on the variable Stringency Index we observe a switch of the governmental policies to tackle the pandemic. During the second wave, most of the countries do not seem to impose a strict lockdown to tackle the effects of the pandemic. France and Ireland adopted the strictest measures (stringency index above 70). However, aiming to capture more variation the stringency index is reduced from 70 to 60. Consequently, the countries that consist the treatment group are Belgium, France, Ireland, Netherlands, Portugal, Sweden. However, the results suggest that countries that adopted stricter lockdown policies during the second wave of the pandemic had a positive impact on their stock market returns. The effect is also significant at 1% significance level. Hence, hypothesis 2a is rejected. It appears though that the relatively small coefficients that are obtained

do not allow a clear interpretation of a positive effect of the lockdown on stock market returns. This negative effect of lockdown on stock markets has been detected by several other studies. Based on the findings, and as already discussed, it appears that strict lockdown policies negatively affect the stock market performance (Davis et al., 2021; Bannigidadmath et al., 2021).

Table 12

Difference in differences: Effect on Stock returns after the imposition of a strict lockdown first wave

	(1) First wave	(2) Second wave
Dependent variable: Stock market returns		
α0	0.304*** (0.057)	-0.702*** (0.010)
Strict Lockdown	0.161** (0.072)	0.053*** (0.016)
Treatment group	0.453*** (0.16)	0.025*** (0.009)
Treatment group x Strict Lockdown	-0.454*** (0.16)	-0.089*** (0.017)
Market Capitalization	0.018*** (0.003)	0.010*** (0.001)
Price to book value	-0.062*** (0.014)	-0.0162*** (0.003)
Crude oil	-0.002*** (0.001)	-0.001 (0.001)
Exchange rate	-0.001*** (0.001)	-0.001*** (0.001)
Observations	171,827	151,207
Number of Countries	10	10
Firm Fixed effects	Yes	Yes

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

4.3 Sectoral analysis

Tables 13 to 16 represent the coefficients derived from the fixed effects panel data regressions. The results obtained display the impact of Covid-19 on 10 different sectors during the first and the second wave of the pandemic.

4.3.1 First wave of the pandemic

Tables 13 and 14 represent the results derived for the first wave of the pandemic. Following the results as displayed in table 13, it appears that for the health care sector both higher daily cases and deaths lead to an increase in stock market returns. As it was expected the healthcare industry, which includes the pharmaceutical sector, has a positive and significant effect on stock market returns. The stock market returns indicate this positive trend. The results are significant at 1% significance level. Thus, hypotheses 3a and 3b are not rejected. Being in the centre of the attention during the first wave, the pharmaceutical industry faces higher stock market returns. Consequently, it can be assumed that the expectations of the vaccine development during the first wave of the pandemic lead to an investor friendly environment with respect to the pharmaceutical industry.

As observed in tables 13 and 14, the results are positive and significant for most of the sectors suggesting a positive effect of increased Covid-19 cases and deaths on stock market returns. Of great importance are the results for all sectors with respect to the rest of the explanatory and control variables. Higher market capitalization has a positive effect on stock market returns. Nevertheless, insignificant results are observed for the price to book value. In respect to the macroeconomic determinants, higher crude oil prices lead to an increase on stock market returns for all the sectors while the exchange rate has a negative effect.

4.3.2 Second wave of the pandemic

Tables 13 and 14 represent the results derived for the second wave of the pandemic. Following the results as displayed in tables 13 and 14, it appears that for the health care sector both higher daily cases and deaths lead to a decrease in stock market returns. The results are significant at 1% significance level. Thus, hypotheses 3c and 3d are rejected. It is observed that the expectations of the vaccine development during the first wave of the pandemic lead to an investor friendly environment with respect to the pharmaceutical industry. The high expectations for the development of a vaccine are related to the expected growth of the industry. Nevertheless, it must be clearly indicated that during the first wave there were no official announcements for a vaccine. As can be seen from table 1- it was during the middle of the summer when the phase II of clinical Trials to 30.000 volunteers was announced. However, on table 1 it is observed that in the beginning of November the phase III of clinical trials showed a 90% efficacy rate while a few days

later, the FDA granted an emergency use of the vaccine. These events seem to be present in the investors' behaviour. During the second wave of the pandemic, it is observed that the expectations were turned to reality. Taking that into account it appears that the uncertainty about the vaccine development was reduced. As a result, the risk for the investors reduced significantly. Thus, it is argued that the negative sign of the pharmaceutical industry during the second wave reflect this trend in investors' decision, which appears with a decrease in stock market returns.

As observed in tables 13 and 14, the results are negative and significant for most of the sectors suggesting a negative effect of increased Covid-19 cases and deaths on stock market returns. In line with the first wave of the pandemic, it is observed that higher market capitalization has a positive effect on stock market returns. Insignificant results are observed for the price to book value. In respect to the macroeconomic determinants, it is also observed that during the second wave of the pandemic higher crude oil prices lead to an increase on stock market returns while the exchange rate has a negative effect.

Table 13

Panel regression with specific sectors dummy variable - First wave.

	Industrial	Communication Services	Real estate	Consumer Discretionary	Health Care	Financials	Energy	Consumer Staples	Information Technology	Other
Dependent variable: Stock market returns										
α0	-1.364*** (0.077)	3.832*** (1.092)	-0.466** (0.228)	0.5070*** 0.152	-0.42*** (0.073)	-1.639*** (0.095)	-3.278 (1.010)	0.544*** (0.197)	1.240** (0.616)	-0.361*** (0.062)
Covid-19 Cases	0.043*** (0.011)	0.026 (0.029)	0.039** (0.016)	0.064** (0.025)	0.074*** -0.018	0.023** (0.010)	-0.012 (0.030)	0.046*** (0.009)	0.059*** (0.008)	0.045*** (0.008)
Market Capitalization	6.891*** (0.638)	6.465*** (1.637)	2.346 (2.344)	4.711*** (0.454)	5.007*** -0.567	7.265*** (0.544)	14.556** (6.873)	7.883*** (0.947)	3.904*** (1.246)	5.931*** (0.803)
Price to book value	0.092** (0.045)	-0.004 (0.147)	-0.1246 (0.160)	0.059 (0.056)	-0.007 (0.027)	-0.046 (0.107)	-0.309 (0.307)	0.026 (0.031)	0.094 (0.063)	0.008 (0.051)
Crude oil	0.273*** (0.031)	0.255*** (0.067)	0.452*** (0.061)	0.341*** (0.061)	0.061 (0.398)	0.0271*** (0.029)	0.133 (0.310)	0.119 (0.086)	0.222*** (0.044)	0.267*** (0.051)
Exchange rate	-0.512*** (0.025)	-0.422*** (0.057)	-0.43*** (0.050)	-0.5248 (0.152)	-0.32*** -0.023	-0.451*** (0.031)	-0.64*** (0.054)	-0.316*** (0.031)	-0.410*** (0.020)	-0.482*** (0.021)
Observations	15,243	3,074	8,969	6,066	13,049	12,058	3,306	6,410	15,797	20,792
Number of Countries	10	10	10	10	10	10	10	10	10	10
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0861	0.0480	0.0258	0.0604	0.0500	0.0618	0.0869	0.0458	0.0466	0.0718

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 14

Panel regression with specific sectors dummy variable - First wave.

	Industrial	Communication Services	Real estate	Consumer Discretionary	Health Care	Financials	Energy	Consumer Staples	Information Technology	Other
Dependent variable: Stock market returns										
α0	-1.278*** (0.088)	3.658*** (1.240)	-0.230 (0.357)	0.723*** (0.187)	-0.114 (0.077)	-1.617*** (0.127)	-3.19*** (1.166)	0.922*** (0.251)	1.083** (0.568)	-0.225*** (0.066)
Covid-19 Deaths	0.034** (0.0138)	0.051 (0.037)	0.033* (0.018)	0.071** (0.034)	0.060*** (0.011)	0.010 (0.006)	0.033** (0.012)	0.037*** (0.010)	0.050*** (0.007)	0.040*** (0.011)
Market Capitalization	7.166*** (0.655)	6.150*** (1.841)	2.712 (2.884)	5.435*** (0.6561)	4.588*** (0.678)	8.468*** (0.761)	15.944* (8.380)	9.325*** (1.176)	3.264*** (1.139)	5.957*** (0.770)
Price to book value	0.028 (0.058)	0.114 (0.185)	0.176 (0.177)	0.054 (0.053)	0.001 (0.031)	-0.010 (0.156)	-0.303 (0.341)	0.023 (0.040)	0.100* (0.060)	-0.006 (0.055)
Crude oil	0.261*** (0.035)	0.281*** (0.087)	0.398*** (0.056)	0.363*** (0.069)	-0.017 (0.042)	0.257*** (0.034)	0.138 (0.309)	0.063 (0.104)	0.196*** (0.047)	0.250*** (0.031)
Exchange rate	-0.442*** (0.0312)	-0.378 (0.069)	-0.351*** (0.060)	-0.488*** (0.057)	-0.21*** (0.025)	-0.406*** (0.034)	-0.59*** (0.061)	-0.256*** (0.037)	-0.322*** (0.024)	-0.404*** (0.025)
Observations	13,227	2,673	7,889	5,262	11,487	10,271	2,933	5,594	13,811	18,085
Number of Countries	10	10	10	10	10	10	10	10	10	10
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0684	0.0443	0.0170	0.0570	0.0340	0.0639	0.0835	0.0421	0.0301	0.0525

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 15
Panel regression with specific sectors dummy variable - Second wave.

	Industrial	Communication Services	Real estate	Consumer Discretionary	Health Care	Financials	Energy	Consumer Staples	Information Technology	Other
Dependent variable: Stock market returns										
α0	-0.730***	0.808	1.453***	0.995*	-1.181***	-1.148***	-3.827***	1.139***	1.737	-0.910***
	(0.204)	(1.566)	(0.362)	(0.561)	(0.278)	(0.145)	(0.835)	(0.386)	(1.094)	(0.141)
Covid-19 Cases	-0.001	-0.041	0.010	-0.044***	-0.033***	-0.045***	-0.078**	-0.026*	-0.079***	-0.047***
	(0.017)	(0.030)	(0.010)	(0.014)	(0.011)	(0.009)	(0.030)	(0.013)	(0.012)	(0.007)
Market Capitalization	6.461***	1.449	5.366***	4.322***	5.336***	4.009***	8.474***	8.282***	5.158**	4.460***
	(0.358)	(2.624)	(0.724)	(1.218)	(0.658)	(0.780)	(1.793)	(1.085)	(2.044)	(0.731)
Price to book value	0.067***	0.673*	-0.46***	0.068	0.024	-0.038	0.182**	0.006	0.062	0.135***
	(0.025)	(0.383)	(0.158)	(0.065)	(0.070)	(0.051)	(0.074)	(0.049)	(0.047)	(0.041)
Crude oil	0.033	-0.001	-0.386*	0.135	0.681***	0.539***	1.36**	-0.041	0.328*	0.237**
	(0.143)	(0.413)	(0.201)	(0.222)	(0.174)	(0.131)	(0.567)	(0.226)	(0.183)	(0.114)
Exchange rate	-0.186***	-0.053	-0.029	-0.103***	-0.169***	-0.181***	-0.414***	-0.098**	-0.111***	-0.132***
	(0.035)	(0.105)	(0.038)	(0.033)	(0.034)	(0.023)	(0.100)	(0.039)	(0.031)	(0.021)
Observations	15,128	3,157	8,848	5,993	12,723	12,266	3,379	6,584	15,805	36,398
Number of Countries	10	10	10	10	10	10	10	10	10	10
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0315	0.0105	0.0297	0.0232	0.0262	0.0223	0.0420	0.0337	0.0259	0.0206

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 16
Panel regression with specific sectors dummy variable - Second wave.

	Industrial	Communication Services	Real estate	Consumer Discretionary	Health Care	Financials	Energy	Consumer Staples	Information Technology	Other
Dependent variable: Stock market returns										
α0	-0.509**	1.039	2.617***	2.101***	-0.637*	-0.811***	-3.339	1.549***	2.275*	-0.129
	(0.240)	(1.640)	(0.378)	(0.785)	(0.332)	(0.179)	(0.931)	(0.447)	(1.273)	(0.186)
Covid-19 Deaths	-0.009	0.003	-0.012	-0.006	-0.068***	0.014	-0.035***	-0.025**	0.011	0.008
	(0.013)	(0.031)	(0.015)	(0.024)	(0.016)	(0.013)	(0.030)	(0.011)	(0.013)	(0.014)
Market Capitalization	6.555***	1.204	5.964***	5.687***	5.375***	3.795***	7.571***	8.527***	5.097**	5.19***
	(0.339)	(2.754)	(0.494)	(1.727)	(0.687)	(0.809)	(1.418)	(1.126)	(2.218)	(0.780)
Price to book value	0.031	0.709*	-0.50***	-0.001	0.043	-0.021	0.302***	-0.004	0.057	0.14***
	(0.030)	(0.412)	(0.117)	(0.040)	(0.082)	(0.046)	(0.097)	(0.046)	(0.046)	(0.049)
Crude oil	-0.045	-0.238	-0.65***	-0.177	0.452**	0.444***	1.174*	-0.181	0.080	-0.054
	(0.166)	(0.478)	(0.212)	(0.252)	(0.205)	(0.147)	(0.646)	(0.254)	(0.208)	(0.137)
Exchange rate	-0.19***	-0.015	0.006	-0.093**	-0.152***	-0.164***	-0.383***	-0.081*	-0.077*	-0.1***
	(0.041)	(0.120)	(0.042)	(0.038)	(0.039)	(0.025)	(0.113)	(0.045)	(0.035)	(0.025)
Observations	13,033	2,812	7,700	5,055	11,008	10,568	3,083	5,808	13,486	25,767
Number of Countries	10	10	10	10	10	10	10	10	10	10
Firm Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0315	0.0098	0.0342	0.0226	0.0260	0.0187	0.0377	0.0330	0.0227	0.0215

The robust standard errors are presented in parentheses. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

5 Discussion & Conclusion

5.1 Discussion of the results

The results that derive from the research are important both from scientific perspective but also from policy one. This paper contributes to the existing literature as it illuminates the response of stock markets to the outbreak of Covid-19 during the first and the second wave of the pandemic.

5.1.1 First wave

During the first wave the results derived do not support the negative association between daily Covid-19 cases/deaths and stock market returns. Instead, the relation between the two independent variables and the returns appears to be positive. An explanation is the nature of the selected dataset that includes the daily stock returns of all firms listed in 10 different stock exchanges for an extended time frame. Overall, based on the results retrieved the non-damageable effect of Covid-19 on Stock Markets might be concluded. With respect to governmental measures, the results suggest that countries which adopted stricter measures faced larger drops in their stock prices. Thus, it can reasonably be concluded that strict actions to tackle the negative effects of the pandemic had a negative impact on stock market returns. Finally, with respect to the sectoral analysis the results confirmed the positive sign of the health care sector, providing evidence of the increased importance and the good financial performance of the pharmaceutical industry.

5.1.2 Second wave

During the second wave the results derived support the negative association between daily Covid-19 cases and stock market returns. This was in line with the existing literature and the expectations of a negative relation between the dependent and independent variables. However, there is no evidence of the effect of daily cases on stock market returns. Thus, it can be reasonably concluded that the announcement of the vaccine had a positive impact on investors decisions. This can be translated with a non-significant effect of daily cases on stock returns. With respect to governmental measures, the results suggest that countries which adopted stricter measures had a negative effect on their stock market returns. Finally, the results were surprisingly interesting with respect to the sectoral analysis. It appears that the pharmaceutical industry had a negative and significant effect on stock market returns. As in the case of governmental actions, it can be concluded a trend of dissociation of the effect of Covid-19 on stock market returns.

5.2 Conclusion

Looking back on the results derived during the second wave of the pandemic, it is observed the non-significant effect of daily Covid-19 deaths on stock market returns. Future literature might extend this study be examining the effect of Covid-19 cases and deaths on stock market returns

during the third and currently the fourth wave of the pandemic for the countries of interest. Based on the existing literature, I could mention some limitations detected on my paper. Even though all the countries are in close geographical proximity there is heterogeneity among them. Since France is the biggest country in the sample it comprises almost 1/3 of the total observations. Consequently, the results are driven by this factor. In addition, the large time frame does not allow to focus on changes that take place in each month. As a result, important events during these months that potentially affect the trend in stock market returns might have been missed. This segmentation of the sample between 1st and 2nd wave does not allow us this examination. A shorter time frame would allow a better understanding of the results of every industry. Indeed, most of the existing academic papers focus both on a smaller number of countries and in a shorter time frame. Overall, this paper investigates the effect of Covid-19 measured by two important determinants (Covid-19 cases and deaths) on Stock Markets. In addition, it provides evidence of the importance of governmental policies and country characteristics to tackle the pandemic. Finally, I also argue that several sectors are heavily affected by the pandemic while others seem to perform better in a fast-changing environment. The cross sectoral analysis illuminates the industries' response on the changes occurred for the chosen European countries.

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