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COVID-19's Impacts on European Stock Markets: A Sectoral Analysis

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Abstract

The novel coronavirus represents an emergency for the world, impacting various economic and financial fields. One of these fields was the stock market. However, this market had asymmetric effects at the sectoral level. Thus, while revenues from some sectors fell sharply, other had demand for their goods and services increased exponentially. For this reason, the focus of this study is to provide critical analysis of all transmission channels between the current pandemic and the European stock market, highlighting the main reasons for the heterogenic behavior of the market. Therefore, the daily data of 940 firms based in 17 European countries were analysed from 5 September 2019 to 26 February 2021, using the event study.

The main finding was that the pandemic harmed European stock markets. However, this impact presented heterogeneity at a sectoral level. On the one hand, the basic resources and hardware sectors showed positive results over the period. On the other hand, the aerospace, airlines, and hospitality sectors presented the worst results had analysed, which is consistent with the current literature. In the second phase, the discovery of the vaccine had positive impacts on the market, but the appearance of new strains slowed its growth.

The variables related to the number of confirmed cases and the number of deaths had a negative impact, but the number of people vaccinated showed no effect. In addition, the impacts of government measures were mixed. On the one hand, mobility restrictions negatively impacted returns, but economical support and stimulus positively impacted stock markets. Finally, variables that capture market sentiment have all had negative impacts, evidencing the role of this channel in the stock markets.

JEL codes: G10; G14; G18; I18

Keywords: contagion; coronavirus; COVID-19; Europe; event study; heterogeneity; spillover effects; stock market; sectoral analysis

Resumo

O novo coronavírus representa uma emergência para o mundo, impactando vários campos económicos e financeiros. Um destes campos foi o mercado de ações. Contudo, este mercado apresentou efeitos assimétricos ao nível setorial. Enquanto que as receitas de alguns setores caíram drasticamente, outros tiveram a procura pelos seus bens e serviços a aumentar exponencialmente. Por esta razão, o foco deste estudo, é providenciar uma análise crítica de todos os canais de transmissão entre a atual pandemia e o mercado de ações europeu, evidenciando os principais motivos do comportamento heterógeno do mercado. Com efeito, os dados diários de 940 empresas, sediadas em 17 países europeus foram analisadas para o período entre 5 de setembro de 2019 a 26 de fevereiro de 2021, empregando o estudo de eventos.

O principal resultado foi de que a pandemia teve um impacto negativo no mercado de ações europeu. Contudo, este impacto apresentou uma heterogeneidade a um nível setorial. Por um lado, os setores de recursos básicos, e *hardware* apresentaram resultados positivos ao longo do período. Por outro, o setor aeroespacial, companhias aéreas, e hotelaria apresentaram os piores resultados analisados, o que é consistente com a literatura atual. Na segunda fase, o descobrimento da vacina teve impactos positivos no mercado, mas o aparecimento de novas estirpes desacelerou o seu crescimento.

As variáveis relacionadas com o número de casos confirmados, e o número de mortes tiveram um impacto negativo no mercado, mas, o número de pessoas vacinadas não mostrou qualquer impacto. Para além disso os efeitos das medidas governamentais foram mistos. Por um lado, as restrições à mobilidade impactaram negativamente os retornos, mas os apoios e estímulos económicos impactaram positivamente os mercados de ações. Por último, variáveis que capturam o sentimento de mercado tiveram todas impactos negativos, evidenciando o papel deste canal nos mercados de ações.

Códigos JEL: G10; G14; G18; I18

Palavras-chave: contágio; coronavírus; COVID-19; Europa; estudo de eventos; heterogeneidade; efeitos de repercussão; mercado de ações; análise setorial

Table of contents

List of Figures

List of Tables

Abbreviations and acronyms

AR – Abnormal Return

ARCH – Autoregressive Conditional Heteroscedasticity

CAR – Cumulative Abnormal Return

COVID-19 – Coronavirus Disease

EC – European Commission

ECB – European Central Bank

EMA – European Medicines Agency

EMH – Efficient Market Hypothesis

EU – European Union

GARCH – Generalized Autoregressive Conditional Heteroscedasticity

GDP – Gross Domestic Product

IMF – International Monetary Fund

OLS – Ordinary Least Squares

PEPP – Pandemic Emergency Assets Purchase Programme

SARS – Severe Acute Respiratory Syndrome

UK – United Kingdom

US – United States

WHO – World Health Organization

1. Introduction

The years 2020, 2021, and most likely 2022 will be forever marked by coronavirus disease (COVID-19). Although it first manifested itself on 31 December 2019 in Wuhan, China, it spread rapidly throughout the world in 2020. After being considered a "Public Health Emergency of International Concern," the fact that it spread globally (Porta, 2014) led the World Health Organization (WHO) to confirm COVID-19 as a pandemic on 11 March 2020 (WHO, 2020).

Since the novel coronavirus' emergence, many researchers have begun to work on discovering the impacts of this pandemic in various fields, such as health, economy, environment, financial markets, among others (Chaudhary et al., 2020; Huo & Qiu, 2020; Sharif et al., 2020; Yue et al., 2020). This study targets stock markets due to a few factors. The first and fundamental is that stock markets represent an essential part of the economy, being the pillar of the financial sector (Huo & Qiu, 2020; Phan & Narayan, 2020; Rout et al., 2020). Countries whose financial markets are well regulated and developed, markets act as a barometer, signalling their global economic situation (Chang et al., 2020; Chaudhary et al., 2020; He, Sun, et al., 2020; Liu, Manzoor, et al., 2020), and the situation of the different sectors (Zhou et al., 2020). Secondly, unlike the real macroeconomic impacts of the pandemic that can only be analysed in the long-term, stock markets are impacted much faster (Bai et al., 2021; Lee et al., 2021; Liu, Wang, et al., 2020; Seven & Yılmaz, 2021). Finally, stock markets allow the analysis of investors' current expectations, translating into a continuous and updated summary of their beliefs (Bai, 2014; Mukanjari & Sterner, 2020). In the stock market, groups of sophisticated, knowledgeable, and opinionated investors are found, which provides a more accurate analysis of expected future results, making its analysis crucial, especially in times of crisis (Ashraf, 2020a; Chaudhary et al., 2020; Wagner, 2020).

These markets suffered drastic falls, driven by some factors. In turn, it is essential to understand how the stock price is formed for a better comprehension of how these factors impacted the markets. First, the stock price can be calculated by expecting a company's future cash flow behavior. This process is the rational way of valuing a stock: considering all expected future cashflows of a company, discounted to the present, it is possible to have a notion of its intrinsic value. Thus, since the pandemic forced the closure of most of the

business activity, it would be expected that its cashflows would be lower, and for this exact reason, caused stock prices to fall (Aggarwal et al., 2021; Heyden & Heyden, 2021; Lee et al., 2021; Reis & Pinho, 2020; Vasileiou, 2021; Zaremba et al., 2020). Likewise, some models are based on the dividends distributed by companies, such as the famous Gordon Model. This model reveals that the current share price can be determined by updating all expected dividends that the company will pay if this share is detained *ad aeternum* (Mishkin, 2019, pp. 191 - 194). Thus, if the company faces a crisis, the probability of these dividends being distributed is virtually nil, leading to a fall in the stock price (Gormsen & Koijen, 2020; Lee et al., 2021; Vasileiou, 2021).

Second, stock prices depend not only on a company's economic and financial fundamentals but also on investors' irrational expectations (Ozili & Arun, 2020). When stock prices began to fall infinitely, many investors stopped rationally analysing the value of each, and assuming that prices would continue to fall, they preferred to sell at the highest possible value (Chaudhary et al., 2020; Singh et al., 2020). Thus, fear and uncertainty started the price game and, the sale of shares in large numbers caused the price to fall even further (Liu, Manzoor, et al., 2020; Wagner, 2020; Zaremba et al., 2020).

As a result, these effects have triggered a rampant fall on the part of the stock markets (ALAM et al., 2020; Ding et al., 2020; Huo & Qiu, 2020; Sharif et al., 2020; Shehzad, Xiaoxing, & Kazouz, 2020), and many markets saw their worst results in years (Chaudhary et al., 2020). Interestingly, although all economic activities have suffered, specific sectors have been more affected than others. A pioneering study by Goodell (2020) revealed that the pandemic would already have more impacts in other sectors than others. Moreover, that is really what was observed. Some authors like Al-Awadhi et al. (2020), Liu, Wang, et al. (2020), and Mazur et al. (2021) (to name a few) showed that some sectors had relatively better results, such as information technology, education, and health. On the other hand, transport, mining, and electricity performed significantly worse. The fact that there are sectors that have suffered and continue to suffer from the COVID-19 outbreak, and others that may benefit from it, underlines the relevance of studies in this field (Goodell & Huynh, 2020; Juergensen et al., 2020; Wójcik & Ioannou, 2020).

Therefore, this study aims to analyse the asymmetric impacts at the sectoral level on the European stock market in this line of reasoning. The sectors cover about 940 companies based in 17 European countries. The event study was employed using daily stock data

between 5 September 2019 and 26 February 2021. In a second phase, some variables were analysed through a simple regression, which impacted/benefited the European market (STOXX 600 Europe).

The main results showed that effectively the pandemic harmed the European stock market. However, this impact has not been homogeneous at a sectoral level. Sectors such as basic resources, and hardware, were ten times higher than those recorded in aerospace, airlines, and hospitality. This impact was analysed econometrically through an Ordinary Least Squares (OLS) regression, in which the number of confirmed cases and deaths negatively impacted the stock market. These variables were joined by others that capture market sentiment, showing the effect of panic and fear experienced during the first phase of the pandemic. However, some government measures such as economic support have somewhat calmed the market. In the second phase, the announcement of the discovery of the vaccine had a positive effect, but the variable related to the vaccinated population was not statistically significant. The appearance of new strains did not allow the market to show better results.

In short, this study contributed to the literature as follows: first, the fact that few studies analyse the sectoral asymmetric impacts on European stock markets reinforces the importance of this study. Secondly, the period adopted in the methodology is vast. In other words, a single study analyses the reaction of markets to a first wave, the discovery of the vaccine, and the appearance of new strains[1]. Finally, in such urgent and critical times, it is crucial to manage and direct each country's budget to the most affected sectors and companies (Gu et al., 2020; Mukanjari & Sterner, 2020). Therefore, it is expected, above all, that sufficient support bases will be set up to help all policymakers.

The rest of the study is organized as follows: in Chapter 2, the literature review will be presented, which will address the various channels that impacted stock markets, showing the main reasons for the heterogeneity experienced at the sector level. Chapter 3 addresses the methodology; in Chapter 4, the results will be presented, and Chapter 5 will conclude.

1 At the time of writing this study, there were still no studies on the impacts of COVID-19 on stock markets in 2021.

2. Literature review

This chapter will address the literature review. Then, other infectious diseases will be presented to contextualize, historically, the current pandemic, showing their similarities. From this point, the distinctive characteristics of the COVID-19 pandemic will be revealed, highlighting the main reasons why its catastrophic impacts were unprecedented. Finally, the main focus will be announcing contagion channels between COVID-19 and stock markets, addressing the asymmetric effects between the various sectors.

2.1. Previous infectious diseases

According to Porta (2014), a pandemic arises when an epidemic spreads over an extensive area, crossing international borders and generally affecting many people. In turn, the pandemics can significantly negatively impact public health and cause economic, social, and political disturbances (Madhav et al., 2017; Yamey et al., 2017). COVID-19 was not the first pandemic that humankind experienced. In the past, there have been other infectious diseases that have negatively affected stock markets, such as the Great Influenza Pandemic in 1918, the severe acute respiratory syndrome (SARS) in 2003, or the swine flu in 2009 (Alexakis et al., 2021; Anh & Gan, 2021; Aslam et al., 2020). Although they all have unique characteristics, there are some similarities. All these diseases have generated concerns in investors, causing significant losses in the markets. Furthermore, all of them have severely damaged economic growth and public health (Anh & Gan, 2021; Ding et al., 2020; Gu et al., 2020). For these reasons, studies that have analysed the impacts of these infectious diseases are crucial references.

2.1.1. Great Influenza pandemic

When referring to pandemics, it is inevitable not to address the Great Influenza Pandemic of 1918, popularly known as 'Spanish Flu.' Moreover, the fact that descendants of the 1918 virus caused many pandemics made it nicknamed the 'Mother of all Pandemics' (Taubenberger & Morens, 2006). The Great Influenza Pandemic has affected a third of the population and killed about 50 million people worldwide, representing at the time about 3% of the world's population, making it the pandemic with one of the highest mortality rates in history. Only Black Death (14th century) had a higher mortality rate (Burdekin, 2020; Fernandes, 2020; Neumann et al., 2009; Potter, 2001; Yan et al., 2020). Furthermore,

the fact that it coincided temporally with World War I encouraged the spread of the infection due to the return of thousands of military to their countries, resulting in large-scale movements globally (Barro et al., 2020).

Despite being widely exploited, the fact that it passed over 100 years ago makes access to data quite difficult. For this reason, the costs of this pandemic remain inconclusive (Fan et al., 2016). For example, Barro et al. (2020) and Fernandes (2020) estimated that the pandemic had killed 40 million people (10 million fewer than previously seen), representing about 2.1% of the world's population. However, Barro et al. (2020), even though it reached a considerably lower number, concluded that the aggregate Gross Domestic Product (GDP) of 43 countries fell by 8%, and consumption fell by 6%. In addition, they analysed the annual prices of the stock markets of these same countries and concluded that the actual return on shares was less than 26 percentage points, showing substantial short-term declines in real stock returns.

In this line, Burdekin (2020) complemented the previous study using monthly data for the US and 9 European countries. The results are consistent with the previous ones, showing that the stock markets reacted significantly and negatively to the mortality rates observed during the Spanish Flu.

2.1.2. Severe acute respiratory syndrome

As for SARS, its similarities with the current virus in epidemiological terms is something to be taken into account. In addition to belonging to the same family, both belong to the same genus of the subfamily Coronavirinae: β-coronavirus. These viruses co-infect humans and vertebrate animals, and SARS-CoV-2 (the virus that causes COVID-19) shares about 80% of the genetic sequence of SARS-CoV (the virus that caused SARS) (Crimi et al., 2020; Li et al., 2020; J. Xu et al., 2020; Yang et al., 2020). According to Ru et al. (2020a), the similarities between SARS-CoV-1 and SARS-CoV-2 are sufficient, presenting symptoms and forms of transmission very similar. Chan et al. (2020) investigated the familial cluster of pneumonia associated with SARS-CoV-2 and conducted a phylogenetic analysis showing the similarities between viruses. In the same line, van Doremalen et al. (2020) found that the stability of SARS-CoV-2 in aerosols and on various surfaces is similar to that of SARS-CoV-1.

It will be to SARS that this study will pay more attention in this subsection for all these reasons. Although the first recorded case occurred in November 2002 in a Chinese province, the outbreak spread to 26 other countries in 2003. This outbreak resulted in more than 8000 cases, and it is estimated that the deaths are around 800 people (Ding et al., 2020; Fernandes, 2020; Ru et al., 2020b; L. Xu et al., 2020). In economic terms, SARS accounted for about US$54 billion in economic damage (globally), causing a 1% drop in Chinese GDP, being the country that suffered the most from the outbreak (Ding et al., 2020; L. Xu et al., 2020).

In financial terms, several authors have studied the impact of SARS. For example, Chen et al. (2007) analysed the effects of SARS on the Taiwan stock exchange using the event study. The results of this investigation clearly showed that a tragic event such as the SARS outbreak had attenuated the Taiwan Stock Exchange. However, not all sectors were affected in the same way. Tourism has been seriously damaged, including restaurants, travel agencies, and car rental companies. On the other hand, manufacturing, and retail, were less affected. This study was complemented by Chen et al. (2009), who reported that the demand for respiratory masks and health care production increased sharply, causing stock prices related to these sectors to increase.

Wang et al. (2013) added that SARS caused a significant drop in tourism in Taiwan and the Asian region. Of the countries in its sample, China was the most affected, with not only the tourism sector being affected but also retail sales, hotels, and the air transport sector. On the other hand, as the disease spread, demand for drugs, vaccines, and medical products increased. As a result, the main R&D activities related to technology research in Asia benefited.

In sum, although much lower than that of the current pandemic, the impact of SARS can provide some interesting hints on the future of COVID-19's economic and financial impacts. *A priori,* tourism was expected to be the sector most affected, and, on the other hand, the health and the pharmaceutical sectors would benefit from it. These conclusions will be analysed later.

2.2. The distinctive features of COVID-19

The current pandemic has dragged the global economy into a long and wide-ranging crisis, making its comparison with others inevitable. The main conclusion to be made from these comparisons is that the current crisis is unique and that its impacts are unprecedented (Baker, Bloom, et al., 2020; Narayan, Phan, et al., 2021). Moreover, its consequences were the same or even worse in specific dimensions than the Great Depression of 1929 (Alexakis et al., 2021; Altig et al., 2020; Fernandes, 2020; Lee et al., 2021; Lyócsa et al., 2020; Mazur et al., 2021; Sharif et al., 2020; Shen et al., 2020).

For example, Rout et al. (2020) analysed the reactions of the G-20's stock markets between 1 January 1998 and 30 June 2020, using value-at-risk models. This sampling period allowed the authors to compare several crises, such as the Asian financial crisis of 1998-1998, the Internet Bubble Bursting in 2002, the Global Financial Crisis in 2008, and the current COVID-19. According to them, COVID-19 was the worst scenario, in certain dimensions, for most countries.

Thus, compared with other infectious diseases and other crises, the impacts of COVID-19 become unique and unprecedented. Therefore, a big question arises: Why?

Some authors have already answered this question, and the factors that explain this situation can be summarized in four points. The first is based on the fact that the world in 2020 is quite different from previous crises (Yeo, 2020). Today, we live in an era in which the Internet interconnects the world, and for this reason, information is transmitted rapidly throughout the world (Baker, Farrokhnia, et al., 2020; Rout et al., 2020). The previously major crises have been intensified by traditional media, such as newspapers, television, radio, among others. However, with the emergence of the Internet and the increase in electronic communication sources, this field has grown significantly (Yarovaya et al., 2020). More recently, social networks have spread across borders and at a dizzying pace. During previous crisis episodes, social networks played a much less important role in shaping public opinion, pressure on the government to formulate policies, and investor expectations (Ding et al., 2020; Ramelli & Wagner, 2020; Yarovaya et al., 2020).

Second, over the years, there has been a development of transport infrastructure, increasing the population flow rate. Consequently, the spread of the COVID-19 pandemic was much larger and faster (Baker, Bloom, et al., 2020; Shen et al., 2020). This has caused, despite its

low fatality rate (Altig et al., 2020), the current virus became much more dangerous than the previous (Liu, Manzoor, et al., 2020; Ruiz Estrada et al., 2020; Sharif et al., 2020; Shehzad, Xiaoxing, Arif, et al., 2020).

The third point is that, unlike other crises in which economic activities did not stop, this one led to many countries completely shutting down their activities. These closures increased unemployment levels and decreased production and consumption. All these factors together resulted in lower economic growth (Rout et al., 2020). Finally, China's power and role in the global economy have changed substantially over time. Currently, China is a centrepiece in the world economy, causing Chinese production losses to disrupt global value chains (Fernandes, 2020; Shehzad, Xiaoxing, Arif, et al., 2020).

In this way, the current crisis is not comparable with other crises or pandemics because its challenges are much greater (Ding et al., 2020; Fernandes, 2020).

2.3. How COVID-19 affected the stock markets?

The pandemic outbreak has quickly turned into a global economic crisis (Singh & Neog, 2020), which has also led to financial market turmoil (Baig et al., 2021; Chaudhary et al., 2020; Chia et al., 2020; Sun et al., 2021). Indeed, financial markets have been studied by most researchers who have observed the reasons for such turbulence. However, the reasons remain unclear. The closure of most economic activities, price pressure due to economic uncertainty, the exacerbated fear of investors, the significant drop in oil prices, and rising unemployment are some of the COVID-19's impacts (ALAM et al., 2020; Singh & Neog, 2020; Tang et al., 2021; Topcu & Gulal, 2020).

The immensity of channels that this pandemic unleashed has been paid attention to by many researchers. Of many, stands out Yarovaya et al. (2020), Ramelli and Wagner (2020), Ozili and Arun (2020). The authors dubbed these channels, such as contagion, spillover effects, drivers, transmission mechanisms, among others. Although the terms differ, their conclusions were quite similar. Thus, it is possible to conclude four significant contagion channels between COVID-19 and the financial markets (particularly the stock markets) by aggregating these authors' main ideas.

The first is COVID-19 itself. According to Yarovaya et al. (2020), this 'black swan' event is the primary catalyst for contagion (He, Liu, et al., 2020; He, Sun, et al., 2020; Zaremba et al., 2021). Although its direct impact has not been so noisy as the others, it is considered

the catalyst because, without its existence, none of the other channels would have been triggered. This subject will be analysed in more detail in subsection 2.3.1. In the face of the spread of the virus, several governments have been forced to apply restrictive measures to the population and the companies. Thus, government measures are the second channel, which will be explored in subsection 2.3.2. In addition, the virus caused panic and uncertainty throughout the population, including investors. This theme is the third channel to be analysed in subsection 2.3.3. Finally, globalization is the fourth channel of transmission. By intensifying all the other channels' impacts, this study attributed it to the intensifier concept. Details will be seen in subsection 2.3.4. The summary of COVID-19's impacts on the stock markets can be seen in Annex 1.

2.3.1. The main catalyst

The main channel of contagion was COVID-19 (Singh et al., 2020; Singh & Neog, 2020). The fact that it is principal is not because it caused the most significant direct impacts but because it is a catalyst. That is, it is the driver of all the contagion observed. Like Yarovaya et al. (2020) showed, COVID-19 can be considered a "black swan," as it has triggered unprecedented shocks that rarely occur and cause significant effects on financial markets and the economy.

Several authors have analysed the effects of the pandemic on stock markets, and the conclusions seem to differ. In this divergence, three groups of results emerged. The first one states no relationship between the number of confirmed cases/deaths in the stock markets (Chia et al., 2020; Smales, 2021).

Interestingly, Sansa (2020) revealed that the relationship between the number of confirmed cases and the Chinese and US stock markets was positive during March 2020. This result does not seem to have a theoretical foundation. Perhaps the simplicity of the model used or the short period may have biased the results.

Finally, the group that gathered the greatest consensus was that there was indeed a negative relationship between the pandemic and stock markets. Topcu and Gulal (2020) revealed that the infection rate negatively impacted equity markets in 26 emerging economies for March, using the Driscoll-Kraay estimator. Looking at developed economies, Zeren and Hızarcı (2020) showed the same results for the equity markets of China and Spain during the period between 23 January 2020 and 13 March 2020, using cointegration tests.

Yilmazkuday's (2020) study arises as it covered a longer period, more specifically between 21 January 2020 and 6 August 2020. The author employed a structural model of vector auto-regression and showed that the markets of US stocks were seriously affected by the number of daily cases accumulated.

In addition to the number of confirmed cases, other authors reported that the number of deaths also negatively affected stock markets (Baig et al., 2021). For example, Al-Awadhi et al. (2020) analysed all stocks in the Hang Seng Index and Shanghai Stock Exchange Composite Index for the period between 10 January 2020 and 16 March 2020 and found that the pandemic interacted negatively with stock market returns. Similarly, Apergis and Apergis (2020) documented that the daily variation in confirmed cases and deaths caused by COVID-19 negatively impacted Chinese stock returns between 27 January 2020 and 30 April 2020.

In a nutshell, there is, in the current literature, a consensus that pandemic-related variables negatively affect stock markets (Ashraf, 2020b; Baek et al., 2020; Narayan, Gong, et al., 2021; O'Donnell et al., 2021). Thus, variables that try to capture the effect of the pandemic (such as the number of confirmed cases, deaths, and, more recently, of vaccinated people) are essential variables to incorporate into the econometric model. In addition, in theory, the pandemic has affected national health systems, and it would be expected that countries that had better preparation have been less affected than others. In this way, countries with more developed health systems may be better prepared to fight the pandemic and thus alleviate potential economic consequences (Yarovaya et al., 2020; Zaremba et al., 2021). Finally, some demographic variables are also justified to incorporate themselves into the regression. Population density and migration patterns can facilitate the spread of the disease. In addition, as the new coronavirus mainly affects older people, age-related variables of the population are important (Liu, Manzoor, et al., 2020; Yarovaya et al., 2020).

2.3.2. Government measures

Due to its great transmissibility (Mazur et al., 2021; Xiong et al., 2020), COVID-19 was considered a danger to public health, leading many authorities to impose quarantines on the population and shutdown most business activities. These closures resulted in low productivity, which led to reduced costs, particularly those of labour, resulting in lay-offs (Leduc & Liu, 2020; Ramelli & Wagner, 2020). Furthermore, this evaporation of wealth

had social and economic consequences, such as decreased consumption (Lyócsa et al., 2020). Consequently, firms' expected future cashflows are shallow, leading to a revaluation of their market values and a significant fall in the stock price (Mazur et al., 2021).

Until December, no vaccine had been discovered, and therefore approaches to stopping the virus from spreading were limited. Among these approaches were policy responses by governments and other institutions. The ban on local and international travel, and roadblocks, were some of the measures implemented around the world (Aggarwal et al., 2021; ALAM et al., 2020; Albers & Rundshagen, 2020; Ashraf, 2020a; Barrot et al., 2021; Narayan, Phan, et al., 2021; Okorie & Lin, 2021; Topcu & Gulal, 2020). In addition to public health and human control measures, others included stimulus packages that took monetary and fiscal forms (Ozili & Arun, 2020).

Many central banks have adopted expansionary monetary measures to stimulate the economy through interest rate adjustments. Similarly, money supply measures were also adopted through bond purchase programs or aid funds (Ozili & Arun, 2020). On 18 March, the Bank of England announced the purchase of £200 billion in state bonds, and the ECB (European Central Bank) announced the purchase of €750 billion in government and corporate bonds. In the same week, dozens of central banks cut interest rates and introduced quantitative easing (Fernandes, 2020; Wójcik & Ioannou, 2020). Germany reacted to the pandemic with a stimulus package worth 0.8 trillion dollars (20.5% of its GDP) (Seven & Yılmaz, 2021). These are some of the examples of governments' aids[2].

However, government measures were considered a 'double-edged sword' (Zhou et al., 2020). This is because, on the one hand, the measures allowed several lives to be saved, and the spread of the virus becoming smaller and smaller (Coibion et al., 2020; Eichenbaum et al., 2020). Nevertheless, on the other hand, the same measures significantly impacted the global economy (Ashraf, 2020a; L. Xu et al., 2020; Zaremba et al., 2020; Zhou et al., 2020). In this way, all policymakers were faced with the great decision to choose one of the two scenarios since getting both was impossible (Ozili & Arun, 2020).

The diversity of measures adopted makes their effects on stock markets inconclusive (Stordal et al., 2021), causing a heated debate in the current literature. As seen above, the

[2] For more detailed information on government supports, see https://www.imf.org/en/About/FAQ/imf-response-to-covid-19.

number of cases and deaths related to COVID-19 negatively impacted the markets, and therefore, measures that help slowdown the spread of the virus had positive impacts on the markets, but on the other hand, stopping economic activity could harm them.

Ozili and Arun (2020) studied the impacts of the measures on some of the most important indexes in the world between 23 March and 23 April 2020. According to them, different measures had different effects on the markets. For example, the restriction on internal movement and expenditure on the fiscal policy had a positive impact (Seven & Yılmaz, 2021). On the other hand, international travel restrictions and monetary policy decisions have had a negative impact. The conclusions imply that spending on fiscal policy appears to be more effective in mitigating the effect of the COVID-19 pandemic than monetary policy decisions, especially since monetary policy adoption may exacerbate inflationary pressures that could exacerbate macroeconomic stability in the short-term (Ozili & Arun, 2020)

In short, the effects of government measures are not consensual in the literature. However, it seems that the economic stimulus has shown to have positive effects on the stock markets (Chia et al., 2020; Narayan, Phan, et al., 2021), and mobility restrictions had negative impacts (Aggarwal et al., 2021; Ashraf, 2020a; Chowdhury et al., 2021).

The measures imposed by governments impacted all economic activities. However, some sectors were more affected, and some benefited from the pandemic. Sectors whose economic activities were considered 'non-essential' and which depended essentially on face-to-face meetings were seriously affected, as people were encouraged to stay at home and others who chose it as a voluntary action (del Rio-Chanona et al., 2020; Ding et al., 2020; Fana et al., 2020; Gupta et al., 2020; Pagano et al., 2020; Shen & Zhang, 2021). Essential activities, i.e., those that are primarily related to the satisfaction of primary human needs, could continue to work, while 'non-essential' activities had to shut down or operate at a much smaller time (Fana et al., 2020; He, Niu, et al., 2020). Thus, sectors such as retail, catering, stores, leisure services, agriculture, among others, were seriously affected by the pandemic (He, Sun, et al., 2020; Huo & Qiu, 2020; Tashanova et al., 2020). In addition, places that crowd a large number of people were closed, such as sports matches, music shows, theme parks, film productions, and other meetings in general, which affected the sports and entertainment sectors (Fernandes, 2020; He, Sun, et al., 2020; Shen et al., 2020; Yan et al., 2020).

2.3.2.1. Domino effect and the oil shock

Of the most affected sectors, transport was the first and most impacted sector. This impact was mainly due to the prohibitions of most national and international travel (Al-Awadhi et al., 2020; Fu & Shen, 2021; Ruiz Estrada et al., 2020). Furthermore, as people were unwilling to use public transport due to large clusters, airlines, trains, and buses were no longer used (Yan et al., 2020). Thus, with this sector 'falling,' begins the 'domino effect,' since many other sectors depend on it as a logistics medium. In this way, the entire supply chain was affected, which negatively influenced economic activity (del Rio-Chanona et al., 2020; Tashanova et al., 2020).

In this way, cross-sectoral links[3] have played a crucial role (Singh & Neog, 2020). The tourism sector, for example, was affected as the movement of tourists was impeded. The ban on domestic and, above all, international travel has caused millions of flights and hotel reservations to be cancelled, negatively affecting airlines and the hospitality sector (Baum & Hai, 2020; Nicola et al., 2020; Sobieralski, 2020).

Travel restrictions impacted not only the movement of people but also the productive factors, thus interrupting the global supply chain (Guerrieri et al., 2020). Vidya and Prabheesh (2020) claim that industrial production is increasingly interconnected, and therefore the pandemic that originated in China quickly disrupted the entire supply chain. It should be noted that China, over the years, has gained importance, being currently the "workshop of the world," and thus a negative shock in supply has disrupted commercial networks through the cessation of production processes and prevented transport and logistics (Fernandes, 2020; Tang et al., 2021). The Chinese manufacturing sector was unable to start production, which inevitably affected the development of upstream and downstream companies in the international industrial chain, leading to the contraction of the global supply chain (Tang et al., 2021). For example, in the US, 75% of companies reported interruptions in their productions. Car companies closed operations for lack of parts (Fernandes, 2020), the mining sector, which depends on transport as a logistical means, had its production without a destination, and pharmaceuticals had medicines stuck in China[4] (Ozili & Arun, 2020). All these reasons have led to certain sectors such as mining

[3] See del Rio-Chanona et al., (2020), and Barro et al., (2020).

[4] About 60% of the world relies heavily on medicines made in Chinese factories (Ozili & Arun, 2020).

and pharmaceuticals being severely affected (He, Niu, et al., 2020; He, Sun, et al., 2020; Liu, Wang, et al., 2020).

With all these impacts, the financial sector has failed to escape the effects of the pandemic. Although not immediately observed (and the worst may still be to come), firms' defaults, non-performing loans, a high number of deposit withdrawals, and drops in mortgages has also made the banking sector resent the pandemic (Coibion et al., 2020; del Rio-Chanona et al., 2020; Goodell, 2020; Wójcik & Ioannou, 2020). According to Ozili and Arun (2020), the macroeconomic slowdown led to an increase in non-performing loans in the banking sector by 250 basis points. In addition, there was a general decrease in the volume of bank transactions, which represented fewer commissions charged by banks (Chaudhary et al., 2020; Goodell, 2020; Wójcik & Ioannou, 2020).

The 'domino effect' caused another shock during 2020: the abrupt fall in oil price. According to Sharif et al. (2020), this drop was the worst since the Gulf War, with oil-related futures prices for the first time hit downbeat in the US (Mukanjari & Sterner, 2020). Several factors caused this fall. One of them was the price war between Russia and Saudi Arabia, which prompted the Saudi authorities' decision to offer price discounts of $6 to $8 to their main customers in Europe, Asia, and the US (Ashraf, 2020b; Ozili & Arun, 2020; Sharif et al., 2020). In addition, the disruption of the transport sector represented a huge drop in demand for oil, consequently lowering its price (Gil-Alana & Monge, 2021; Iyke, 2021; Narayan, 2020; Qin et al., 2021).

This fall deserves special attention since Sharif et al. (2020) reported that the oil shock had disrupted stock markets more than the pandemic itself. In fact, the price of oil plays a key role in the performance of economies (Narayan et al., 2014). Consequently, a fluctuation in their prices will have severe repercussions on the economy and financial markets.

The fall in oil price dragged the entire energy sector (Wójcik & Ioannou, 2020). In addition, the decrease in industrial production (due to confinements) led to a reduction in electricity demand, which further impacted this sector (Gu et al., 2020). However, electricity consumption increased due to the demand associated with quarantines and medical services, which caused the sector not to be so damaged (Ruiz Estrada et al., 2020).

2.3.2.2. Opportunities

Up to this point, only the sectors that suffered the most from the pandemic and the reasons have been identified. However, the government measures have brought several opportunities for other sectors that had their stock returns grow throughout the pandemic. Because people have spent more and more time at home, the demand for essential household products has increased (Tashanova et al., 2020). With these products, food is highlighted since the restaurants have been closed to the public. As a result, the food and grocery distribution sectors benefited (Mazur et al., 2021).

One of the sectors that also benefited the most from the pandemic was the pharmaceutical sector. Although, as previously seen, this sector has suffered from the supply chain's disruption, this sector is also characterized by playing a vital role on the front lines of the battle against the novel coronavirus (Aravind & Manojkrishnan, 2020; Verma et al., 2021). In addition to the demand for medicines, the thousands of additional investments in the race to develop vaccines have made this sector perform well. Manufacturers of diagnostic test kits, disinfectants, and protective masks have increased to meet unprecedented demand (Ding et al., 2020; Huo & Qiu, 2020).

However, the primary sector was undoubtedly the technology sector. Thousands of people had to implement telework, and many students started taking classes over the Internet, highlighting the role of information technologies. Thus, platforms that allowed meetings, classes, and other subjects to be handled remotely had the demand for their products exponentially. In addition, according to Roberts (2020), due to the closure of people at home, the average leisure time has increased considerably, and, since outdoor entertainment has been banned, people have looked for other solutions. Consequently, most world populations have acquired digital entertainment platforms and electronic games (Ding et al., 2020; He, Sun, et al., 2020; Tashanova et al., 2020; Yan et al., 2020).

2.3.2.3. Reversals

These results were, in a way, similar for all regions. However, the impacts were not the same over time. For example, the health care sector was immediately impacted by the pandemic since all health systems were not prepared for the exponential growth in the number of cases and hospitalizations (Liu, Wang, et al., 2020; Ozili & Arun, 2020; Ramelli

& Wagner, 2020; Shen et al., 2020). However, over time countries have had to invest more in the health sector to look for medical solutions to combat the pandemic.

Similarly, the manufacturing sector was also impacted at the beginning of the pandemic as many factories had to shut down their operations. However, as public health awareness increased, the demand for masks and gloves faced the same pattern. Besides, the need for ventilators and other medical equipment worldwide has increased, causing the manufacturer sector related to medical equipment to benefit (Chia et al., 2020; He, Sun, et al., 2020; Ramelli & Wagner, 2020).

To this phenomenon, Huo and Qiu (2020) termed it as reversals (Lyócsa et al., 2020; Naidu & Ranjeeni, 2021). Thus, sectors that suffered from the pandemic in the short-term benefited from it later. This temporal question is particularly interesting to explain one reason for choosing the methodology used in this study (as announced in Chapter 3).

2.3.2.4. Mitigation factors or even more asymmetric impacts?

Two significant factors mitigated these measures. One of them was telework because it allowed alleviating some of the negative consequences caused by social distancing and restrictions on activities. Professional services and business management made this transition easy. However, not all sectors have benefited from this form of work, as it depends mainly on the nature of the sector's economic activity (del Rio-Chanona et al., 2020; Dingel & Neiman, 2020; Fana et al., 2020; Hensvik et al., 2020). Retail, trade, agriculture, accommodation and, catering are sectors that are not so easily carried out remotely (Barrot et al., 2021; Fana et al., 2020).

The second factor that helped mitigate the pandemic's problems was digitalization (Baek et al., 2020). Ding et al. (2020) revealed that even with the majority of activities closed, commercial activities not only continued to occur but also increased during the outbreak, but this time online since consumers spent more time on the Internet. For the same reason, online shopping has become one of the most popular online activities, allowing specific sectors to turn the crisis into opportunities by providing/using digital solutions to grow their business (Ozili & Arun, 2020). Thus, a company or sector with a pre-existing digital ecosystem has managed and continues to deal with emergencies. During the beginning of the pandemic, as stores and factories were closed due to social distancing regulations,

companies that initiated digital transformation responded better than performing digital activities instead of a complete stoppage (Ding et al., 2020).

In short, this entire subsection demonstrated that government measures had an impact on stock markets while at the same time managing to impact certain sectors and benefit others. In this way, based on Hale et al. (2020), this study will monitor the daily changes in European policies to examine their role in the European stock market's returns. However, the success of these measures depends on the government's ability to implement them and society's willingness to adhere to those measures. In this way, specific cultural characteristics are essential to implement in the methodology (Zaremba et al., 2021). In addition, cross-sector links also played an essential role. Impacts in one sector are easily absorbed by others linked to it. In turn, these interconnections will also be incorporated into the methodology. Finally, the price of oil and other economic/financial measures can be critical to its ability to toughen due to a pandemic (Zaremba et al., 2021).

2.3.3. Panic and fear

The loss of stock market value was due to the rational assessment of investors, as companies' results decreased considerably due to the pandemic. However, markets were not only affected by the closure of business activities (Ozili, 2020). According to Behavioural Finance theories, emergencies like this pandemic impact investor behavior, significantly impacting stock prices (He, Sun, et al., 2020; Heyden & Heyden, 2021; Naidu & Ranjeeni, 2021). Reis and Pinho (2020) claim that the academy has shown widely that the price movement of financial assets is also explained by sentiment, especially in periods of irrational panic, unjustified, or exaggerated optimism (Benhabib et al., 2016). According to Fama and French (2015), 28% remain unexplained and possibly attributed to feelings or irrationality of investors in explaining the returns of the shares beyond the company's fundamentals. Thus, the third channel emerges: the panic/fear that affected consumer behavior and investor confidence. This channel will be dissected in the following subsections.

2.3.3.1. The role of news and announcements

The pandemic outbreak spread rapidly worldwide through the news (Goodell & Huynh, 2020; Liu, Wang, et al., 2020), triggering the second major pandemic of this period:

'infodemic' (Mejova & Kalimeri, 2020). The news, as well as announcements made by institutions (such as WHO, for example), and Google searches for coronavirus, played a crucial role in keeping people informed about the state of the crisis, influencing investors to make decisions in stock markets (Lee, 2020; Singh et al., 2020). In addition, globalisation and social networks have intensified panic and uncertainty (as discussed in the following section). These two ingredients, together with trade tensions between China and the US, news of Brexit, and middle east conflicts, have resulted in extreme and unprecedented volatility in stock markets[5] (Altig et al., 2020; Baek et al., 2020; Baker, Bloom, et al., 2020). Volatility is fundamental to the functioning of financial markets, acting as a barometer of financial risk or uncertainty around financial investments (Zaremba et al., 2020), and the literature agrees on one thing: as volatility increased, stock markets fell (Ali et al., 2020; Lyócsa & Molnár, 2020).

2.3.3.2. Consumer behavior

The fact that there was no official medical treatment (at least until December 2020) caused panic to spread among the world's citizens (Maneenop & Kotcharin, 2020). Studying the impact at the micro-level is important because families are the main protagonists of the economic system (Yue et al., 2020). Uncertainty is a fact of life, but it can reach higher values in pandemic situations. Questions such as understanding the disease, when a vaccine would be discovered, what effects of government policies, how people will respond, and so on (Wagner, 2020) cause uncertainty to increase to extreme values (Ashraf, 2020b). Long-term economic decisions are challenging because they often have lasting consequences and require people to make some pre-commitments. Moreover, once certain decisions are made, they can be costly to reverse. Thus, when times are uncertain, households devote consumption and investment decisions to increase savings for precaution (Leduc & Liu, 2020).

In addition to its decrease, families also altered consumption (Baker, Farrokhnia, et al., 2020). Moreover, this change was fundamental to intensify the asymmetric effects at the sectorial level (Smales, 2021). On the one hand, people began to fear going to public areas

[5] Volatility is measured by several indices, known as fear gauge. One of the best known is the CBOE Volatility Index (VIX) which presented values never recorded before (Leduc & Liu, 2020; Li et al., 2020; Shehzad, Xiaoxing, Arif, et al., 2020).

and other closed spaces, which led to the cancellation of trips and stays (Uğur & Akbıyık, 2020), reducing the demand for hotels and restaurants services, among others (Lee et al., 2021). On the other hand, in some parts of the world, the insane purchase of durable goods has been seen (like toilet paper), which has made certain sectors, such as the retailer, see the demand for their products increase (Aggarwal et al., 2021; Baek et al., 2020; Fernandes, 2020).

A thought regarding consumer procedures was that of Fernandes (2020). According to him, a person who is thinking of buying a mobile phone or microwave will most likely wait and buy that product later (assuming this shock is temporary and still has a job and disposable income when finished). However, it is doubtful that people will start dining out every day to make up for the "missed dinners" or cut hair twice a week. This thought is in line with del Rio-Chanona et al. (2020), which estimate three types of scenarios. The first referent that expenses for a good or service is only delayed but will occur later. The second estimate that expenses will not be compensated will return to normal when a pandemic end. Furthermore, the third estimate that expenses decrease to a permanently lower level as families changes as their favourites in light of the "new normal."

In this way, consumer behavior affects sales (and, consequently, future cash flows) of companies related to specific sectors, such as hotels and tourism. These sectors will not only face an impact on their business models in the short-term but even after the pandemic ends.

2.3.3.3. Investor sentiment

Panic has also reached investors. The sentiment of these players was affected, which caused an increase in pessimism about future returns, resulting, consequently, in a greater risk aversion (Aggarwal et al., 2021; Baker & Wurgler, 2007; Kaplanski & Levy, 2010; Vasileiou, 2021; Youssef et al., 2021). It has therefore been documented that investors sold their shares to invest in safer securities such as treasury securities (Leduc & Liu, 2020) and in "safe-haven investments" (Baele et al., 2020). One example was gold, because of its intrinsic value, investors replaced their currency with gold to safeguard against fluctuating currency values when the stock market becomes volatile (Huynh et al., 2021; Yan et al., 2020) and cryptocurrencies (Corbet et al., 2020). This withdrawal of their investments from the stock markets caused the prices for these assets to start to fall.

The sentiment of investors who remained in the market changed over time. At first, when the pandemic outbreak began to generate greater uncertainty, investors began selling shares associated with sectors whose activities depended on physical contact. Thus, if all investors thought the same way, the cascading sale caused the drop in the price of these shares to be abrupt. This feeling was intensified by herding behavior (Espinosa-Méndez & Arias, 2021; Kizys et al., 2021). In other words, herding behavior is a process in which investors mimic each other's actions (Hirshleifer & Hong Teoh, 2003). There are individual and institutional investors in the market that continuously monitor the news and new information that comes to the market. People, in general, do not always have sufficient knowledge and skills to interpret news quickly and correctly, and, therefore, it becomes easier to copy and imitates the positions of 'professional' investors (Yarovaya et al., 2020). This behavior is intensified with the appearance of online social trading platforms, where it is possible to copy the portfolios of other investors.

On the other hand, investors saw opportunities in the pharmaceutical sectors, increasing demand for their shares, increasing their price (Chia et al., 2020; Goodell & Huynh, 2020; Liu, Wang, et al., 2020). This result was mainly due to investor expectations that demand for pandemic prevention tools and medical services would increase exponentially (Huo & Qiu, 2020). In this way, people began to pursue medicine-related actions, resulting in abnormally positive returns for the pharmaceutical sector (Liu, Wang, et al., 2020). However, throughout the pandemic, investors began to feel that they could buy great companies at a discounted price, and so they started again to buy stocks associated with sectors that suffered most from the pandemic (Yan et al., 2020).

In short, the panic triggered by the pandemic caused consumers to change their consumption behavior. This behavior change attenuated the demand for goods and services in many sectors. Investors showed a certain irrationality for failing to assess the financial fundamentals of companies and sell/buy shares by herding behavior. However, they realized which sectors would be most affected, allowing them to assert certain rationality in their behavior (Shen & Zhang, 2021; Smales, 2021), especially in European investors (Reis & Pinho, 2020). Since this transmission channel has impacted the stock markets, it is important to incorporate variables that allow capturing the uncertainty experienced in the market.

2.3.3.4. Relationship between measures and panic

In Annex 1, there is a bilateral arrow between government measures and panic. This is because both channels were interconnected with each other. On the one hand, panic has affected the population and policymakers, causing them to anticipate the government measures imposed. On the other hand, government measures have also served to mitigate some of the panic. People seeing the measures being imposed felt more 'calm' to learn that someone 'superior' took over the situation. Investors can interpret these measures as a positive sign, giving them confidence, thereby encouraging investment (Maneenop & Kotcharin, 2020; Pandey & Kumari, 2021; Sharif et al., 2020; Verma et al., 2021). However, this idea is not defended by all authors. For example, Baig et al. (2021) report that restrictive government policies can cause uncertainties that can spur portfolio and commercial activity restructuring, destabilizing markets. Zhang et al. (2020) grouped these two results in a single conclusion. That is, the authors' government measures can work in the short-term as they stop the panic, but in the long run, they can create inconsistencies between short- and long-term expectations in investors (Gormsen & Koijen, 2020). In turn, these measures may introduce more significant uncertainty in global markets (Chen et al., 2016).

2.3.4. Globalisation

The pandemic spread all over the world since the spreading effect was enormous. This was mainly due to globalisation, which has become the main engine and the most crucial underlying force (Yarovaya et al., 2020). As previously seen, globalisation is not considered in this study a channel but an intensifier because, with it, all the effects from the other channels mentioned above were amplified.

First, globalisation has increased transport connectivity by improving them in terms of quality and prices, which encourages the movement of people around the world by helping the spread of the virus through international travel (Lee, 2020; Nikolaou & Dimitriou, 2020). Moreover, according to the 2017 report by the European Commission for Mobility and Transport[6], the performance of all modes of transport is reaching record levels. Thus,

[6] Source: https://ec.europa.eu/info/publications/annual-activity-report-2017-mobility-and-transport_en.

this effect has amplified the catalyst by exponentially increasing the number of confirmed cases and deaths worldwide, particularly in Europe (Nikolaou & Dimitriou, 2020).

Second, globalisation has increased economic and financial ties between countries (Youssef et al., 2021). This integration of financial markets is a dynamic process related to increased financial liberalisation (Ramelli & Wagner, 2020; Yarovaya et al., 2020). In this way, nationalist responses to border closures and the ban on exports of medical equipment were painfully exposed. Particularly in the EU, where the free flow of goods, services, capital, and people were considered cardinal principles, unilateral closure of borders and export bans were at least unprecedented (Aslam et al., 2020; Yeo, 2020).

Third, globalisation highlighted the role of the media, resulting in greater involvement in social networks, official mass media, and online information portals. In this way, the main catalyst is quickly captured by the press and transmitted to all stakeholders. The role of social networks arises to the extent that often the (un)information (or 'fake news') shared there is distributed with great speed, reach, and penetration, along with the misunderstanding and (mis)handling of the issues surrounding COVID-19 (Cepoi, 2020; Merchant & Lurie, 2020). Consequently, this diffusion played a key role in forming real expectations and public opinion, which led to the impacts of the two channels being intensified. On the one hand, the greater ease of gathering information (often erroneous) has put panic on the general population and, on the other hand, has pressured governments and institutions to respond to the shock of the crisis (Haroon & Rizvi, 2020; Mejova & Kalimeri, 2020; Ramelli & Wagner, 2020; Rout et al., 2020; Uğur & Akbıyık, 2020; Yarovaya et al., 2020).

In a view, the role of globalisation has become particularly interesting throughout covid-19's contagion process in financial markets. To capture this effect, the country's economic opening, the number of people with internet access, and the dependence of exports on the country's trade balances are some of the variables to be incorporated.

3. Data and methodology

3.1. Data

The data used was collected from different sources. The daily closing prices of the constituent stocks of the European sector indices were collected from Datastream and based on their classification. This classification divides companies into ten supersectors, 18 sectors, and 42 subsectors. This study uses 13 sectors and 16 subsectors[7], covering 940 firms based in 17 European countries (Annex 2). For consistency and not to confuse the reader, all groups will be called 'sectors.'

All other variables can be observed in more detail in Annex 3. In line with Zaremba et al. (2021), all values are expressed in U.S. Dollars, allowing for greater consistency. For example, the three Fama-French factors are only available in US dollars, as are other variables used, and, for these reasons, this was also the reference currency of this study.

3.2. Event study and the Efficient Market Hypothesis (EMH)

Stock markets react to specific events. Previous studies have highlighted this finding evaluating the impact of several important events that affected stock markets, such as disasters (Kowalewski & Śpiewanowski, 2020), political events (Bash & Alsaifi, 2019), among others. In this line of reasoning, we can consider the current pandemic as an exogenous event that impacted the stock markets.

Thus, a methodology that captures this same effect is necessary, and, in the literature, a great methodology emerges: the event study. This methodology arose, according to MacKinlay (1997), with James Dolley in 1933 (Dolley, 1933), but gained the attention of all researchers with the famous articles of Ball and Brown (1968) and Fama et al. (1969) in the late 1960s (Binder, 1998; Bowman, 1983; MacKinlay, 1997). These studies introduced the methodology in how the world still knows it today (even with its improvement over the years).

[7] This division was carried out in this way since some sectors had discrepant results because they had subsectors with a wide range of products and services that were quite different. For example, the travel & leisure sector included airlines, but also included betting sites which distorted some of the results obtained. Similarly, the industrial goods & services sector incorporated aerospace & defense (one of the most affected subsectors) and other subsectors that disguised their poor results.

This methodology has often been used as one of the most important in finance and corporate studies (Binder, 1998; Bowman, 1983). Within these areas is its application in accounting and financial practice addressing events such as the announcement of dividends, mergers, splits, among others (He, Sun, et al., 2020; Shehzad & Sohail, 2018). In addition, this methodology has also been commonly used in studies that have analysed the impact of infectious diseases on the stock market (Chen et al., 2009; Chen et al., 2007; Wang et al., 2013).

An event study measures the impact of a specific event on the value of a company based on the EMH (MacKinlay, 1997). This hypothesis was created by Eugene Fama (Fama, 1970), which applies rational expectations to stock prices and other securities. Overall, the impact of a given event is expected to be reflected in stock price changes in a relatively short period around the event (Bowman, 1983). In other words, EMH is based on the assumption that securities prices reflect all available information. The more information is incorporated into prices, the more efficient the market becomes, thus giving rise to three distinct forms: strong, semi-strong, and weak (Fama, 1970).

The strong form assumes that securities prices reflect all available information, both public and private, not allowing investors to get abnormally high returns. However, the existence of crushes and bubbles, in which asset prices rise far above their economic fundamentals, casts serious doubts on the stronger form. On the other side of the spectrum, there is the weak form. This form assumes that securities prices only reflect past information, suggesting that future changes are not possible. In the 'middle' lies the semi-strong form. This form takes that the achievement of abnormal returns (ARs) is possible but is quickly discovered by the market. This is because there may be some delay before the price reflects all available information in the semi-strong form. This time lag may vary depending on the market and shared information (ALAM et al., 2020).

Event studies often support the view that the market is semi-strong. Fama (1991), in its review of the HME, adapts the concepts previously seen, changing the concept of semi-strong form's tests to the " common title, event studies." Straightforwardly, as will be seen in more detail in the following subsection, the typical approach of the event study begins with a regression of stocks' profitability on market returns, thereby providing the expected stock returns (fair values). Abnormal returns are then estimated as the difference between

the value observed and what was expected. If the market is semi-strong, abnormal returns should tend towards zero, implying that market prices are the same as fair value.

3.2.1. The temporal question

The diversity of the event study literature, both in terms of the range of topics covered and the specific technical choices available, can be overwhelming. However, the event structure is relatively simple (Bowman, 1983). According to Bowman (1983) and MacKinlay (1997), when an event study is carried out, the initial task is to define the entire temporal issue that this methodology requires. This question is divided into some parts, such as the definition of the time interval of the data, the definition of the key events, the event window, the estimation window, and the post-event window.

Regarding the first part, the decision of the sample time interval is important in the event study methodology. The fact that the data used are daily, weekly, monthly or annual can completely change the entire structure of the methodology. Although there are some criticisms pointed to the daily data (see Brown and Warner (1985)) is the range that allows a greater statistical power (Elliott et al., 1984). In addition, daily data were applied for a better understanding and analysis of the impact of COVID-19 in a relatively short period. The objective is to analyse the response of stock markets to specific events. In addition, the event study allows a better analysis of reversals, referred to in subsection 2.3.2.3.

As for the second part, the task of accurately identifying the events' dates is crucial. Brown and Warner (1980) found that the statistical power is susceptible to the accuracy with which an event date could be identified. In cases where the date of the event is difficult to identify or is partially anticipated, studies are less useful (Bowman, 1983; MacKinlay, 1997). This is one of the only assumptions present in this study, i.e., it is assumed that the official announcement of the competent authorities is the beginning of the event and that no information related to it has ever been 'acquired' by the market. Furthermore, during a troubled period such as what we experienced in the first quarter of 2020 and even at the end of 2020 (for example, with the election of Joe Biden), it is expected that other events could interfere with the impact of the events under study.

As for this theme, there are several options in the literature. Of the most used are 20 January 2020 (Liu, Manzoor, et al., 2020; Liu, Wang, et al., 2020; Singh et al., 2020), characterized by the beginning of the dissemination of news in the media concerning the

virus; 23 January 2020 (He, Sun, et al., 2020; Shen & Zhang, 2021; Xiong et al., 2020), the day when Wuhan's blockade took place; and 25 January 2020 (Huo & Qiu, 2020), date marked by The Chinese New Year 2020. All these events had something in common: the importance for the target markets of the referenced studies, which in this case was China. However, in this study, the application of the same events is not prudent since European stock markets only began to register concerns about the severity of the pandemic in mid-February (Vasileiou, 2021). Mukanjari and Sterner (2020) revealed that the first event to impact the reactions of European stock markets was February 22, the day the Italian Government announced quarantine measures for the country. Likewise, Maneenop and Kotcharin (2020) also revealed that February 21 (the authors opted for this day to coincide with a business day) was the first event to show abnormal returns for international stock markets. On this day, the Italian Government introduced the first lockdown, causing news to reach all the countries of Europe, triggering concern and panic.

For this reason, it will be the first event to consider in this study. In this way, February 21 becomes time zero in event time. All other periods will be given as a function of zero time when the event occurred (Bowman, 1983). However, this study divides the impact of the pandemic into two distinct subperiods: the first characterized by the first wave of the pandemic (14 February 2020 – 12 June 2020) and the second characterized by the discovery of a potential vaccine (2 November 2020 – 26 February 2021. Therefore, 9 November 2020 becomes the second key event of this study. The day was marked by the announcement of Albert Bourla, CEO of Pfizer, on the development, in consortium with the German BioNTech, a vaccine with more than 90% efficacy against coronavirus.

Once the key events are defined, the next step is to determine the various windows. This theme presents even more discrepancies in the literature, and there is no 'standard' or 'rule' in the definition of the same (Lee & Lu, 2021). The definition of the estimation window depends on some factors such as the data range (daily, weekly or monthly) and the model applied. In this line, Peterson (1989) and Armitage (1995) suggest that the average range of the estimation period should be between 100 and 300 trading days for studies that apply daily data. For a better understanding, the pre-event window is a period called ‘normal,’ in which there were no major events that impacted the stock markets. In this way, returns are estimated according to this normal time to obtain the returns that would be expected if no event happened. Then, the difference between these returns and the effects observed

returns would give us abnormal returns. He, Sun, et al. (2020) and Sayed and Eledum (2021) report a clear trade-off between a short and a long period. They argue that if the window is too short, the results will be biased and that if it is too long, the forecast structure may change. That is, on one side of the spectrum, some authors argue that the window cannot be too short since the predictive power of the model will be inadequate (Lee & Lu, 2021). On the other side of the spectrum, Okorie and Lin (2021) suggest that relatively short periods be selected before and after the event to minimize the occurrence of other shocks or exogenous factors that may affect stock markets and thus distort the study's findings. The basic idea is that other events may have occurred after the event has been studied. As such, the effect of the particular event study is best captured using a relatively small window around the event announcement date (Maneenop & Kotcharin, 2020).

However, in this study, the likelihood that other factors impacted the stock markets (at least at the COVID-19's dimension) is minimal. As seen earlier, European stock markets have reported an underreaction to the severity of the pandemic, and their markets began to fluctuate further by mid-February. For this reason, this study follows the suggestion of Brown and Warner (1985) and MacKinlay (1997) to use a 120-day trading window in the first phase before the event. In the second phase, for the estimation window not to coincide with the post-event window of the first phase, only 100 trading days will be adopted. In addition, in both phases, the estimation period goes up to five trading days before the key event. Like MacKinlay (1997) advises, the pre-event window is immediately before the period before the event window, and that does not overlap to prevent the event from influencing the normal estimates of the model.

3.2.2. Abnormal returns

The first variable used in this study is the abnormal returns of the various indexes under analysis. Since the closing prices of the different sector indexes show wide differences in magnitude, it is prudent to calculate the daily returns:

$$R_{i,t} = ln\left[\frac{P_{i,t}}{P_{i,t-1}}\right] \qquad 3.1$$

where $R_{i,t}$ is the return of index i on day t; ln is the natural logarithm; $P_{i,t}$ is the closing price of index i on day t; and $P_{i,t-1}$ is the closing price of index i on the previous trading day (t – 1).

There are several types of models for calculating abnormal returns (He, Sun, et al., 2020). Overall these years, the most widely used model was the market model (Bowman, 1983; MacKinlay, 1997), and in the current literature, it was no exception (ALAM et al., 2020; He, Sun, et al., 2020; Liu, Wang, et al., 2020; Sayed & Eledum, 2021; Xiong et al., 2020). This is also the model used in this study for the market analysis:

$$R_{i,t} = \alpha_{1i} + \beta_{1i} R_{m,t} + \varepsilon_{i,t} \quad 3.2$$

where $R_{i,t}$ is the actual return of index i on day t; $R_{m,t}$ is the market return on day t, and ε is the residual term.

In addition to this model, a multi-factor model will be applied. Although, in general, the gains from their use for event studies are limited, there is a great reason for its application: if companies have a common characteristic, such as being all members of a specific sector (MacKinlay, 1997), as is the case with this study. Furthermore, additional factors are important to eliminate factors unrelated to the investigation's effects (Mukanjari & Sterner, 2020). Within these models, there is evidence that the three-factor model by Fama and French (1993) has more explanatory power compared to the single-factor model (Fama & French, 1992, 1993, 1996). This model includes two additional factors to explain the excess of returns and is given as:

$$R_{i,t} - R_{f,t} = \alpha_{2i} + \beta_{2i}(R_{m,t} - R_{f,t}) + \beta_{3i} HML + \beta_{4i} SMB + \varepsilon_{i,t} \quad 3.3$$

where $R_{i,t}$ is the actual return of sector index i on day t; $R_{f,t}$ is the risk-free return on day t (U.S. one month T-bill rate); $R_{m,t}$ is the return on a region's value-weight market portfolio on day t[8]; HML is the measured value factor as the difference in returns between high and low book-to-market ratio stocks on day t, SMB is the measured dimension factor as the difference in returns between small and large stock firms on day t, and ε is the residual term.

From equations 3.2. and 3.3., abnormal returns of index i on day t is given as:

[8] See Fama and French (2012).

$$AR_{i,t} = R_{i,t} - \widehat{\alpha_{1i}} - \widehat{\beta_{1i}}\, R_{m,t} \quad (3.4)$$

and

$$AR_{i,t} = \left(R_{i,t} - R_{f,t}\right) - \widehat{\alpha_{2i}} - \widehat{\beta_{2i}}\left[R_{m,t} - R_{f,t}\right] - \widehat{\beta_{3i}} HML_t - \widehat{\beta_{4i}}\, SMB_t \quad (3.5)$$

To estimate $\widehat{\alpha_i}$, $\widehat{\alpha_2}$, $\widehat{\beta_{1i}}$, $\widehat{\beta_{2i}}$, $\widehat{\beta_{3i}}$, and $\widehat{\beta_{4i}}$ the most used model in the literature is the OLS model (Liu, Wang, et al., 2020; Mukanjari & Sterner, 2020; Orhun, 2021; Sun et al., 2021). However, this estimation requires some assumptions for parameter estimates to be efficient and test statistics consistently based on them (Akgiray, 1989; Corhay & Rad, 1994). According to Sayed and Eledum (2021), one of these assumptions is the homoscedasticity of OLS residues, that is, that their distribution varies constantly. If heteroscedasticity is present, models that use stock returns must be adjusted (Giaccotto & Ali, 1982). This adjustment can be conducted using the Autoregressive Conditional Heteroscedasticity (ARCH) models proposed by Engle (1982) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models, developed by Bollerslev (1986) that allow nonlinear intertemporal dependence on the residual series.

In this way, following the reasoning of Sayed and Eledum (2021), before estimating the models presented in equations 3.4. and 3.5., tests must be performed to analyse their heteroscedasticity. Several tests allow this analysis, such as the Breush-Pagan-Godfrey, Harvey, or White tests. This study applies ARCH tests.

The results can be observed in more detail in Annex 5. Still, briefly, only models that incorporate the returns of the sector related to Food and Health (in the first phase) and Electronic (in the second phase) have ARCH effects. Thus, the estimators involved in these models will be estimated through GARCH models. All other models are estimated by OLS, during the period of -124 to day -5 (first phase) and from -104 to day -5 (second phase).

As seen earlier, if the EMH is verified, it is expected that ARs tend to zero, which implies that the returns are the same as what was already expected by the market. Thus, cumulative abnormal returns (CARs) (sum of abnormal returns) also tend to zero. Therefore, these CARs can be calculated as follows:

$$CAR_{i(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_{i,t} \quad (3.6)$$

where t_1 is the first day of the event window and t_2 the last. This cumulative abnormal return concept is required to accommodate a multi-period event window (MacKinlay, 1997). Thus, CARs can be defined for any time that is important to be analysed. Liu, Manzoor, et al. (2020) and Liu, Wang, et al. (2020) refer that it is important to explore various CARs and, if possible, with different lengths to reflect the multiple response speeds and trends change of the stock markets (Naidu & Ranjeeni, 2021). The impact of the COVID-19 pandemic is expected to be longer than these same events. Furthermore, for this reason, stock markets are expected to have different behaviours at different stages of the pandemic cycle (Singh et al., 2020). Like Sayed and Eledum (2021), Annex 4 shows the different CARs and their justification.

Once all the ARs and CARs are defined, it is usual to test hypotheses about these same variables (Binder, 1998; Sayed & Eledum, 2021). In this step, there are two categories of tests: parametric and nonparametric tests. The former is the most used in the literature (Barber & Lyon, 1996). Still, it requires that two conditions be met: independent variables and normal distribution (Binder, 1998). If these assumptions are not checked, all results will be asymptotic. Consequently, non-parametric tests will have to be applied to confirm the results or evaluate the influence of outliers. The use of nonparametric statistical tests has expanded to include many different procedures, including the Kolmogorov-Smirnov one-sample test, the Wilcoxon matched-pairs signed-ranks test, and the Marm-Whitney U test (Bowman, 1983).

In this way, it is necessary to test the assumptions seen earlier to carry out the parametric tests. The Shapiro-Wilk test, the most powerful test for normality (Mohd Razali & Yap, 2011), was conducted for all variables that were shown to be normally distributed, a t-test was performed, and the distribution of CAR in H_0:

$$CAR_{i(t_1,t_2)} \sim N\left(0, \sigma^2_{i(t_1,t_2)}\right) \tag{3.7}$$

Moreover, therefore, the t-statistic can be defined as:

$$t_{stat} = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{N}}} \sim t_{(n-1)} \tag{3.8}$$

where $\bar{X}$ is the sample mean, s is the unbiased sample standard deviation, N is the number of observations of X, and μ is the test mean (which in this case is zero). If X is normally

distributed under the null hypothesis, the t-statistic follows a t-distribution with N-1 degrees of freedom. Given the normality of the variables, the bilateral parametric test can be performed. The hypotheses are defined as well:

$$\begin{cases} H_0: CAR = 0 \\ H_1: CAR \neq 0 \end{cases} \quad 3.9$$

Thus, if the ρ-value is lower than the significance level, we reject the null hypothesis and, if it is equal or higher, we do not reject the null hypothesis. In other words, if H_0 is found there was no impact on the stock markets since $CAR = 0$. However, if we reject the null hypothesis, we can state that there was an impact depending on the signal of the observed test. However, not all sector indices are equipped with a normal distribution. For this reason, and by complement, nonparametric tests will be conducted in the same way. Nonparametric tests have the advantage of analysing the median instead of the mean, as is the case with the applied parametric tests. Thus, in the presence of outliers, while the mean is affected, the median is not.

3.3. Regression Analysis

Despite the advantages taken from the event study methodology, those that will be taken are only theoretical. In other words, although the calculation of CARs is empirical, its interpretation will be due to a "match" between the results and the major events during that period. Thus, a simple regression will be applied using the OLS method to better understand the impacts of transmission channels on stock markets. In general, the model is presented as follows:

$$R_{i,t} = \alpha_t + \beta_i X_{i,t} + \varepsilon_{i,t} \quad 3.10$$

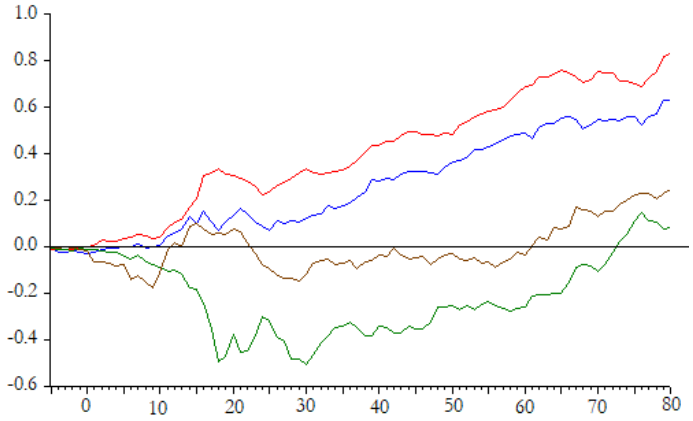
where $R_{i,t}$ is the return of index i on day t, $\varepsilon_{i,t}$ is the residual term, and $X_{i,t}$ is a vector of variables that will be announced in the next subsections. This regression is intended to analyse the impacts of some variables on the returns of the European stock market (STOXX Europe 600). The objective is to study some characteristics that try to explain the resilience of a country to the impact of the pandemic. For this reason, the period uses only the period between 21 February 2020 and 12 June 2020.

4. Empirical results and discussions

4.1. First phase: 14 February 2020 – 12 June 2020

The behavior of the CARs can be observed graphically in Figure 1. The results are presented in Table 1, and, in general, if all the CARs observed are added, the sector that performed best was the basic resources sector (83.20%). This result is largely because the masks produced needed resources exploited by this sector (e.g., cotton). On the other hand, the sectors with the worst results were the aerospace & defense sectors (8.02%) and airlines (24.48%), which is consistent with the literature. Interestingly, even for the sectors most affected by the pandemic, the respective CAR (-5, 80) is positive. This shows that even in the face of the ineptitude outbreak in Europe, stock returns have recuperated during the period.

Figure 1. CARs between 14 February and 12 June 2020



Notes: The figure shows the CARs of basic resources (red line), hardware (blue line), aerospace & defense (green line), and airlines (brown line) during the period between 14 February to 12 June 2020. Only the two sectors with the best results and the two with the worst results were inserted for better visualization. The bottom axis displays the days in relation to the event [-5, 80]. The left axis shows the decimal value of the CARs. Own elaboration using *Eviews* for this purpose.

Analysing the results by periods can be observed that the market recorded negative values before the event. This may be due to the anticipation of the market to the event or that they are already suffering from the outbreak still experienced in China. This result worsens in the period (0, 7), a period characterized by the CAR that records the behavior of the indexes to the event under analysis (outbreak in Italy and consequent lockdown). In this period, without any surprises, it was the airline sector that recorded the worst result. Unsurprisingly, the outbreak in Italy, one of the central points of European tourism, has begun to close borders, and many trips were cancelled to and from their country.

Table 1. First phase results

Sectors	(-5, -1)	(0,7)	(8,13)	(14,17)	(18,20)	(21,35)	(36,43)	(44,50)	(51,58)	(59,68)	(69,74)	(75,80)
Oil & Gas	**0.37**	0.87**	-10.82**	-4.12*	**0.32**	23.27*	7.82**	7.15*	10.15*	8.27*	6.36*	5.68*
Chemicals	-0.77***	0.85***	**3.50**	3.96*	1.07**	4.33***	9.78*	5.19*	7.80*	8.26*	7.21*	5.00**
Basic Resources	-0.31*	5.62*	**6.31**	20.05**	**-1.00**	**2.46**	14.51*	0.84*	14.59*	7.50*	**-1.61**	**11.87**
Construction	**0.40**	2.70*	-1.34*	-4.55*	**1.09**	**6.66**	5.48*	7.40*	8.00*	11.29*	6.70*	3.37**
Aerospace	-0.92*	-2.86**	-8.34*	-23.23***	**-2.71**	**4.06**	-3.42**	12.29*	-2.80***	20.39*	**14.03**	2.73*
General Industrials	-1.26**	**0.26**	**1.87**	**0.29**	**-0.25**	8.49**	8.45*	9.14*	10.47*	14.65*	4.14*	3.50*
Electronic	**2.55**	3.21**	**2.69**	**3.81**	**-2.65**	0.42*	10.57*	6.63*	7.83*	7.27*	5.23*	6.34**
Engineering	-1.42*	4.34**	**4.75**	9.28**	**-0.95**	0.39*	11.16*	5.19*	10.76*	7.94*	3.58*	**4.66**
Transportation	**-0.41**	-1.88*	**2.88**	0.00***	**2.41**	**3.76**	10.65*	7.27*	7.40**	10.18*	5.95**	6.99**
Automobiles	**0.78**	**2.60**	**4.73**	-0.70**	**0.92**	**8.82**	11.46*	10.65*	6.80*	14.40*	4.69*	5.65**
Beverages	0.47*	-8.62*	-6.03**	-16.65**	**3.32**	13.00**	0.99**	14.25*	**1.19**	17.66*	15.47*	3.89*
Food Producers	3.41*	-2.70*	-4.27***	-9.34*	**-0.27**	9.69***	5.33*	7.57*	5.87**	8.76*	10.31*	7.42*
Household Goods	**0.33**	**-0.62**	4.96*	**2.91**	1.96**	1.07*	9.11*	6.66*	8.75*	4.32*	3.44*	7.23**
Leisure Goods	**0.81**	1.90***	**-0.15**	**11.33**	-4.78***	**3.86**	9.04*	10.37*	11.97*	9.49*	2.39**	**6.54**
Personal Goods	-1.40**	1.83*	0.87***	**-0.14**	1.64***	1.59*	4.64*	8.10**	**2.68**	12.33*	11.83*	7.11*
Tobacco	-8.34***	0.27**	5.37*	**7.86**	1.48***	21.73*	5.05*	9.84**	10.71*	**-2.08**	**0.85**	9.81**

Table 1. First phase results (cont.)

Sectors	(-5, -1)	(0,7)	(8,13)	(14,17)	(18,20)	(21,35)	(36,43)	(44,50)	(51,58)	(59,68)	(69,74)	(75,80)
Health Care	-4.10*	**0.99**	8.68**	**-3.92**	16.76*	-5.01*	-1.90**	11.66*	**6.01**	4.09*	4.21*	6.60***
Pharmaceuticals	-0.74**	-2.73**	**-0.37**	-5.14*	**-3.24**	8.66**	11.22*	6.13*	7.71*	4.32***	4.63*	6.88*
Retail	**-0.57**	3.08*	4.98**	10.94***	1.78***	0.45*	10.41*	2.86***	12.15*	3.50*	5.24*	5.58**
Media	**-0.06**	**-2.97**	-1.17**	-6.92**	**-1.29**	12.66*	4.20**	7.17**	5.48*	12.17*	10.10*	4.80*
Airlines	-1.32***	-11.41**	**12.93**	5.17*	**2.10**	-14.69*	3.54**	**0.87**	-2.50*	21.31*	**3.37**	4.27*
Gambling	-3.32*	4.80*	-0.27**	-37.86**	**12.66**	41.34*	12.47*	6.61*	10.71*	4.84*	-2.97*	**0.92**
Hospitality	-1.80***	-6.41**	-6.37*	**-15.30**	**-0.48**	-3.59**	9.34*	12.04**	3.37*	30.70*	-6.59*	18.71*
Telecommunications	2.68**	-2.69**	**-3.24**	0.92***	2.25***	2.71**	6.73*	7.93*	9.17*	8.26*	10.98*	3.75*
Utilities	2.55*	**-0.31**	**-8.43**	-8.62*	**-4.68**	**4.81**	**0.66**	10.43*	3.17***	12.25*	13.59*	4.04*
Banks	-1.65*	**-1.07**	**4.99**	7.66***	3.47**	-11.48*	9.49*	7.72*	8.43*	7.48*	2.71*	6.19**
Insurance	**-1.18**	-2.02**	**0.41**	-8.93*	**1.31**	9.38*	7.08*	7.49**	4.28*	9.50*	9.56**	5.04**
Real Estate	0.55*	**-1.48**	**-2.50**	-19.12**	**3.13**	**7.97**	-1.34*	8.75*	1.96***	11.82*	14.97*	2.71*
Financial Services	-0.79**	**1.99**	8.90**	5.18***	3.96**	**1.77**	11.09*	7.59*	7.48*	8.33*	5.14*	5.43*
Software	**-0.33**	2.42*	**3.73**	4.49**	**0.38**	**4.91**	6.07*	5.75**	9.06*	8.45*	4.68*	7.57**
Hardware	-2.52*	3.66**	**6.51**	3.04**	**3.02**	**3.72**	13.95*	4.94***	11.28*	3.04*	**1.44**	**7.18**
Market	-0.41**	-0.78***	1.13*	-1.13**	0.55***	-2.68*	0.98*	-1.80**	1.29*	-1.34*	-0.96**	1.18*

Notes: The table shows the respective CARs from the first analysis phase. The choices and the justifications of the CARs can be seen in Annex 4. Each result is calculated according to equation 3.6. The results are displayed in percentage (%). *, **, and *** indicates significance at 1, 5, and 10%, respectively. The bold results are not statistically significant.

Consequently, the hospitality sector also recorded the worst results, confirming the 'domino effect.' The fact that the trips were cancelled, numerous hotels and restaurants had their revenues fall severely due to the lack of tourists. The beverage sector also belonged to the group of sectors that suffered the most, which is consistent with Liew (2020). According to the author, the beverage sector is also related to tourism. The sectors with the best results stand out the sectors related to basic resources, industrial engineering, gambling, and hardware. The result referring to the first sector is due to what has been presented earlier, i.e., the beginning of masks' production may have driven this result. The hardware sector had its revenues skyrocket, as people needed to buy electronics to continue working and attend classes. This result is contradictory to Yan et al. (2020) since, according to them, the hardware sector would suffer more than the software sector because of the factories and stores shutdown due to the containment. However, this is not the case for European companies. Perhaps, because European software companies are not so challenging and offer the same products as American companies, these results have been observed.

The period (8, 13) was characterised by the fact that WHO officially declared COVID-19 as a pandemic, the ECB announcing the restriction of non-essential travel, and the spread of the virus throughout Europe. However, during this period, the European Commission (EC) set up an investment fund worth EUR 25 billion in the face of economic destruction. Perhaps at the beginning of this latest event, the market recorded positive values of around 1.13%. During this period, the sector that recorded the worst results was the oil & gas sector. It is recalled that it was during this period that the price of oil recorded negative values and, for this reason, the result obtained is confirmed. This reason also triggered the second-worst result of the period in the aerospace & defense and hospitality sector.

As seen, the health care sector suffered from the impact of the pandemic, but it was over time demonstrating good results. The same happened in this case. The CAR (8, 13) represents, on the actual date, approximately one month after the event under analysis. Furthermore, it was during this period that the health care sector presented the best results. This sector was joined by general financial services, which is consistent with Wójcik and Ioannou (2020), that in their opinion, this sector would deliver good results because companies that went bankrupt or tried to restructure themselves were seeking this type of service.

In terms of moments, the period (14, 17) must have been the worst of this first phase and even probably of the entire period under study. During this period, WHO officially declared Europe as the pandemic's epicentre and, consequently, the US banned travel to and from Europe. In fact, in the face of these events, the market recorded negative values, but surprisingly it was not the worst result of the first phase. This is probably due to capital injections by the EC, Germany, and France and the monetary policies observed in England. The aerospace & defense sector continued to record the worst results, along with gambling and real estate. Gambling may have been caused by the fact that several casinos and other betting placings have been closed. The impact of real estate is in line with Wójcik and Ioannou (2020), who found that real estate transactions are not popular in uncertain conditions. On the other hand, the basic resources sector continues to perform well due to the continued demand for masks. He is joined by the retail sector, which may indicate the 'supermarket race' experienced in Europe at this time.

The period (18, 20) is marked by economic aid in Europe. Rome, for example, has made available a €600 million fund to help airlines. Germany also announced a package of measures to support the economy, such as Spain. For these reasons, the market recorded positive values of around 0.55%. However, the amount of statistically insignificant results does not allow concluding at the sector level. The statistically significant values highlight the values of the health care sector, which recorded its best result during the first phase with a value of 16.76%.

The period (21, 35) is marked by the different deconfinement speeds practiced in Europe. While some countries began to see COVID-19 cases go down, they began planning the process of deconfinement. However, this process was not the same in others countries, and they applied even more strengthened measures. During this period, the market recorded its worst first phase value with a negative 2.68%. The bank sector is highlighted in the sectors that suffered the most. This is consistent with the literature since non-performing loans began to make themselves felt in the banking system, undermining their performance. On the other side, oil & gas, tobacco outperformed jointly with gambling with an astounding 41.34%, which consistent with (Lin & Falk, 2021). The passage of betting on sites has benefited this sector and, the fact that more and more people spend time at home may explain this result.

The period (36, 43) was marked by the continued support of government institutions for its economy. One of the most striking examples was the fact that Eurozone finance ministers reached an agreement on an 'oxygen balloon' of EUR 540 billion. In addition, several research centres involved, such as Germany's BioNTech company, were allowed by the government to conduct human clinical trials. For these reasons, the market has a positive value of 0.98%. Although there is beginning to be evidence of a possible vaccine, the aerospace & defense sector remains the sector with the worst results, and in this case, the only ones to show a negative signal. On the other hand, the basic resources and hardware sector continue to show good performances compared to other sectors. The hardware-related result is consistent with Huo and Qiu (2020), who have shown continued positive values related to this sector.

Advancing for the period (44, 50), the market presents negative values in the order of 1.80%. During this period, European countries, except the UK, have begun to submit their deconfinement plans. However, this period was marked by the beginning of vaccine trials in humans. Perhaps this event explained the value of health care, one of the best sectors during this period. To this, the beverages, aerospace & defense, and hospitality sectors are added. It should be noted that the sectors that suffered the most at the beginning of the pandemic also show a better recovery when announcing a possible vaccine. Perhaps the fact that this happened began to give investors optimism that everything would soon return to 'normal.' All sectors, despite different magnitudes, showed positive values (except the market), which indicates a possible recovery.

In the period (51, 58), the previously presented deconfinement plans began to be put in place. This stimulated the European economies resulting in a positive value of 1.29%. In addition, the ECB has increased the budget of the Pandemic Emergency Assets Purchase Programme (PEPP) by EUR 600 billion. While it is clear that the markets continued to recover at a sectoral level, the aerospace & defense and airline-related sectors continued to show negative values (the only ones for the entire period).

The period (59, 68) was marked by the positive values of the airlines, hospitality, and aerospace & defense sectors. Much is due to the green light given to the free movement of people in the Schengen area. On the negative side, hardware was one of the worst sectors (even if with a positive signal). The conviction of people and investors could be that of summer with tourism and that people would be less and less at home.

The period (69, 74) was marked by the EC announcement on the multi-annual financial framework (EU budget 2021-2027) and a medium-term recovery fund entitled Next Generation EU. The fund had €750 billion to help the 27 Member States, with two-thirds distributed as outright grants and a third via loans. Furthermore, Europe continued to lift measures, including the UK this time around. However, the market registered negative values during this period, not immediately reflecting the major events.

The period (75, 80) was marked by the alliance (France, Germany, Italy, and the Netherlands) to accelerate discovering a vaccine on European soil. In addition, the EC recommended the reopening of borders between the EU Member States, suggesting 1 July for the reopening of external borders, i.e., with neighbouring countries in the bloc and people from other continents by air. Perhaps for these reasons, the hospitality sector's value is not surprising (18,71%). However, the aerospace & defense sector continued to be one of the least evolving sectors. The market in the face of the events during this period and the previous recorded the second-best result of the phase.

In sum, the results observed during the first phase of analysis are somewhat consistent with the literature. First, it is detected that the spread of the virus to Europe and the consequent lockdown by the Italian Government negatively impacted the European stock market. Second, the fact that the CAR observed (throughout the period) of the basic resources sector has been ten times higher than the aerospace & defense sector makes it possible to say that there has been heterogeneous behavior at the sectoral level in European stock markets. Thirdly, the sectors that suffered most from the pandemic were sectors related to transport (namely air) and hospitality. However, the health care and pharmaceutical & biotechnology sector were not the ones that benefited the most, contrary to what would be expected.

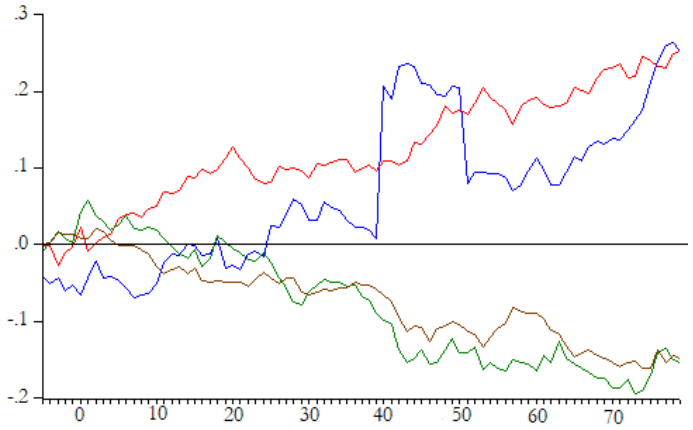
Globally, during the first phase, the market was affected by the spread of the coronavirus. As the number of cases increased, the measures imposed by governments were more severe, which made the stock market, in these periods, present negative CARs. Furthermore, European countries' different containment measures resulted in the worst value of this first phase. However, the economic support provided to national economies and the beginning of suspicions over the discovery of the vaccine alleviated these impacts.

4.2. Second phase: 2 November 2020 - 26 February 2021

In Table 2 can be found all the results for this second phase. Overall, it should be seen that the magnitude of the recorded values is much lower than the first phase. This highlights the smaller market swing in this period. At this stage, the best results are related to the financial services (21.10%), hardware (25.19%), and gambling (25.25%) sectors. On the other hand, the worst results are related to the airlines (-13.64%), auto & parts (-14.56%), real estate (-14.90%), and aerospace & defense (-15.30%) sectors.

Figure 2 shows the behavior of the CARs from the two best/worst sectors of the second phase of analysis. The Gambling-related CAR 'jump' clearly indicates that other events impacted sector indices beyond those associated with the pandemic. Temporally, it corresponds to the beginning of January, which may show the 'January effect' (Chou et al., 2011) or simply because there is more demand for stocks related to gambling sites during this period.

Figure 2. CARs between 2 November 2020 and 26 February 2021



Notes: The figure shows the CARs of hardware (red line), gambling (blue line), aerospace & defense (green line), and real estate (brown line) during the period between 2 November 2020 and 26 February 2021. Only the two sectors with the best results and the two with the worst results were inserted for better visualization. The bottom axis displays the days in relation to the event. The left axis shows the value of the CARs. Own elaboration using *Eviews* for this purpose.

The CAR (-5, -1) is the period for the largest event of the phase: the discovery of the vaccine. Moreover, it was during this period that the pharmaceutical & biotechnology sector presented the best results. Perhaps there were already rumours about how it was a vaccine, so the demand for stocks related to this sector has increased.

Table 2. Second phase results

Sectors	(-5, -1)	(0,10)	(11,16)	(17,25)	(26,30)	(31,40)	(41,64)	(65,79)
Oil & Gas	**-0.82**	7.18*	**-1.38**	4.05*	-1.25*	0.30*	1.04*	5.40*
Chemicals	0.65***	-3.76*	**-0.12**	-0.96*	-0.15**	**-0.90**	-3.71*	-1.39*
Basic Resources	-0.75***	-0.05*	2.29*	4.99*	0.85*	-0.07*	-1.99*	10.29*
Construction	0.51**	-2.58**	-2.11**	-1.72*	-1.39*	-1.61**	**-2.07**	-0.58*
Aerospace	**0.33**	1.59*	-4.76*	0.41*	-3.76*	**-3.62**	-5.00*	-0.50*
General Industrials	**-1.35**	-7.67*	-2.07*	0.17***	0.86**	-1.48**	1.24**	-3.35*
Electronic	-1.38***	-2.38*	-2.38*	-0.86*	**0.13**	-1.42**	**-3.47**	-1.41*
Engineering	-1.72***	-2.47*	-2.84**	**0.34**	**-0.24**	-1.80*	**-2.00**	2.63*
Transportation	0.55***	-5.97*	**-1.78**	-2.59*	0.98*	-2.29*	-3.13*	**1.39**
Automobiles	-1.37**	-4.34*	-1.38**	-2.39*	3.25*	-3.49**	0.05*	-4.90*
Beverages	-0.92*	3.66*	-0.47*	1.95*	-0.92*	**-2.35**	-0.68*	-5.76*
Food Producers	0.53**	**-2.00**	0.64*	0.82*	0.43**	2.27*	-4.05*	**-0.52**
Household Goods	1.16**	3.15*	-1.23*	-4.46*	0.40**	-0.09*	-0.18*	-1.53*
Leisure Goods	2.39*	-1.63*	**1.44**	**-5.62**	-2.82***	**-0.21**	-3.04*	-0.83*
Personal Goods	**0.90**	4.21*	-1.08**	1.98**	**-1.29**	-0.26**	-2.70*	3.12*
Tobacco	-3.80**	16.83*	-7.22**	14.52*	**-0.14**	5.80*	-2.00*	-4.27**
Health Care	-0.08**	1.97*	-9.25**	3.68**	-4.47*	**-2.94**	**0.91**	6.96*
Pharmaceuticals	2.48*	2.82*	1.34*	0.95*	**-0.86**	1.52**	2.36*	2.44*
Retail	0.87**	1.42*	**-0.27**	-2.87*	-3.08**	0.02*	**-0.91**	1.19**
Media	0.86***	0.60*	-1.38*	0.86**	**-0.02**	**-0.75**	**-0.67**	2.73*
Airlines	2.09***	**-4.65**	-4.36*	**-2.02**	-3.35*	-3.08*	-1.30*	3.03*
Gambling	-5.33*	**0.18**	3.74*	**3.93**	0.64***	**17.49**	-11.14*	15.75*
Hospitality	**2.93**	**-2.75**	**1.30**	2.55*	-8.43*	2.16*	4.09*	**4.17**
Telecommunications	-1.56**	-0.26***	1.69*	-0.40**	-1.86**	0.93*	**3.04****	-3.17*
Utilities	**-0.13**	**-0.94**	**-0.98**	-1.00*	**-1.04**	2.92*	-5.24*	-6.02*
Banks	**-1.23**	-3.27*	-0.31***	**-1.19**	-2.79**	-0.28*	0.86*	0.80*
Insurance	1.92**	-0.30**	-1.77*	-2.30*	0.83**	0.18*	-3.26*	1.35*
Real Estate	1.37**	-4.31**	-1.75***	**0.30**	**-2.09**	-0.09*	-6.61*	-1.72*
Financial Services	3.61**	5.12**	**-1.98**	3.74*	**0.37**	6.21*	3.83**	**0.20**
Software	-1.65*	0.68*	0.57*	-0.40**	0.16***	**-1.26**	**0.98**	4.83*
Hardware	**-0.22**	5.27*	4.76*	**-1.67**	0.49*	2.21*	7.55*	6.81*
Market	**-0.08**	0.31***	-1.49**	1.05*	-1.23***	1.42*	-1.25*	0.98*

Notes: The table shows the respective CARs from the first analysis phase. The choices and the justifications of the CARs can be seen in Annex 4. Each result is calculated according to equation 3.6. The results are displayed in percentage (%). *, **, and *** indicates significance at 1, 5, and 10%, respectively. The bold results are not statistically significant.

The period (0, 10) is when the impact of the vaccine discovery on the markets is verified. During this period, Pfizer announced a vaccine with more than 90% efficacy against the coronavirus. In general, the market presented a positive value, but not of the magnitude that was expected. Moderna and AstraZeneca joined Pfizer with the discovery of two other vaccines. Surprisingly, there were no major reactions to these announcements at the sector level, with the sectors that presented the best results were the oil & gas and tobacco sectors.

Because of this discovery, many European countries announced, in the period (11, 16), that they intended to start the vaccination plan even before the end of the year. However, the fear on the part of the population with the vaccine and the controversy of AstraZeneca, the market registered negative values during this period. Perhaps for these reasons and because they believe that vaccination would take some time, the airlines, and aerospace & defense sectors were most affected during this period. However, it was the health care-related sector that registered the worst result with a negative 9.25%. Of the sectors that benefited most, the hardware sector continued to reign.

The UK started its vaccination plan in the period (17, 25). It should be noted that the UK is the country with the most companies based in the sample of this study, and, this reason, can explain the positive market values, in the order of 1.05%. However, this feeling of positivity in the market was quickly destroyed with the emergence of new variants: British and South African. With this event, the UK suspended travel to and from its country, causing the airlines, aerospace & defense, and hospitality sectors to immediately resent these events, causing them to record the worst results of the period (26, 30). The market also presented a negative value of 1.23%.

Despite the discovery of vaccines, they still had to be approved by several institutions for their commercialization to begin. This approval occurred in the period (31, 40) with the green light given to the vaccine developed by BioNTech and Pfizer by the European Medicines Agency. This caused vaccination in Europe to take off even during this period. Thus, the market recorded its best value throughout this second phase with 1.42%. However, the airline sector did not respond, presenting one of the worst results of this period.

In the period (41, 64), the new British variant was reported in 31 other countries, and the spread of the South African variant caused a great deal of concern in Europe. This spread

has caused European countries to consider restricting both internal and external borders. For these reasons, the market recorded the second-worst result of this second phase with a negative 1.25%. The aerospace & defense sector was consistent with the worst-case events.

Vaccination already initiated by the UK was intensified in the period (65, 79), in which about 15 million people received the first dose of the vaccine against the new coronavirus. However, in other European countries such as France, for example, cases have increased again due to the spread of the new variants. The market had a positive value of 0.98%.

Overall, the market registered a positive reaction to the announcement of the vaccine. In all periods where vaccination was the main event, the market registered positive values. However, the appearance of new variants that triggered a wave much worse than the first caused the market to slow its growth. At the sectoral level, the aerospace & defense sector continued to be the sector with the worst results, demonstrating that, even with the discovery of the vaccine (and the potential end of the pandemic), investors did not seek stocks related to this sector. On the other hand, the hardware sector continued to show good performances, showing that even given the event under analysis, the demand for stocks related to the technological sector increased. The literature on the pandemic is growing, but the sectoral impacts on European equity markets for 2021 had not yet been analysed at the time of writing this study. Thus, it is not possible to state that the observed results are or are not consistent with the current literature.

4.3. Regression results

4.3.1. Catalyst related variables

In this category (as in all others that will follow this one), the final model is achieved by including the variables one by one. The last combination is thus achieved when the model is jointly statistically significant using the greatest number of possible variables, which, in this case, is model (3) (Table 3). In this model, the growth of confirmed cases per million people (Gtcpm), the growth of deaths per million people (Gtdpm), and the growth of tests per thousand people (Gttpt) are jointly statistically relevant (F-stat's ρ-value < 0,05), and all these variables negatively impacted the stock market. The first two variables are consistent with the literature (subsection 2.3.1.). The growth of tests per thousand people negatively impacted the market because the more tests carried out, the greater the probability of

detecting cases of COVID-19. In fact, a correlation between the tests performed and the number of cases is 56% (Annex 8).

Table 3. Catalyst's impacts on the stock market

	(1)	(2)	(3)	(4)
Variable	**Coefficients**			
Constant	0.002998	0.003159	0.005889	0.002282
	(0.828)	(0.839)	(1.458)	(0.722)
Gtcpm	-0.037100**	-0.030485	-0.004840	0.358754
	(-2.562)	(-0.744)	(-0.112)	(1.471)
Gtdpm	-	-0.006515	-0.015087	-0.401288
		(-0.173)	(-0.402)	(-0.943)
Gttpt	-	-	-0.0.042459***	-0.042654
			(-1.723)	(-1.588)
Gtvph	-	-	-	-0.005400
				(-1.043)
F-stat	6.562443**	3.254811**	3.216008**	1.522330
R-squared	0.078533	0.078895	0.113978	0.076993
Obs.	79	79	79	78

Notes: The table presents four different models. Models (1), (2), and (3) show the impact of the pandemic on the stock market during the period between 21 February 2020 and 12 June 2020. Model (4) is the regression between 9 November 2020 and 26 February 2021. In addition, the variable Gtvph (daily variation in the number of vaccines administered) is added to capture the effect of vaccination on stock markets. In both models, the dependent variable is the daily market returns (Mkt) (STOXX Europe 600). All the models were regressed by the OLS method using *Eviews* for the purpose. The details about the independent variables are available in Annex 3. T-stats are presented in parentheses. **, and *** indicates significance at 5 and 10%, respectively.

The same regression was performed for the second phase to test whether the number of people vaccinated impacted returns. None of the variables related to vaccination proved to be statistically significant, demonstrating the poor response of markets to vaccination. This result can be explained by the fact that, until 26 February 2021, vaccination had not taken place at the pace that the markets would have expected.

4.3.2. Government measures related variables

In this category, several models were built to analyse the impact of different measures on stock returns (Table 4). Although only four variables are statistically significant at the individual level, model (1) is, jointly, statistically significant (F-stat's ρ-value < 0,05), which

demonstrates that all variables together explain the behavior of market returns for the first phase of the pandemic. The coefficients associated with schools closing (C1), cancelling public events (C3), closing public transport (C5), and staying at home requirements (C6) show positive signs. In other words, the more demanding these measures were, the better the performance presented by the stock markets. These results can be explained by the fact that these measures allowed to lower the spread of the virus[9], calming the number of confirmed cases and deaths related to the pandemic. On the other hand, the coefficients associated with the closure of workplaces (C2), restrictions on gatherings (C4), restrictions on internal movements (C7), and international travel controls (C8) show negative signs. The result associated with variable C2 is explained by the more demanding these measures were, the more companies had their activities closed. Thus, the country's productivity is lower, negatively impacting its stock returns. Likewise, the results of national and international mobility restrictions reflect the importance of the circulation of goods, capital, and people in Europe.

As for government measures related to health, the variable associated with vaccination could not be used in model (2) since no person had yet been vaccinated in the first phase. All the variables together explained the behavior of returns on the European stock market (F-stat's ρ-value $<$ 0,1). The coefficients associated with public information campaigns (H1), facial covering (H6), emergency investment in health care (H4), and investment in vaccines (H5) show a negative sign. However, the coefficients associated with the last two variables announced are close to zero, which does not state that they affect returns. Theoretically, it still does not make much sense that the other two variables have a negative sign. In other words, it would be expected that more announcements about the severity of the pandemic and recommendations for the use of masks would cause the cases to go down and, consequently, calm the stock markets. One possible explanation is the fact that people, even in the face of government warnings, did not respect these same measures.

One possible explanation is the fact that people, even in the face of government warnings, did not respect these same measures.

[9] The correlation between the Stringency Index (representative index of measures C1 to C8) and the growth of cases and deaths is -70% and -65%, respectively (Annex 8).

Table 4. Government measures' impacts on the stock market

(1)		(2)		(3)		(4)		(5)	
Variable	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**	**Variable**	**Coefficient**
Constant	-0.016472 (-1.566)	Constant	-0.006613 (-0.231)	Constant	-0.058009 (-1.656)	Constant	-8.295097 (-0.537)	Constant	-6.104352 (-1.146)
C1	0.002984 (0.235)	H1	-0.002419 (-1.275)	E1	0.021986 (1.302)	Strin	-0.00416 (-0.102)	HICP	0.127842 (1.141)
C2	-0.004236 (-0.481)	H2	0.001621 (0.198)	E2	0.016141 (0.559)	Con	-0.000380 (-0.068)	WTI	-0.015086 (-0.534)
C3	0.030135*** (1.740)	H3	0.015820 (1.401)	E3	-3.80E-13 (-1.468)	Eco	0.001247 (1.274)	Brent	0.062087** (2.306)
C4	-0.014730 (-1.422)	H4	-6.19E-12*** (-1.713)	E4	-3.08E-11 (-0.359)	Gov_rep	5.571061 (0.537)	GBP	0.215248 (1.151)
C5	0.041853** (1.999)	H5	-8.82E-11 (-0.610)	Eur	0.012696 (0.215)			USD	-0.047375 (-0.073)
C6	0.034076** (2.060)	H6	-0.003253 (-0.334)	Sonia	0.080730** (2.372)			CHN	-0.095774 (-0.753)
C7	-0.006564 (-0.529)	H8	0.015181** (2.616)	Yield	0.035194** (1.157)			Tran_ts	-0.537339 (-0.660)
C8	-0.025162** (-2.127)								
F-stat	2.428**		2.019***		3.777*		2.879**		2.977*
R-squared	0.217212		0.166061		0.271387		0.132306		0.226929
Obs.	79		79		79		79		79

Notes: This table presents the government measures impact regression on market returns from 21 February 2020 to 12 June 2020. The dependent variable is, in all models, the daily market returns ($R_{i,t}$) (STOXX Europe 600) and is regressed into thirty and three independent variables. All the models were regressed by the OLS method using *Eviews* for the purpose. The details about the independent variables are available in Annex 3. The t-statistic is reported in parentheses. *, and **, indicates significance at 1 and 5%, respectively.

On the other hand, the coefficients associated with the testing policy (H2), contact tracing (H3), and the protection of the elderly people (H8) show positive signs. This denotes that the countries concerned with tracking down COVID-19 patients and sending them directly to quarantine could deal better with the pandemic. Variable H8 has the particularity that, individually, it is also statistically significant. This denotes that the more a country supported and defended the health of the elderly population (the age group most affected by the pandemic), the better its stock markets performed.

As for the variables related to economic measures presented in the model (3), only the coefficients associated with fiscal measures (E3) and international support (E4) show negative signs, but with values very close to zero. All other coefficients show a positive sign, which demonstrates that the economic support of governments and institutions to the economies had positive impacts on their stock markets. Furthermore, the role of Euribor, sterling overnight interbank average rate (Sonia), and the Monetary Union's yield rate should be highlighted, which show positive signs evidencing the role of national and supranational institutions in the stock markets.

In general, the three sub-categories seen can be grouped into general indexes (Hale et al., 2020): stringency index, containment and health index, and economic support index. This analysis gave rise to model (4), which, jointly, is statistically significant (F-stat's ρ-value $<$ 0.05). The coefficients associated with the stringency index and the containment and health index show a negative sign, which demonstrates that, in general, government measures harmed the markets. The force of the shutdown of business activities had more impact than measures to stop the virus from spreading. The coefficient associated with economic support has a positive sign, reinforcing the results previously seen. That is, economic support had positive impacts on stock markets. These indices were joined by the government effectiveness (Gov) variable, reflecting the quality of policy formulation and implementation and the credibility of the government's commitment to these policies. The coefficient associated with this variable has a positive sign, reflecting that the countries with more independence in policy formulation and greater credibility were more resilient to the pandemic.

Also, in this category, model (5) used other financial/economic measures. Together, all of them explain the market returns observed during the first phase of analysis (F-stat's ρ-value $<$ 0.01). The coefficient associated with the harmonized index of consumer prices (HICP)

has a positive sign, indicating that inflation positively impacts stock markets. As for the oil price, measured by two different variables, it presents different conclusions. On the one hand, the coefficient associated with the West Texas Intermediate (WTI) has a negative sign, representing the abrupt drop in oil price on the stock markets. However, on the other hand, the coefficient associated with the European Brent oil price (Brent) shows a positive sign. Perhaps the impact of the oil price was not so abrupt on European stock markets as in American.

As for exchange rates, only the coefficient associated with the pound sterling/euro (GBP) has a positive sign. In contrast, the coefficients associated with the US dollar (USD) and the Chinese renminbi (CHN) show a negative sign. This result agrees with Narayan et al. (2020), who highlighted the role of exchange rates in stock markets. Finally, the coefficient associated with the value-added of transport services as a percentage of total services (Tran_ts) denotes a negative sign. This indicates that countries that rely primarily on transport services were more affected than the rest. This result is consistent with the impact of the pandemic on the transport sector.

Therefore, to capture the 'domino effect,' a correlation matrix (and respective Pearson's coefficients) was created with all sector index returns (Annex 8). Most indexes are positively correlated, demonstrating that one sector's negative/positive impact is quickly transmitted to all others.

4.3.3. Panic and fear related variables

In this category, no variable was statistically significant, individually. However, together, all variables explain the returns of the European stock market during the first phase analysed (F-stat's ρ-value < 0.1). All coefficients associated with the variables denote a negative sign, demonstrating that the panic and fear observed impacted European stock markets. In this model (Table 5), the 'fear gauge' was measured by the global fear index (GFI), instead of the more recognized index (VIX), since the latter only incorporates the volatility of the American stock markets (S&P 500) (Ru et al., 2020a). In turn, the GFI measures daily concerns and emotions about the spread and severity of COVID-19, being composed of two factors: reported cases and deaths. Thus, the fact that the coefficient associated with this index is negative reinforces the results observed in the first category of variables related to the impact of the catalyst on stock markets. The coefficients associated with the other

variables also show negative signs, demonstrating that political uncertainty and geopolitical risk also negatively impacted equity markets and the pandemic. The volume of transactions carried out (Trade) is directly correlated with measures representing panic, revealing that investors make more transactions in periods of uncertainty (Annex 8). Thus, the more transactions were carried out, the more the stock markets were impacted.

To examine the relationship between government measures and panic, a correlation analysis was conducted using Pearson's coefficients for this purpose (Annex 8). According to the results, government measures appear to calm the panic and uncertainty experienced in the market for the first phase of the pandemic impact. This is evidenced by the fact that the daily news sentiment index (DNS) and the economic policy uncertainty (EPU) are negatively correlated with the three indices representing government measures, in the order of 80%.

Table 5. Panic and fear's impacts on the stock market

Variable	Coefficient	t-Statistic
Constant	0.149920	(1.144)
EPU	-0.00357	(-1.231)
DNS	-0.005665	(-0.106)
GFI	-0.000136	(-0.418)
GPR	-0.000335	(-0.927)
Trade	-2.74E-0.5	(-0.877)
F-stat	2.024***	
R-squared	0.121755	
Obs.	79	

Notes: This table presents the panic and fear impact regression results on market returns from 21 February 2020 to 12 June 2020. The dependent variable is the daily market returns ($R_{i,t}$) (STOXX Europe 600) and is regressed into five independent variables. The model was regressed by the OLS method using *Eviews* for the purpose. The details about the independent variables are available in Annex 3. *** indicates significance at 10%.

The category related to globalization is characterized by not employing any variable that is available in daily data. The fact that this does not happen makes no combination possible to analyse and, therefore, the role of globalisation is not observed econometrically.

5. Conclusions

In mid-February, the China-led outbreak spread to Europe, consequently infecting stock markets. To analyse this impact, the present study divided the empirical process into two parts. First, using the event study, the behavior of the different sector indexes was analysed, covering about 940 companies headquartered in 17 European countries during the period between February 2020 and February 2021. Secondly, through a regression by the OLS method, the second part allowed the analysis of some variables that impacted Europe's stock market (STOXX Europe 600). This study explores a hundred variables belonging to various fields, allowing a comprehensive analysis of what impact on European stock markets.

The main results of this study reveal that the spread of the pandemic for Europe and the consequent Italian lockdown negatively impacted the stock markets. However, this impact was not the same for all the sectors. The basic resources sector recorded values ten times higher than the aerospace sector, evidencing the heterogeneous behavior at the sectoral level. The second event, the announcement of the vaccine's discovery, had positive effects on the market. Still, the appearance of new strains and consequent lockdowns led the market not to register values that would be expected. In the second stage, the impacts of transmission channels between COVID-19 and stock markets were presented. The daily variation in the number of confirmed cases and the number of deaths negatively impacted the stock markets during the first half of 2020. Government measures had a mixed impact. On the one hand, efforts to contain and restrict mobility negatively impacted the stock markets, while, on the other hand, economic support stimulated financial markets. In addition, the country's ability to establish policies and be credible in those same formulations is crucial to maintaining investor confidence in equity markets. Finally, panic and fear were recorded throughout the period, negatively impacting markets.

These research results have important implications for policymakers and investors. Investors can use this study to help them reformulate their portfolios, including the pandemic risk in their decisions. It is essential to detain stocks of active companies in countries with greater resilience to possible future scenarios. Furthermore, diversification by non-interconnected sectors is, in a way, necessary to avoid the 'domino effect' observed in this study. As for policymakers, it is essential to realize that despite the progress of vaccination (and the possible end of this pandemic), the economic consequences caused

will last over time. Therefore, governments' support will be extremely important for the sectors that suffered the most to revive them in the post-pandemic period. In this way, policymakers can find this helpful research from a macroeconomic perspective, realizing their strengths and weaknesses and understanding the effects of their policy decisions. The current change of course of the pandemic to places such as South America and India highlights the importance of these results for policymakers in these countries, as it allows them to observe the effect of measures already imposed by other governments. This observation could make these countries take more effective and efficient measures.

This study also provides some recommendations. One of them is to note that countries responded differently despite the severity of the pandemic (Mukanjari & Sterner, 2020), worrying only about the population and the national economy. These measures, at different speeds, slowed the growth of stock markets in an area where the free movement of goods, services, persons, and capital is essential. Thus, it is imperative that national policies are in unison with the other Member States.

It may be of particular interest to countries to take advantage of the current pandemic to make lasting reforms in the public health sector and/or public infrastructure. In addition, the role of digitalisation, which was one of the main mitigators, is highlighted. This recommendation extends to all companies that may avoid having to shut down their activity in the next few seasons completely. Digitalisation combines the role of telework which has proved to be very useful during the pandemic.

However, the present study leaves room for further research. The fact that this study only analyses the impact on public companies allows it to be extended to unlisted companies. Second, the most significant limitation of this study was the lack of current and daily data. Thus, this study was not able to analyse the impacts of all the variables used. Future studies can leverage fresher and richer datasets to fill these gaps. This subject can be expanded to database creators who take this same subject into mind. Furthermore, since some containment measures have had positive effects, it may be interesting to formulate a variable of "non-compliance" by the population to these measures, which may explain to some extent the greater spread of the virus and potentially adverse effect on stock markets. Another recommendation is to use more rigorous models in statistical terms than the OLS model.

6. Appendices

Appendix A. ARCH tests

The ARCH test statistics are computed from an auxiliary test regression. To test the null hypothesis, i.e., that there is no ARCH up to order q in the residuals:

$$\varepsilon_t^2 = \beta_0 + \left(\sum_{s=1}^{q} \beta_s \, \varepsilon_{t-s}^2 \right) + \mu_t \qquad 6.1$$

where ε is the residual of the models presented in equations 3.3 and 3.4. This is a regression of the squared residuals on a constant and lagged squared residuals up to order q (in this study, $q = 1$). The results of these tests are shown in Annex 5.

Appendix B. GARCH model

The models that have ARCH effects are estimated according to the GARCH model (1,1), which according to Bollerslev (1986), is given as:

$$\begin{gathered} R_{i,t} - R_{f,t} = \alpha_{2i} + \beta_{2i}\left(R_{m,t} - R_{f,t}\right) + \beta_{3i} HML + \beta_{4i} SMB \; + \varepsilon_{i,t} \\ \varepsilon_{i,t} | \psi_{t-1} \sim N\left(0, h_{i,t}\right), \\ h_{i,t} = \alpha_0 \alpha_1 \varepsilon_{i,t-1}^2 + \beta_1 h_{t-1} \end{gathered} \qquad 6.2$$

where $\alpha_0 > 0$, $\alpha_1 \geq 0$, and $\beta_1 \geq 0$.

Appendix C. Shapiro-Wilk test

The W test statistic (Shapiro-Wilk test) for normality is defined, according to Shapiro and Wilk (1965), by:

$$W = \frac{(\sum_{i=1}^{n} a_i y_i)^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \qquad 6.3$$

where $\bar{y}$ is the sample mean. The results are shown in Annex 6 and Annex 7.

Appendix D. Wilcoxon test

The Wilcoxon test is given as:

$$Z_W = \frac{W_R - \mu_{W_R}}{\sigma_{W_R}} \tag{6.4}$$

where $\mu_{W_R} = \frac{n(n+1)}{4}$, $\sigma_{W_R} = \sqrt{\frac{n(n+1)(2n+1)}{24} - \frac{\sum t^3 - \sum t}{48}}$ and t represents the number of times the ith value occurs.

For large samples (n>10):

$$Z_G = \frac{\frac{n(n+1)}{2}}{\left[\frac{n(n+1)(2n+1)}{4}\right]^{1/2}} \tag{6.5}$$

The hypotheses are defined as well:

$$\begin{cases} H_0 : m = 0 \\ H_1 : m \neq 0 \end{cases} \tag{6.6}$$

where m is the median of CARs.

Appendix E. Pearson's coefficients

For ordinary Pearson correlations, the t-statistic, according to (Sheskin, 2011, pp. 1249 - 1256), is computed as:

$$t = \frac{r\sqrt{n-k-1}}{\sqrt{1-r^2}} \tag{6.7}$$

where r is the estimated correlation, and k is the number of conditioning variables, including the implicit mean adjustment term, if necessary. The p-value is obtained from a t-distribution with $n-k-1$degrees-of-freedom.

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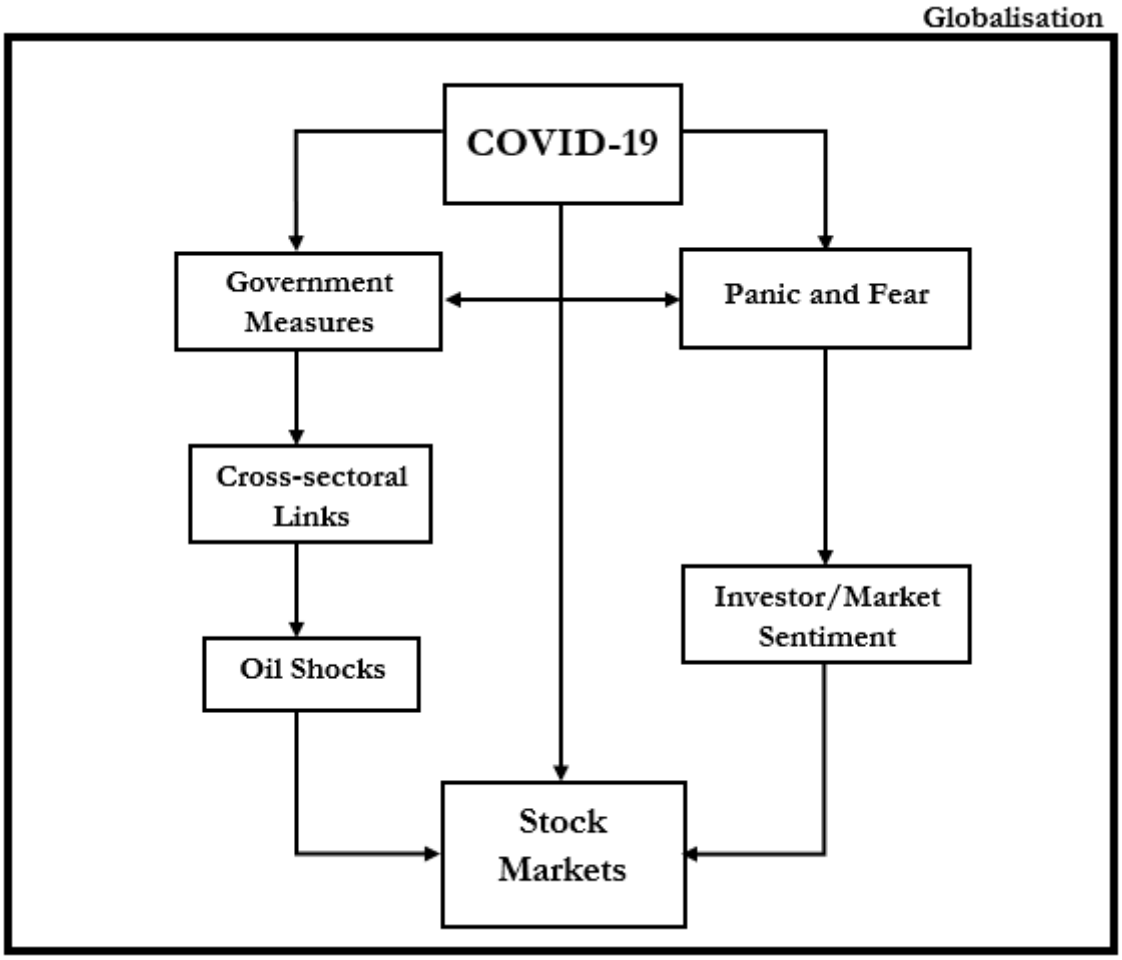
8. Annexes

Annex 1. Transmission channels between COVID-19 and stock markets



Notes: The figure shows the different transmission channels between COVID-19 and the stock markets. Own elaboration.

Annex 2. Firm's distribution by country and sector

Sectors & Countries	Aus	Bel	Den	Fin	Fra	Ger	Ire	Ita	Lux	Net	Nor	Pol	Por	Spa	Swe	Swi	UK	Total
Oil & Gas	1	-	1	1	2	1	-	2	1	1	4	1	1	3	1	-	2	**22**
Chemicals	-	2	-	-	2	8	-	-	-	2	1	-	-	-	-	3	3	**21**
Basic Resources	1	-	-	2	-	-	-	-	-	1	1	1	-	-	6	-	7	**19**
Construction & Materials	1	-	1	-	5	1	1	-	-	1	-	-	-	3	5	4	1	**23**
Aerospace & Defense	-	-	-	-	4	2	-	2	-	-	-	1	-	-	2	-	8	**19**
General Industrials	2	1	1	2	1	3	1	4	-	-	3	3	1	1	5	3	6	**37**
Electronic Equipment	-	1	1	2	6	3	-	2	-	3	2	2	-	-	3	6	7	**38**
Industrial Engineering	2	-	-	5	-	12	-	3	-	-	4	4	-	1	9	12	3	**55**
Industrial Transportation	2	2	5	2	4	6	-	4	-	3	12	3	1	3	4	3	5	**59**
Automobiles & Parts	-	-	-	1	4	5	-	2	-	-	-	-	-	-	-	-	-	**12**
Beverages	-	1	2	2	2	-	-	1	-	3	1	2	-	-	-	-	5	**19**
Food Producers	1	2	-	1	1	2	3	1	-	2	10	3	-	2	3	6	4	**41**
Household Goods	-	-	-	1	3	2	1	1	-	-	-	4	-	-	5	1	9	**27**
Leisure Goods	-	-	-	2	2	-	-	2	-	-	-	7	-	-	5	-	1	**19**
Personal Goods	-	-	1	1	5	3	4	-	-	-	-	2	-	-	1	3	2	**22**
Tobacco	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	2	**4**
Health Care	-	3	4	3	6	5	1	2	-	2	2	1	-	-	13	4	3	**49**

Sectors & Countries …	Aus	Bel	Den	Fin	Fra	Ger	Ire	Ita	Lux	Net	Nor	Pol	Por	Spa	Swe	Swi	UK	Total
Pharmaceuticals	-	5	8	2	3	5	-	1	-	-	6	10	-	5	11	9	7	**72**
Retail	-	-	-	-	2	1	-	-	-	-	-	-	-	1	1	1	8	**14**
Media	-	-	-	2	-	2	-	-	-	1	-	-	-	-	1	-	5	**11**
Airlines	-	-	-	1	1	1	1	-	-	-	-	1	-	1	1	-	2	**9**
Gambling	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	1	**4**
Hospitality	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	4	**6**
Telecommunications	-	1	-	2	2	2	-	2	1	1	1	-	-	2	3	1	2	**20**
Utilities	1	1	1	1	4	3	-	5	-	-	-	-	1	5	-	-	6	**28**
Banks	3	1	1	1	4	2	1	4	-	2	1	2	-	6	4	2	7	**41**
Insurance	-	1	1	1	3	3	-	2	-	3	2	1	-	-	-	5	9	**31**
Real Estate	-	3	-	1	5	6	-	-	-	-	1	-	-	2	8	3	11	**40**
General Financial Services	-	7	-	3	6	5	-	11	-	2	3	4	-	1	13	4	24	**83**
Software & Computer Services	-	1	2	5	6	10	-	2	-	2	8	10	-	2	8	2	11	**69**
Technology Hardware	1	2	1	-	3	5	-	-	-	3	1	1	-	-	5	4	-	**26**
Total	**15**	**34**	**31**	**44**	**87**	**99**	**14**	**53**	**2**	**32**	**63**	**63**	**4**	**38**	**120**	**76**	**165**	**940**

Notes: The sectors are ordered by code and not alphabetically (see https://www.stoxx.com/document/Indices/Common/Indexguide/stoxx_index_guide.pdf). For layout constraints, the symbol of each country corresponds to the first three letters of its name in the English language. Aus: Austria; Bel: Belgium; Den: Denmark; Fin: Finland; Fra: France; Ger: Germany; Ire: Ireland; Ita: Italy; Lux: Luxembourg; Net: Netherlands; Nor: Norway; Pol: Poland; Por: Portugal; Spa: Spain; Swe: Sweden; Swi: Switzerland; UK: United Kingdom.

Annex 3. Variables' definitions

Symbol	Variable	Measure/Definition	Year	Source
-	Closing prices	Last price at which a stock traded during the regular trading day.	2019 - 2021	Datastream
-	Adjusted closing prices	Amends a stock's closing price to reflect that stock's value after accounting for any corporate actions.	2019 - 2021	Yahoo Finance[(a)]
-	Returns	R = ln (Pt/Pt-1)	2019 - 2021	Own calculation
-	Fama-French factors	See Fama and French (2012) for details.	2019 - 2021	Kenneth French website[(b)]
Mkt	Market returns	Market returns correspond to STOXX Europe 600 index returns.	2019 - 2021	Datastream
O&G	Oil & Gas sector returns	Oil & Gas returns englobe the following subsectors: exploration & production, integrated oil & gas, oil equipment & services, pipelines, renewable energy equipment, and alternative fuels.	2019 - 2021	Datastream
Chem	Chemicals sector returns	Chemicals sector returns englobes the following subsectors: commodity chemicals and specialty chemicals.	2019 - 2021	Datastream
Basic	Basic & Resources sector returns	Basic & Resources sector returns englobes the following subsectors: forestry, paper, aluminium, nonferrous metals, iron & steel, coal, diamonds & gemstones, general mining, gold mining, and platinum & precious metals.	2019 - 2021	Datastream
Const	Construction & Materials sector returns	Construction & Materials sector returns englobes the following subsectors: building materials & fixtures, and heavy construction.	2019 - 2021	Datastream
A&D	Aerospace & Defense sector returns	Aerospace & Defense sector returns englobes the following subsectors: aerospace and defense.	2019 - 2021	Datastream
GenInd	General Industrial sector returns	General Industrial sector returns englobes the following subsectors: containers & packing, and diversified industrials.	2019 - 2021	Datastream
Elet	Electronic Equipment sector returns	Electronic Equipment sector returns englobes the following subsectors: electrical components & equipment.	2019 - 2021	Datastream
IndEng	Industrial Engineering sector returns	Industrial Engineering sector returns englobes the following subsectors: commercial vehicles & trucks and industrial machinery.	2019 - 2021	Datastream
IndTran	Industrial Transportation sector returns	Industrial Transportation sector returns englobes the following subsectors: delivery services, marine transportation, railroads, transportation services, and trucking.	2019 - 2021	Datastream
Auto	Automobiles & Parts sector returns	Automobiles & Parts sector returns englobes the following subsectors: automobiles, auto parts, and tires.	2019 - 2021	Datastream

Symbol	Variable	Measure/Definition	Year	Source
Beve	Beverages sector returns	Beverages sector returns englobes the following subsectors: brewers, distiller & vintners, and soft drinks.	2019 - 2021	Datastream
Food	Food Producers sector returns	Food Producers sector returns englobes the following subsectors: farming, fishing & plantations, and food products.	2019 - 2021	Datastream
House	Household Goods sector returns	Household Goods sector returns englobes the following subsectors: durable household products, nondurable household products, furnishings, and home construction.	2019 - 2021	Datastream
Leisu	Leisure Goods sector returns	Leisure Goods sector returns englobes the following subsectors: consumer electronics, recreational products, and toys.	2019 - 2021	Datastream
Person	Personal Goods sector returns	Personal Goods sector returns englobes the following subsectors: clothing & accessories, footwear, and personal products.	2019 - 2021	Datastream
Tobac	Tobacco sector returns	Tobacco sector returns just englobe companies related to tobacco manufacture.	2019 - 2021	Datastream
Health	Health Care sector returns	Health Care sector returns englobes the following subsectors: health care providers, medical equipment, and medical supplies.	2019 - 2021	Datastream
Pharma	Pharmaceuticals sector returns	Pharmaceuticals sector returns englobes the following subsectors: biotechnology, and drug retailers & wholesalers.	2019 - 2021	Datastream
Ret	Retail sector returns	Retail sector returns englobes the following subsectors: apparel retailers, broadline improvement, retailers, specialized consumer services, and specialty retailers.	2019 - 2021	Datastream
Media	Media sector returns	Media sector returns englobes the following subsectors: broadcasting & entertainment, media agencies, and publishing.	2019 - 2021	Datastream
Air	Airlines sector returns	Airline's sector returns just englobe companies related to the airlines.	2019 - 2021	Datastream
Gamb	Gambling sector returns	Gambling sector returns just englobes companies related to gambling.	2019 - 2021	Datastream
Hosp	Hospitality sector returns	Hospitality sector returns englobes the following subsectors: hotels, recreational services, and restaurants & bars.	2019 - 2021	Datastream
Telec	Telecommunications sector returns	Telecommunications sector returns englobes the following subsectors: fixed-line telecommunications and mobile telecommunications.	2019 - 2021	Datastream
Util	Utilities sector returns	Utilities sector returns englobes the following subsectors: conventional electricity, alternative electricity, gas distribution, multi-utilities, and water.	2019 - 2021	Datastream
Bank	Banks sector returns	Banks' sector returns just englobe banks.	2019 - 2021	Datastream

Symbol	Variable	Measure/Definition	Year	Source
Insur	Insurance sector returns	Insurance sector returns englobes the following subsectors: full line insurance, insurance brokers, property & casualty insurance, reinsurance, and life insurance.	2019 - 2021	Datastream
Real	Real Estate sector returns	Real Estate sector returns englobes the following subsectors: real estate holding & development, real estate services, industrial & office REITs, retail REITs, residential REITs, diversified REITs, specialty REITs, mortgage REITs, and hotel & lodging REITs.	2019 - 2021	Datastream
Financ	General Financial Services sector returns	General Financial Services sector returns englobes the following subsectors: asset managers, consumer finance, specialty finance, investment services, mortgage finance, equity investment instruments, and nonequity investment instruments.	2019 - 2021	Datastream
Softw	Software & Computer Services sector returns	Software & Computer Services sector returns englobes the following subsectors: computer services, internet, and software.	2019 - 2021	Datastream
Hardw	Technology Hardware sector returns	Technology Hardware sector returns englobes the following subsectors: computer hardware, electronic office equipment, semiconductors, and telecommunications equipment.	2019 - 2021	Datastream
Gtc	Growth total cases	Daily variation of total confirmed cases of COVID-19.	2020 - 2021	Our World in Data[c]
Gtcpm	Growth total cases per million	Daily variation of total confirmed cases of COVID-19 per 1,000,000 people.	2020 - 2021	Our World in Data
Nc	New cases	Number of new confirmed cases of COVID-19.	2020 - 2021	Our World in Data
Ncpm	New cases per million	Number of new confirmed cases of COVID-19 per 1,000,000 people.	2020 - 2021	Our World in Data
Gtd	Growth total deaths	Daily variation of total deaths attributed to COVID-19.	2020 - 2021	Our World in Data
Gtdpm	Growth total deaths per million	Daily variation of total deaths attributed to COVID-19 per 1,000,000 people.	2020 - 2021	Our World in Data
Nd	New deaths	Number of new deaths attributed to COVID-19.	2020 - 2021	Our World in Data
Ndpm	New deaths per million	Number of new deaths attributed to COVID-19 per 1,000,000 people.	2020 - 2021	Our World in Data
Gtt	Growth total tests	Daily variation of total tests for COVID-19.	2020 - 2021	Our World in Data
Gttpt	Growth total tests per thousand	Daily variation of total tests for COVID-19 per 1,000 people.	2020 - 2021	Our World in Data
Ntpt	New tests per thousand	Number of new tests for COVID-19 per 1,000 people.	2020 - 2021	Our World in Data

Symbol	Variables	Measure/Definition	Year	Source
Gtv	Growth total vaccinations	Daily variation of the total number of COVID-19 vaccination doses administered.	2020 - 2021	Our World in Data
Gpv	Growth people vaccinated	Daily variation of the total number of people who received at least one vaccine dose.	2020 - 2021	Our World in Data
Gpfv	Growth people fully vaccinated	Daily variation of the total number of people who received all doses.	2020 - 2021	Our World in Data
Nv	New vaccinations	Daily variation of new COVID-19 vaccination doses administered.	2020 - 2021	Our World in Data
Gtvph	Growth total vaccinations per hundred	Daily variation of the total number of COVID-19 vaccination doses administered per 100 people in the total population.	2020 - 2021	Our World in Data
Pvph	People vaccinated per hundred	Daily variation of the total number of people who received at least one vaccine dose per 100 people in the total population.	2020 - 2021	Our World in Data
Pfvpt	People fully vaccinated per thousand	Daily variation of the total number of people who received all doses per 100 people in the total population.	2020 - 2021	Our World in Data
CHE	Current health expenditure (% GDP)	The level of current health expenditure is expressed as a percentage of GDP. Estimates of current health expenditures include health care goods and services consumed during each year.	2018	World Health Organization Global Health Expenditure database[(d)]
Hosp	Hospital beds per thousand	Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centres.	2018	World Health Organization Global Health Expenditure database
Nurwid	Nurses and midwives (per 10,000 people)	Nurses and midwives include professional nurses, professional midwives, auxiliary nurses, auxiliary midwives, enrolled nurses, enrolled midwives, and other associated personnel, such as dental nurses and primary care nurses.	2018	World Health Organization's Global Health Workforce Statistics[(c)]
Medoc	Medical doctors (per 10,000 people)	Includes generalists, specialist medical practitioners, and medical doctors not further defined in the given national and/or subnational area.	2019	World Health Organization's Global Health Workforce Statistics
Lifexp	Life expectancy at birth, total (years)	Life expectancy at birth indicates the number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	2018	United Nations Population Division[(f)]

Symbol	Variables	Measure/Definition	Year	Source
Resp	Respiratory disease death rate	Age-standardized death rates from respiratory disease, measured as the number of deaths per 100,000 individuals across both sexes.	2017	Global Burden of Disease Collaborative Network. Global Burden of Disease[g]
HAQ	Health care Access and Quality Index	The Health Care Access and Quality (HAQ) Index is measured on a scale from 0 (worst) to 100 (best) based on death rates from 32 causes of death that could be avoided by timely and effective medical care (also known as 'amenable mortality').	2015	Global Burden of Disease Collaborative Network. Global Burden of Disease
Cardio	Cardiovascular death rate	The annual number of deaths from cardiovascular diseases per 100,000 people.	2017	Global Burden of Disease Collaborative Network. Global Burden of Disease
UHC	UHC Service Coverage Index	Coverage of essential health services. The indicator is an index reported on a unitless scale of 0 to 100.	2017	World Health Organization, Global Health Observatory Data Repository[h]
HDI	Human Development Index	The Human Development Index (HDI) summarizes key dimensions of human development: a long and healthy life, a good education, and a decent standard of living.	2017	United Nations Development Programme (UNDP)[i]
Pop	Population	Historical estimates of population, combined with the projected population to 2100 based on the UN's medium variant scenario.	2021	Gapminder, HYDE, and United Nations Population Division[j]
Pop_den	Population density	The number of people per km² of land area.	2017	Food and Agriculture Organization and World Bank population estimates[k]
Med_age	Median age	The median age divides the population into two parts of equal size: that is, there are as many persons with ages above the median age as there are with ages below the median ages.	2025	UN Population Division, World Population Prospects[l]
Aged_65	Aged 65 older	Total population 65 years of age or older. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.	2019	World Bank staff estimates[m]
Net_mig	Net migration	Net migration is the net total of migrants during the period, that is, the total number of immigrants less the annual number of emigrants, including both citizens and non-citizens.	2017	United Nations Population Division[n]

Symbol	Variables	Measure/Definition	Year	Source
Gov_rep	Overall government response index	Records how the response of governments has varied overall indicators in the database, becoming stronger or weaker throughout the outbreak.	2020	(Hale et al., 2020)[o]
Strin	Stringency index	Government Response Stringency Index: composite measure based on nine response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response).	2020	(Hale et al., 2020)
C1	C1_School closing	Record closings of schools and universities.	2020	(Hale et al., 2020)
C2	C2_Workplace closing	Record closings of workplaces.	2020	(Hale et al., 2020)
C3	C3_Cancel public events	Record cancelling public events.	2020	(Hale et al., 2020)
C4	C4_Restrictions on gatherings	Record limits on gatherings.	2020	(Hale et al., 2020)
C5	C5_Close public transport	Record closing of public transport.	2020	(Hale et al., 2020)
C6	C6_Stay at home requirements	Record orders to "shelter-in-place" and otherwise confined to the home.	2020	(Hale et al., 2020)
C7	C7_Restrictions on internal movement	Record restrictions on internal movement between cities/regions.	2020	(Hale et al., 2020)
C8	C8_International travel controls	Record restrictions on international travel. This records policy for foreign travellers, not citizens.	2020	(Hale et al., 2020)
Cont	Containment and health index	Combines 'lockdown' restrictions and closures with measures such as testing policy and contact tracing, short-term investment in health care, and investments in the vaccine.	2020	(Hale et al., 2020)
H1	H1_Public information campaigns	Record presence of public info campaigns.	2020	(Hale et al., 2020)
H2	H2_Testing policy	Record government policy on who has access to testing. This records policy about testing for current infection (PCR tests), not testing for immunity (antibody test).	2020	(Hale et al., 2020)

Symbol	Variables	Measure/Definition	Year	Source
H3	H3_Contact tracing	Record government policy on contact tracing after a positive diagnosis. We are looking for policies that would identify all people potentially exposed to Covid-19; voluntary Bluetooth apps are unlikely to achieve this.	2020	(Hale et al., 2020)
H4	H4_Emergency investment in health care	Announced short-term spending on the health care system. Only record amount additional to previously announced spending.	2020	(Hale et al., 2020)
H5	H5_Investment in vaccines	Announced public spending on Covid-19 vaccine development. Only record amount additional to previously announced spending.	2020	(Hale et al., 2020)
H6	H6_Facial coverings	Record policies on the use of facial coverings outside the home.	2020	(Hale et al., 2020)
H7	H7_Vaccination policy	Record policies for vaccine delivery for different groups.	2020	(Hale et al., 2020)
H8	H8_Protection of elderly people	Record policies for protecting elderly people (as defined locally) in Long-term Care Facilities and/or the community and home setting.	2020	(Hale et al., 2020)
Eco	Economic support index	Records measures such as income support and debt relief.	2020	(Hale et al., 2020)
E1	E1_Income support	Record if the government is providing direct cash payments to people who lose their jobs or cannot work.	2020	(Hale et al., 2020)
E2	E2_Debt/contract relief	Record if the government is freezing financial obligations for households.	2020	(Hale et al., 2020)
E3	E3_Fiscal measures	Announced economic stimulus spending. Only record amount additional to previously announced spending.	2020	(Hale et al., 2020)
E4	E4_International support	Announced offers of Covid-19 related aid spending to other countries. Only record amount additional to previously announced spending.	2020	(Hale et al., 2020)
GDP_ppp	GDP per capita, PPP (constant 2017 international $)	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. Data are in constant 2017 international dollars.	2018	International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme(p)

Symbol	Variables	Measure/Definition	Year	Source
GDS_gdp	Gross domestic savings (% of GDP)	Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption).	2019	World Bank national accounts data, and OECD National Accounts data files[q]
Unemp	Unemployment, total (% of the total labor force)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment. Definitions of labor force and unemployment differ by country.	2019	International Labour Organization, ILOSTAT database[r]
HICP	Harmonised index of consumer prices (HICP)	The Harmonised Index of Consumer Prices (HICP) gives comparable measures of inflation for the countries and country groups for which it is produced. It is an economic indicator that measures the change over time of the prices of consumer goods and services acquired by households.	2020	Eurostat[s]
WTI	Cushing, OK WTI Spot Price FOB (Dollars per Barrel)	A crude stream produced in Texas and southern Oklahoma serves as a reference or "marker" for pricing a number of other crude streams and which is traded in the domestic spot market at Cushing, Oklahoma.	2020	U.S. Energy Information Administration[t]
Brent	Europe Brent Spot Price FOB (Dollars per Barrel)	A blended crude stream produced in the North Sea region serves as a reference or "marker" for pricing a number of other crude streams.	2020	U.S. Energy Information Administration
Energy	Energy use (kg of oil equivalent per capita)	Energy use refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.	2015	IEA Statistics OECD/IEA[u]
DCPS_gdp	Domestic credit to the private sector (% of GDP)	Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations.	2019	International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates[v]
Rating	Credit Rating	Credit rating reflects the creditworthiness of the sovereign debt of a given country. Moody's is one of the most common and influential rating agencies.	2020	Moody's website[w]
Labor	Labor force participation rate, total (% of total population ages 15-64)	Labor force participation rate is the proportion of the population ages 15-64 that is economically active: all people who supply labor to produce goods and services during a specified period.	2019	International Labour Organization, ILOSTAT database

Symbol	Variables	Measure/Definition	Year	Source
GBP, USD, CHN	Exchange rate	The exchange rate includes UK Pound-to-Euro, US Dollar-to-Euro, and Chinese Renminbi-to-Euro, respectively	2020	Datastream
Yield	European Monetary Union, Government Bond Yield - 10 Year	A yield curve represents the relationship between market remuneration rates and the remaining time to maturity of debt securities. A yield curve can also be described as the term structure of interest rates.	2020	European Central Bank - Statistical Data Warehouse[x]
MRO	Main refinancing operations	The interest rate on the main refinancing operations (MRO) provides the bulk of liquidity to the banking system.	2020	Datastream
DF	Deposit facility	The rate on the deposit facility is the rate that banks may use to make overnight deposits with the Eurosystem.	2020	Datastream
MLF	Marginal lending facility	The rate on the marginal lending facility is the rate that offers overnight credit to banks from the Eurosystem.	2020	Datastream
Eur	Euribor 3 months	Euribor is short for Euro Interbank Offered Rate. The Euribor rates are based on the interest rates at which a panel of European banks borrows funds from one another.	2020	Datastream
Eonia	EONIA	Eonia is short for Euro Overnight Index Average. The Eonia rate is the 1-day interbank interest rate for the Eurozone. In other words, it is the rate at which banks provide loans to each other with a duration of 1 day.	2020	Datastream
Sonia	SONIA	The Sterling Overnight Interbank Average Rate is the effective overnight interest rate paid by banks for unsecured transactions in the British sterling market. It is used for overnight funding for trades that occur in off-hours and represents the depth of overnight business in the marketplace.	2020	Datastream
Nonloan	Bank nonperforming loans to total gross loans (%)	Bank nonperforming loans to total gross loans are the value of nonperforming loans divided by the total value of the loan portfolio (including nonperforming loans before the deduction of specific loan-loss provisions). Thus, the loan amount recorded as nonperforming should be the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.	2019	International Monetary Fund, Financial Soundness Indicators[y]

Symbol	Variables	Measure/Definition	Year	Source
Voice	Voice and Accountability	Reflects perceptions of the extent to which a country's citizens can participate in selecting their government, freedom of expression, freedom of association, and free media. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update[z]
Pol_sta	Political Stability and Absence of Violence/Terrorism	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update
Gov	Government Effectiveness	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update
Reg	Regulatory Quality	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update
Rule	Rule of Law	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update
Corrup	Control of Corruption	Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption and "capture" of the state by elites and private interests. Ranges from approximately -2.5 (weak) to 2.5 (strong).	2019	The Worldwide Governance Indicators, 2020 Update
EFI	Economic Freedom Index (Overall Score)	The Index measures 12 specific components of economic freedom, each of which is graded on a scale from 0 to 100. Scores on these 12 components of economic freedom, which are calculated from a number of sub-variables, are equally weighted and averaged to produce an overall economic freedom score for each economy.	2020	Heritage Foundation[aa]

Symbol	Variables	Measure/Definition	Year	Source
Monet	Monetary Freedom	Monetary freedom combines a measure of inflation with an assessment of various government activities that distort prices. Thus, price stability without microeconomic intervention is the ideal state for the free market.	2020	Heritage Foundation
FF	Financial Freedom	Financial freedom is an indicator of banking efficiency and a measure of independence from government control and interference in the financial sector. State ownership of banks and other financial institutions such as insurers and capital markets reduce competition and generally lowers the level of access to credit.	2020	Heritage Foundation
Agric	Agriculture, forestry, and fishing, value added (% of GDP)	Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.	2019	World Bank national accounts data, and OECD National Accounts data files
Serv	Services, value added (% of GDP)	Include value added in wholesale and retail trade (including hotels and restaurants), transport, government, financial, professional, and personal services such as education, health care, and real estate services. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.	2019	World Bank national accounts data, and OECD National Accounts data files
Tran_ts	Transport services (% total service)	Transport covers all transport services (sea, air, land, internal waterway, pipeline, space, and electricity transmission) performed by residents of one economy for those of another and involving the carriage of passengers, the movement of goods (freight), rental of carriers with the crew, and related support and auxiliary services.	2019	International Monetary Fund, Balance of Payments Statistics Yearbook and data files[ab]
Trav_ts	Travel services (% total service)	Travel covers goods and services acquired from an economy by travellers for their use during visits of less than one year in that economy for either business or personal purposes. Travel includes local transport (i.e., transport within the economy being visited and provided by a resident of that economy) but excludes international transport (which is included in passenger transport. Travel also excludes goods for resale, which are included in general merchandise.	2019	International Monetary Fund, Balance of Payments Statistics Yearbook and data files

Symbol	Variables	Measure/Definition	Year	Source
Sev	Services, value added (% of GDP)	Include value added in wholesale and retail trade (including hotels and restaurants), transport, government, financial, professional, and personal services such as education, health care, and real estate services. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.	2019	World Bank national accounts data, and OECD National Accounts data files
Tran_exp	Transport services (% service exports, BoP)	Transport covers all transport services (sea, air, land, internal waterway, pipeline, space, and electricity transmission) performed by residents of one economy for those of another and involving the carriage of passengers, the movement of goods (freight), rental of carriers with the crew, and related support and auxiliary services.	2019	International Monetary Fund, Balance of Payments Statistics Yearbook and data files
ICT	ICT goods traded (% of total goods traded)	Information and communication technology goods exports include computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods (miscellaneous).	2019	United Nations Conference on Trade and Development's UNCTAD stat database[ac]
EPU	Economic Policy Uncertainty	The index is measured based on newspaper articles regarding policy uncertainty. The index counts the number of newspaper articles counts the number of newspaper articles containing the terms uncertain or uncertainty, economic or economy, and one or more policy-relevant terms.	2020	Economic Policy Uncertainty[ad]
DNS	Daily News Sentiment Index	The DNSI is a high-frequency measure of economic sentiment based on a linguistic analysis of economics-related news articles from 16 major US newspapers. The DNSI is developed in such a way that higher values of the index indicate more positive sentiment.	2020	Federal Reserve Bank of San Francisco[ae]
Goog	Google Trends	Google searches for four terms related to coronavirus. The terms related to coronavirus include "covid," "covid-19", "coronavirus," and "pandemic."	2020	Google Website[af]
VIX	Chicago Board Options Exchange Volatility Index	Daily variation of the CBOE VIX.	2020	Federal Reserve Economic Data[ag]
GFI	Global Fear Index	The index measures daily concerns and emotions on the spread and severity of COVID-19 since the pandemic declaration. Relying on the official reports of COVID-19 cases and deaths globally, the GFI is a composite index of two factors; Reported Cases and Reported Deaths, respectively, indicating absence and presence on a scale of zero to 100 extreme fear/panic.	2020	(Salisu & Akanni, 2020)[ah]

Symbol	Variables	Measure/Definition	Year	Source
EMV	Infectious Disease Equity Market Volatility Tracker	This daily measure is available from January 1985 to the present and is updated daily.	2020	Economic Policy Uncertainty
House	Households and NPISHs final consumption expenditure (% of GDP)	Household final consumption expenditure (formerly private consumption) is the market value of all goods and services, including durable products purchased by households.	2018	World Bank national accounts data, and OECD National Accounts data files
GPR	Geopolitical Risk Index	The Caldara and Iacoviello GPR index reflect automated text-search results of the electronic archives of 11 national and international newspapers. Caldara and Iacoviello calculate the index by counting the number of articles related to geopolitical risk in each newspaper for each month (as a share of the total number of news articles). The index is then normalized to average a value of 100 in the 2000-2009 decade.	2020	(Caldara & Iacoviello, 2018)[ai]
Fin_stress	St. Louis Fed Financial Stress Index	The STLFSI2 measures the degree of financial stress in the markets. It is constructed from 18 weekly data series, including weekly averages of daily data series: seven interest rates, six yield spreads, and five other indicators. The average value of the index, which begins in late 1993, is designed to be zero.	2020	Economic Research Federal Reserve Bank of St. Louis[aj]
Trade	Volume Trade	Turnover by volume traded.	2020	Datastream
Social	Number of people using social media platforms	Estimates correspond to monthly active users (MAUs). This study analyses the platforms: Facebook, Instagram, Twitter, and YouTube.	2018	Our World in Data
Internet	Individuals using the Internet (% of the population)	This indicator can include both; estimates and survey data corresponding to the proportion of individuals using the Internet; based on results from national households' surveys. The number should reflect the total population of the country or at least individuals of 5 years and older.	2019	International Telecommunications Union, World Telecommunication/ICT Development Report and database[ak]
Global	Globalization (trade openness index)	Trade openness is measured as the sum of a country's exports and imports as a share of that country's GDP (in %).	2017	National accounts, ICP benchmark data[al]
Exp_gdp	Export of goods and services (% of GDP)	Exports of goods and services represent the value of all goods and other market services provided to the rest of the world.	2019	World Bank national accounts data, and OECD National Accounts data files

Symbol	Variables	Measure/Definition	Year	Source
Inter	International tourism, receipts (% of total exports)	International tourism receipts are expenditures by international inbound visitors, including payments to national carriers for international transport.	2019	World Tourism Organization, Yearbook of Tourism Statistics, Compendium of Tourism Statistics and data files, and IMF and World Bank exports estimates[am]
Dep_arriv	International tourism, number of departures and arrivals	International outbound tourists are the number of departures that people make from their country of usual residence to any other country for any purpose other than a remunerated activity in the country visited. International inbound tourists (overnight visitors) are the number of tourists who travel to a country other than that in which they have their usual residence but outside their usual environment.	2019	World Tourism Organization, Yearbook of Tourism Statistics, Compendium of Tourism Statistics and data files
FDI_in	Foreign direct investment, net inflows (% of GDP)	Foreign direct investment is the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital, as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors and is divided by GDP.	2019	International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, International Debt Statistics, and World Bank and OECD GDP estimates[an]
FDI_out	Foreign direct investment, net outflows	Foreign direct investment refers to direct investment equity flows in an economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on managing an enterprise resident in another economy. Ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship. This series shows net outflows of investment from the reporting economy to the rest of the world and is divided by GDP.	2019	International Monetary Fund, Balance of Payments database, supplemented by data from the United Nations Conference on Trade and Development and official national sources.

Symbol	Variables	Measure/Definition	Year	Source
FDIst_chn	Foreign Direct Investment Stocks Exposure to China (% total FDI)	Represents the total FDI exposure to China (inflows + outflows) in percent of total FDI.	2019	OECD International Direct Investment Statistics[ao]
FDIfl_chn	Foreign Direct Investment Flows Exposure to China (% total FDI)	Represents the total FDI exposure to China (inflows + outflows) in percent of total FDI.	2019	OECD International Direct Investment Statistics

Notes: Each of the following sources were last accessed on 31 May 2021. (a) Yahoo Finance website (https://finance.yahoo.com/); (b) Kenneth French website (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html); (c) Our World in Data website (https://ourworldindata.org/). This database contain data from various sources (see https://github.com/owid/covid-19-data/blob/master/public/data/owid-covid-codebook.csv); (d) World Health Organization Global Health Expenditure database (https://apps.who.int/nha/database); (e) World Health Organization's Global Health Workforce Statistics (https://apps.who.int/gho/data/); (f) United Nation Population Division (https://population.un.org/wpp/); (g) Global Burden of Disease Collaborative Network (http://ghdx.healthdata.org/record/global-burden-disease-study-2015-gbd-2015-health_care-access-and-quality-index-based-amenable); (h) World Health Organization, Global Health Observatory Data Repository (https://www.who.int/data/gho); (i) United Nations Development Programme http://hdr.undp.org/en/content/download-data; (j) Gapminder, HYDE, and United Nations Population Division https://www.gapminder.org/data/documentation/gd003/; (k) Food and Agriculture Organization and World Bank population estimates https://data.worldbank.org/indicator/EN.POP.DNST; (l) UN Population Division, World Population Prospects https://population.un.org/wpp/Download/Standard/Population/; (m) World Bank staff estimates https://data.worldbank.org/indicator/SP.POP.65UP.TO; (n) United Nations Population Division https://population.un.org/unmigration/index_sql.aspx; (o) (Hale et al., 2020) https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker#data; (p) International Comparison Program https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD; (q) World Bank national accounts data, and OECD National Accounts data files https://www.oecd.org/sdd/na/; (r) International Labour Organization, ILOSTAT database https://www.ilo.org/global/statistics-and-databases/lang--en/index.htm; (s) Eurostat https://ec.europa.eu/eurostat/web/hicp/data/database; (t) U.S. Energy Information Administration https://www.eia.gov/; (u) IEA Statistics OECD/IEA https://www.iea.org/data-and-statistics; (v) International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates https://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS; (w) Moody's website https://countryeconomy.com/ratings; (x) European Central Bank - Statistical Data Warehouse https://sdw.ecb.europa.eu/; (y) International Monetary Fund, Financial Soundness Indicators https://data.imf.org/?sk=51B096FA-2CD2-40C2-8D09-0699CC1764DA; (z) The Worldwide Governance Indicators, 2020 Update https://info.worldbank.org/governance/wgi/; (aa) Heritage Foundation https://www.heritage.org/index/explore; (ab) International Monetary Fund, Balance of Payments Statistics Yearbook and data files https://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52; (ac) United Nations Conference on Trade and Development's UNCTAD stat database https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en; (ad) Economic Policy Uncertainty https://www.policyuncertainty.com/; (ae) Federal Reserve Bank of San Francisco https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/ads; (af) Google Website https://trends.google.com/trends/; (ag) Federal Reserve Economic Data https://fred.stlouisfed.org/; (ah) (Salisu & Akanni, 2020) data were personally provided by the authors (ai) (Caldara & Iacoviello, 2018) https://www.matteoiacoviello.com/gpr.htm; (aj) International Telecommunications Union, World Telecommunication/ICT Development Report and database https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx; (ak) World Tourism Organization, Yearbook of Tourism Statistics https://data.worldbank.org/indicator/ST.INT.XPND.MP.ZS; (al) National accounts, ICP benchmark data https://www.rug.nl/ggdc/productivity/pwt/; (am) International Monetary Fund https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS; (an) OECD International Direct Investment Statistics https://data.oecd.org/fdi/fdi-flows.htm.

Annex 4. Event windows and their justification

Event window	Real date	Justification of event window determination
First phase		
(-5, -1)	14 – 20 Feb	Adaptation of markets before the event.
(0, 7)	21 Feb – 3 Mar	Impact of the event; Spread of the virus in Italy and consequent lockdown.
(8, 13)	4 – 11 Mar	ECB announces the restriction of non-essential travel; Spread of the virus throughout Europe; WHO declares COVID-19 as pandemic; Announcement by the EC of creating an investment fund worth EUR 25 billion.
(14, 17)	12 – 17 Mar	US bans travel to the EU; WHO declares Europe as the epicentre of the pandemic; Increased restrictions in all European countries; Bank of England lowers interest rates to historic levels; EC provides EUR 37 billion; Germany, France, and Spain announce stimulus packages; EU closes the bloc's external borders over the next 30 days.
(18, 20)	18 – 20 Mar	France and Germany prohibit travel; Rome offers a €600 million package to help airlines; Germany announces a package of measures to support the economy (EUR 550 billion); EU leaders gave the green light to the Commission's proposal to close the bloc's external borders over the next 30 days; ECB launches €750 billion stimulus programme.
(21, 35)	23 Mar – 10 Apr	Some European countries reinforce containment measures, and others relax measures; WHO announces 40 potential vaccines; Biopharmaceutical company CureVac says the vaccine could be ready for clinical trials in June.
(36, 43)	13 – 22 Apr	Eurozone finance ministers announce €540 million in support; Gradually will be announced measures and plans to relax the measures, except the UK; Several research centres, such as BioNTech, are given the green light to conduct clinical trials on humans; An Oxford team can start clinical trials.
(44, 50)	23 Apr – 1 May	A Vaccine tested in humans; WHO and Europe publish the gradual relaxation of the measures imposed; RU remains blocked; EU reallocates €54 billion of funds remaining from the budget to cope with the coronavirus crisis.
(51, 58)	4 – 13 May	Europe begins to prepare for progressive destining, but at different speeds; Announcement of the possible free movement of persons within the Schengen area; The European Central Bank has increased the Pandemic Emergency Assets Purchase Programme (PEPP) by EUR 600 billion.
(59, 68)	14 – 27 May	French support for tourism companies worth €18 billion.
(69, 74)	28 May – 4 Jun	EC presents a proposal to rebuild the EU economy based on the multiannual financial framework (EU budget for 2021-2027), and a medium-term recovery fund entitled Next Generation EU worth €750 billion; Europe lifts containment measures, including the UK.
(75, 80)	5 – 12 Jun	France, Germany, Italy, and the Netherlands create an alliance to accelerate discovering a vaccine on European soil; EC announces the recommendation to reopen borders between the EU Member States.

Event Window	Real Date	Justification of event window determination
Second phase		
(-5, -1)	2 – 6 Nov	Adaptation of markets before the event.
(0, 10)	9 – 23 Nov	Impact of the event on the markets; Albert Bourla, CEO of Pfizer, announces that he has developed, in consortium with Germany's BioNTech, a vaccine with more than 90% efficacy against coronavirus; Modern announces that its vaccine has an efficiency rate of 94.5%; European countries begin vaccination planning; New vaccine prepared by the University of Oxford and the pharmaceutical company AstraZeneca has an efficacy of 70.4%.
(11, 16)	24 Nov – 1 Dec	European countries announce vaccination start before the end of the year; The Covid-19 vaccine developed by pharmaceutical company AstraZeneca is fuelling controversy and fears; The British Medicines and Health Care Regulatory Agency approves the BioNTech vaccine vaccinating the population.
(17, 25)	2 – 14 Dec	The mass vaccination campaign in the UK; Several European countries are struggling to organize the distribution of the vaccine, converting large infrastructure into vaccination centres.
(26, 30)	15 – 21 Dec	British authorities report a new variant (SARS-CoV-2 VOC 202012/01); The new South African variant reported; Suspension of travel to and from the UK.
(31, 40)	22 Dec – 4 Jan	The European Medicines Agency gives the green light to the vaccine developed by BioNTech and Pfizer; Vaccination begins in Europe.
(41, 64)	5 Jan – 5 Feb	The new RU variant is reported in 31 other countries/territories/areas; Experts warn that the second wave is more dangerous than the first; Pressure is increasing on AstraZeneca after the EC asked health authorities to inspect an Anglo-Swedish pharmaceutical plant in Belgium; Germany advises against administering AstraZeneca vaccine to people over 65; Europe tightens containment measures.
(65, 79)	8 – 26 Feb	In the UK, more than 15 million people have already received the first dose of the vaccine against the new coronavirus; In France, an increase in the number of cases is expected due to the spread of the new variants; Who confirms the danger of the new British variant.

Notes: All announcements have been removed from the WHO's website (https://www.who.int/news/item/27-04-2020-who-timeline---covid-19), and Euronews' website (https://www.euronews.com/tag/covid-19). Every news was last accessed on 12 March 2021.

Annex 5. ARCH tests

	First Phase		Second Phase			First Phase		Second Phase	
Dependent Variable	**F**	**Prob**	**F**	**Prob**	**Dependent Variable**	**F**	**Prob**	**F**	**Prob**
R Oil & Gas	0.114370	.7358	1.329828	.2512	R Health Care	**23.51152**	**.0000**	0.000104	.9919
R Chemicals	5.580908	.0198	0.004741	.9452	R Pharmaceuticals	0.050677	.8223	0.194162	.6603
R Basic Resources	0.000848	.9768	2.724881	.1015	R Retail	0.941429	.3339	3.546307	.0622
R Construction & Materials	1.459761	.2294	0.042780	.8365	R Media	0.012654	.9106	3.828008	.0528
R Aerospace & Defense	0.029618	.8637	1.001124	.3191	R Airlines	0.909290	.3423	2.107779	.1492
R General Industrials	0.431189	.5127	0.217179	.6421	R Gambling	0.002347	.9614	0.133531	.7155
R Electronic Equipment	0.803340	.3719	**11.11355**	**.0011**	R Hospitality	0.032129	.8581	1.049235	.3078
R Industrial Engineering	0.012908	.9097	0.510040	.4765	R Telecommunications	0.106810	.7444	0.015256	.9019
R Industrial Transportation	0.009827	.9212	0.004812	.9448	R Utilities	0.451006	.5032	2.391740	.1247
R Automobiles & Parts	0.282185	.5963	0.372263	.5430	R Banks	0.786734	.3769	0.017652	.8945
R Beverages	0.020334	.8869	0.581972	.4471	R Insurance	1.678257	.1977	2.350227	.1280
R Food Producers	**31.98392**	**.0000**	2.351362	.1279	R Real Estate	0.257908	.6125	0.001466	.9695
R Household Goods	0.333120	.5649	0.932425	.3362	R General Financial Services	0.163380	.6868	1.289266	.2585
R Leisure Goods	4.784504	.0307	0.419464	.5185	R Software	0.021794	.8829	0.129354	.7198
R Personal Goods	0.005165	.9428	0.488201	.4861	R Hardware & Equipment	0.005096	.9432	0.146067	.7030
R Tobacco	0.098966	.7536	0.413903	.5213	R Market	5.658071	.0190	7.524015	.0700

Notes: The null hypothesis reveals no indications of ARCH effects and the hypothesis of reading revelations that indicate these same effects. Thus, if the p-value (Prob) for greater than a significance level (1, 5, or 10%) the null hypothesis is not rejected. The bold results indicate that the models that incorporate this variable have ARCH effects and, therefore, were estimated by the GARCH method. The letter 'R' before each dependent represents 'return.' The econometric specification is reported in Appendix A. Own elaboration using *Eviews* for this purpose.

Annex 6. Shapiro-Wilk test for CARs (First Phase)

Dependent Variable	(-5, -1)	(0, 7)	(8, 13)	(14, 17)	(18, 20)	(21, 35)	(36, 43)	(44, 50)	(51, 58)	(59, 68)	(69, 74)	(75, 80)
Oil & Gas	.232	.661	.040	.521	.591	.088	.106	.372	.743	.134	.466	.493
Chemicals	.174	.133	.430	.352	**.009**	.466	.837	.412	.821	.197	.960	.385
Basic Resources	.017*	.834	.311	.265	.452	.268	.464	.625	.949	.566	.036	.351
Construction & Materials	.696	.017	.613	.217	.498	.011	.400	.735	.472	.312	.876	.225
Aerospace & Defense	.169	.635	.965	.274	.379	.686	.483	.049	.855	.141	.518	.536
General Industrials	.356	.062	.187	.386	.593	.029	.934	.625	.342	.483	.765	.901
Electronic Equipment	.072	.421	.431	.165	.632	.300	.697	.946	.238	.192	.386	.430
Industrial Engineering	.891	.214	.292	.258	.353	.066	.754	.102	.906	.230	.477	.538
Industrial Transportation	.283	.441	.174	.258	.052	.149	.892	.680	.218	.544	.214	.696
Automobiles & Parts	.611	.492	.960	.207	.995	.044	.259	.700	.326	.969	.105	.825
Beverages	.083	.162	.039	.439	.739	.125	.417	.424	.459	.704	.827	.889
Food Producers	**.004**	.737	.147	.509	.152	.168	.358	.934	.184	.880	.995	**.009**
Household Goods	.576	.947	.265	.920	.925	.924	.669	.767	.479	.507	.407	.327
Leisure Goods	.734	.188	.647	.701	.143	.086	.650	.292	.963	.291	.051	.391
Personal Goods	.651	.155	.091	.924	.321	.734	.124	.512	.142	.671	.616	.422
Tobacco	.329	.127	.493	.176	.718	.014	.822	.315	.060	**.004**	.744	.064
Health Care	.523	.667	.175	.385	.063	.167	.472	.200	.285	.248	.359	.263
Pharmaceuticals	.020	.801	.346	.302	.089	.055	.670	.987	.871	.575	.644	.655
Retail	.747	.372	.481	.401	.872	.212	.261	.517	.422	.264	.031	.618
Media	.900	.200	.232	.092	.708	.234	.297	.252	.272	.922	.496	.886
Airlines	.766	.434	.225	.976	.730	.199	.878	.467	.392	.556	.543	.605

Dependent Variable	…	(-5, -1)	(0, 7)	(8, 13)	(14, 17)	(18, 20)	(21, 35)	(36, 43)	(44, 50)	(51, 58)	(59, 68)	(69, 74)	(75, 80)
Gambling		.891	.681	.993	.935	.329	.476	.438	.104	.197	.366	.030	.884
Hospitality		.279	.339	.035	.756	.668	.240	.050	.304	.825	.925	.128	.885
Telecommunications		.051	.319	.146	.023	.974	.550	.960	.710	.106	.474	.993	.067
Utilities		.964	.810	.162	.193	.504	.095	.203	.477	.636	.709	.467	.013
Banks		.312	.071	.581	.413	**.001**	.094	.884	.827	.685	.377	.526	.372
Insurance		.196	.277	.606	.923	.703	.372	.520	.171	.248	.644	.123	.295
Real Estate		.669	.344	.147	.715	.461	.019	.028	.399	.762	.584	.408	.528
General Financial Services		.250	.343	.436	.067	.774	.531	.345	.805	.758	.135	.743	.967
Software		.960	.914	.863	.344	.832	.027	.241	.101	.576	.290	.600	.347
Technology		.032	.818	.215	.579	.899	.532	.225	.161	.917	.718	.361	.335
Market		.740	.195	.815	.103	.339	.299	.083	.891	.474	.466	.711	.421

Notes: The null hypothesis indicates that the distribution is considered normal. Thus, if the sigma presented in the table to higher at the significance level (1, 5, or 10%), the null hypothesis is not rejected, indicating that the CAR distribution is normal. Bold values indicate no normality and, therefore, nonparametric tests are applied to these cases. The econometric specification is reported in Appendix C.

Annex 7. Shapiro-Wilk test for CARs (Second Phase)

Dependent Variable	(-5, -1)	(0, 10)	(11, 16)	(17, 25)	(26, 30)	(31, 40)	(41, 64)	(65, 79)	…
Oil & Gas	.403	.142	.587	.328	.429	.797	**.002**	.357	
Chemicals	**.001**	.255	.414	.107	.640	.481	.268	.113	
Basic Resources	.252	.627	.831	**.008**	.915	.750	.219	.331	
Construction & Materials	.786	.589	.611	.205	.192	.963	.060	.955	
Aerospace & Defense	.955	.078	1.000	.555	.737	.043	.047	.761	
General Industrials	.966	.288	.142	.705	.813	.060	.035	.181	
Electronic Equipment	.276	.050	.851	.667	.241	.296	.036	.771	
Industrial Engineering	.100	.118	**.009**	.079	.988	.356	.119	.112	
Industrial Transportation	.171	.025	.912	.964	.157	.852	.163	.595	
Automobiles & Parts	.306	.775	.940	.497	.824	.732	.020	.852	
Beverages	.787	.372	.822	.952	.800	.079	.259	.018	
Food Producers	.025	.357	.602	.193	.840	.033	.426	.794	
Household Goods	.830	.437	.199	.949	.807	.108	.080	.624	
Leisure Goods	.806	.789	.753	.390	.424	.237	**.003**	.875	
Personal Goods	.759	.401	.352	.545	.925	.841	.086	.073	
Tobacco	.996	.078	.172	.395	.283	.089	.357	.278	
Health Care	.790	.116	.017	.144	.983	.200	**.001**	.013	
Pharmaceuticals	.984	.021	.694	.242	.034	.049	.112	.788	
Retail	.734	.324	.448	.716	.969	.455	.072	.896	
Media	.716	.244	.637	.725	.366	.133	.142	.105	
Airlines	.447	.155	.848	.396	.793	.477	.391	.475	

Dependent Variable …	(-5, -1)	(0, 10)	(11, 16)	(17, 25)	(26, 30)	(31, 40)	(41, 64)	(65, 79)
Gambling	.816	.270	.631	.269	.886	**.001**	**.001**	.021
Hospitality	.449	**.002**	.809	.836	.311	.187	.432	.309
Telecommunications	.024	.049	.437	.449	.562	.370	**.003**	.255
Utilities	.424	.035	.277	.198	.852	.652	.614	.412
Banks	1.000	.088	.261	.556	.096	.591	.061	.962
Insurance	.669	.258	.398	.116	.259	.685	.687	.932
Real Estate	.164	.599	.382	.264	.235	.946	.974	.519
General Financial Services	.301	.068	.524	.349	.230	.858	.048	.028
Software	.549	.054	.581	.839	.027	.076	.034	.026
Technology	.053	.519	.290	.615	.106	.659	**.003**	.610
Market	.748	.223	.285	.671	.034	.760	.076	.799

Notes: The null hypothesis indicates that the distribution is considered normal. Thus, if the sigma presented in the table is equal or higher at the significance level (1, 5, or 10%), the null hypothesis is not rejected, indicating that the CAR's distribution is normal. Bold values indicate no normality and, therefore, nonparametric tests are applied to these cases. The econometric specification is reported in Appendix C.

Annex 8. Correlation matrix between the most significant variables

Variables	Mkt	Gtcpm	Gtdpm	Gttpt	Strin	Con	Eco	Eur	Son	Yield	USD	GBP	CHN	Brent	WTI	…
Mkt	1.00 -															
Gtcpm	-0.28** (-2.56)	1.00 -														
Gtdpm	-0.26** (-2.44)	0.93* (23.04)	1.00 -													
Gttpt	-0.30* (-2.84)	0.56* (5.94)	0.48* (4.86)	1.00 -												
Strin	0.33* (3.11)	-0.70* (-8.66)	-0.65* (-7.66)	-0.61* (-6.87)	1.00 -											
Con	0.33* (3.14)	-0.73* (-9.47)	-0.69* (-8.56)	-0.64* (-7.41)	0.99* (76.93)	1.00 -										
Eco	0.34* (3.24)	-0.75* (-10.09)	-0.72* (-9.23)	-0.67* (-8.04)	0.95* (28.77)	0.97* (43.03)	1.00 -									
Eur	0.31* (2.91)	-0.61* (-6.91)	-0.61* (-6.92)	-0.56* (-5.95)	0.80* (11.77)	0.80* (11.90)	0.83* (13.19)	1.00 -								
Son	-0.25** (-2.34)	0.72* (9.27)	0.69* (8.48)	0.62* (7.04)	-0.92* (-21.63)	-0.94* (-25.52)	-0.92* (-21.93)	-0.71* (-8.89)	1.00 -							
Yield	0.42* (4.15)	-0.45* (-4.44)	-0.40* (-3.87)	-0.43* (-4.26)	0.60* (6.67)	0.62* (6.98)	0.64* (7.34)	0.46* (4.55)	-0.62* (-7.06)	1.00 -						
US	-0.25** (-2.26)	0.16 (1.43)	0.11 (1.04)	0.14 (1.26)	-0.40* (-3.90)	-0.35* (-3.33)	-0.32* (-3.06)	-0.56* (-5.96)	0.26** (2.39)	-0.33* (3.13)	1.00 -					
UK	0.15 (1.37)	-0.27** (-2.52)	-0.24** (-2.22)	-0.24** (-2.21)	0.44* (4.33)	0.46* (4.58)	0.40* (3.86)	0.02 (0.18)	-0.54* (-5.77)	0.49* (4.94)	0.10 (0.96)	1.00 -				
CHN	-0.12 (-1.10)	-0.12 (-1.08)	-0.15 (-1.34)	-0.11 (-1.02)	-0.07 (-0.69)	-0.005 (-0.04)	0.05 (0.44)	-0.27** (-2.55)	-0.10 (-0.88)	-0.02 (-0.23)	0.89* (17.31)	0.32* (3.03)	1.00 -			
Brent	0.32* (3.05)	-0.18*** (-1.66)	-0.22** (-1.99)	-0.19*** (-1.76)	0.13 (1.15)	0.14 (1.29)	0.17 (1.51)	0.17 (1.58)	-0.14 (-1.27)	0.13 (1.20)	-0.15 (-1.40)	-0.03 (-0.32)	-0.09 (-0.83)	1.00 -		
WTI	0.11 (0.98)	-0.19*** (-1.72)	-0.20*** (-1.87)	-0.13 (-.23)	0.20*** (1.87)	0.20*** (1.88)	0.22 (2.00)	0.23** (2.14)	-0.16 (-1.49)	0.04 (0.38)	-0.17 (-1.56)	-0.05 (-0.51)	-0.08 (-0.73)	0.44* (4.31)	1.00 -	

Variables …	Mkt	Gtcpm	Gtdpm	Gttpt	Strin	Con	Eco	Eur	Son	Yield	US	UK	CHN	Brent	WTI
DNS	-0.21***	0.69*	0.67*	0.58*	-0.86*	-0.88*	-0.83*	-0.60*	0.89*	-0.42*	0.07*	-0.61***	-0.19***	-0.11	-0.13
	(-1.92)	(8.37)	(7.97)	(6.28)	(-15.30)	(-16.68)	(-13.50)	(-6.73)	(17.49)	(-4.11)	(0.66)	(-6.88)	(-1.73)	(-0.98)	(-1.16)
EPU	-0.26**	0.70*	0.70*	0.67*	-0.67*	-0.75*	-0.84*	-0.66*	0.77*	-0.52*	0.01*	-0.31*	-0.38*	-0.18***	-0.20***
	(-2.44)	(8.84)	(8.67)	(7.99)	(-8.09)	(-9.97)	(-14.13)	(-7.91)	(10.71)	(-5.45)	(0.15)	(-2.92)	(-3.63)	(-1.67)	(-1.79)
GFI	-0.07	0.06	0.18	0.06	0.16	0.11	-0.02	-0.32*	-0.19***	0.12	0.10*	0.60	0.07	-0.12	-0.15
	(-0.69)	(0.61)	(1.62)	(0.58)	(1.45)	(1.03)	(-0.23)	(-3.06)	(-1.78)	(1.13)	(0.91)	(6.73)	(0.66)	(-1.13)	(-1.39)
GRP	0.15	-0.47*	-0.53*	-0.44*	0.22**	0.32*	0.47*	0.42*	-0.37*	0.21***	0.16	0.09*	0.45*	0.19***	0.14
	(1.35)	(-4.71)	(-5.56)	(-4.35)	(2.05)	(3.03)	(4.76)	(4.07)	(-3.53)	(1.94)	(1.50)	(0.83)	(4.49)	(1.70)	(1.32)
VIX	-0.25**	0.20***	0.26**	0.29*	0.04	-0.02	-0.18	-0.34*	-0.04	0.01	-0.01*	0.48	-0.12	-0.22**	-0.20***
	(-2.35)	(1.86)	(2.42)	(2.66)	(0.35)	(-0.21)	(-1.63)	(-3.25)	(-0.37)	(0.15)	(-0.14)	(4.89)	(-1.12)	(-2.06)	(-1.82)
Trade	-0.27**	0.32*	0.29*	0.36*	-0.39*	-0.40*	-0.47*	-0.59*	0.28**	-0.21***	0.42***	0.19**	0.27**	-0.13	-0.28**
	(-2.53)	(3.00)	(2.68)	(3.39)	(-3.80)	(-3.88)	(-4.68)	(-6.52)	(2.59)	(-1.89)	(4.12)	(1.74)	(2.54)	(-1.20)	(-2.62)

Variables …	DNS	EPU	GFI	GPR	VIX	Trade
DNS	1.00					
	-					
EPU	0.67*	1.00				
	(7.92)	-				
GFI	-0.26**	0.27**	1.00			
	(-2.41)	(2.49)	-			
GPR	-0.32*	-0.83*	-0.58*	1.00		
	(-3.04)	(-13.58)	(-6.32)	-		
VIX	-0.12	0.50*	0.84*	-0.73*	1.00	
	(-1.06)	(5.07)	(14.08)	(-9.54)	-	
Trade	0.18	0.42*	0.47*	-0.33*	0.52*	1.00
	(16.61)	(4.08)	(4.77)	(-3.11)	(5.34)	-

Notes: This table presents the correlation matrix between the primary variables from 21 February 2020 to 12 June 2020. The t-statistic for ordinary Pearson coefficients is reported in parentheses. The econometric specification is reported in Appendix E. *, **, and *** indicates significance at 1, 5%, and 10%, respectively.

Annex 9. Correlation matrix between the returns of the sectors

	Mkt	O&g	Chem	Basic	Const	Aero	Genind	Elet	Indeng	Indtra	Auto	Bev	Food	House	Leisure	Person	…
Mkt	1.00 -																
O&g	0.88 (16.35)	1.00 -															
Chem	0.95 (26.71)	0.84 (13.97)	1.00 -														
Basic	0.92 (21.32)	0.89 (17.50)	0.90 (18.36)	1.00 -													
Const	0.94 (25.39)	0.85 (14.76)	0.91 (20.36)	0.88 (17.03)	1.00 -												
Aero	0.81 (12.50)	0.75 (10.16)	0.74 (9.80)	0.78 (10.98)	0.91 (20.33)	1.00 -											
Genind	0.92 (21.48)	0.89 (17.39)	0.90 (18.69)	0.91 (19.26)	0.91 (20.30)	0.85 (14.66)	1.00 -										
Elet	0.94 (24.98)	0.83 (13.55)	0.91 (20.26)	0.91 (19.89)	0.68 (8.25)	0.55 (5.81)	0.72 (9.15)	1.00 -									
Indeng	0.94 (24.83)	0.85 (14.67)	0.91 (20.31)	0.91 (19.57)	0.88 (16.62)	0.81 (12.35)	0.86 (15.26)	0.76 (10.31)	1.00 -								
Indtra	0.93 (22.43)	0.85 (14.23)	0.89 (17.98)	0.88 (16.97)	0.81 (12.24)	0.75 (10.02)	0.75 (10.04)	0.70 (8.62)	0.91 (20.56)	1.00 -							
Auto	0.91 (20.59)	0.87 (15.73)	0.89 (17.58)	0.90 (18.66)	0.88 (16.58)	0.86 (15.05)	0.88 (16.57)	0.79 (11.60)	0.90 (19.09)	0.91 (20.33)	1.00 -						
Bev	0.90 (18.96)	0.78 (11.24)	0.86 (14.81)	0.83 (13.14)	0.56 (6.07)	0.56 (6.05)	0.61 (6.88)	0.45 (4.44)	0.88 (17.09)	0.91 (20.30)	0.85 (14.66)	1.00 -					
Food	0.76 (10.46)	0.56 (6.05)	0.74 (9.84)	0.65 (7.67)	0.35 (3.30)	0.32 (2.98)	0.31 (2.86)	0.19 (1.77)	0.73 (9.51)	0.68 (8.25)	0.55 (5.81)	0.72 (9.15)	1.00 -				
House	0.91 (19.62)	0.75 (10.08)	0.86 (15.12)	0.81 (12.50)	0.71 (9.09)	0.60 (6.70)	0.73 (9.40)	0.87 (15.85)	0.86 (15.25)	0.88 (16.62)	0.81 (12.35)	0.86 (15.26)	0.76 (10.31)	1.00 -			
Leisure	0.81 (12.41)	0.71 (8.93)	0.80 (12.05)	0.80 (11.87)	0.87 (15.61)	0.84 (14.01)	0.84 (13.83)	0.76 (10.29)	0.80 (11.80)	0.81 (12.24)	0.75 (10.02)	0.75 (10.04)	0.70 (8.62)	0.80 (11.90)	1.00 -		
Person	0.93 (23.01)	0.80 (12.06)	0.92 (22.04)	0.85 (14.77)	0.87 (15.70)	0.87 (15.70)	0.90 (18.19)	0.90 (18.46)	0.90 (19.14)	0.88 (16.58)	0.86 (15.05)	0.88 (16.57)	0.79 (11.60)	0.85 (14.65)	0.78 (11.22)	1.00 -	

…	Tobac	Health	Pharm	Retail	Media	Air	Gamb	Hosp	Telec	Uti	Bank	Insur	Real	FinSer	Soft	Hard
Tobac	1.00 -															
Health	0.22*** (1.98)	1.00 -														
Pharm	0.51 (5.32)	**0.14** (**1.30**)	1.00 -													
Retail	0.59 (6.49)	0.37 (3.59)	0.76 (10.50)	1.00 -												
Media	0.67 (7.96)	0.35 (3.35)	0.74 (9.68)	0.89 (17.1)	1.00 -											
Air	0.45 (4.51)	0.38 (3.68)	0.41 (4.02)	0.73 (9.55)	0.75 (10.10)	1.00 -										
Gamb	0.53 (5.53)	0.61 (6.90)	0.46 (4.66)	0.70 (8.76)	0.74 (9.74)	0.71 (8.89)	1.00 -									
Hosp	0.44 (4.31)	0.25 (2.33)	0.41 (3.98)	0.61 (6.79)	0.73 (9.39)	0.74 (9.85)	0.69 (8.40)	1.00 -								
Telec	0.53 (5.53)	**0.17** **1.55**)	0.78 (10.9)	0.85 (14.72)	0.81 (12.13)	0.61 (6.81)	0.50 (5.07)	0.48 (4.85)	1.00 -							
Uti	0.60 6.58)	0.25** (2.31)	0.81 (12.16)	0.89 (17.67)	0.85 (14.17)	0.62 (7.08)	0.57 (6.13)	0.51 (5.23)	0.90 (18.58)	1.00 -						
Bank	0.54 (5.63)	0.28** (2.65)	0.58 (6.35)	0.84 (13.68)	0.88 (16.75)	0.81 (12.49)	0.64 (7.41)	0.73 (9.38)	0.83 (13.05)	0.82 (12.81)	1.00 -					
Insur	0.62 (6.99)	0.32 (2.99)	0.66 (7.88)	0.87 (15.77)	0.91 (19.42)	0.82 (12.91)	0.74 (9.86)	0.76 (10.32)	0.79 (11.64)	0.83 (13.53)	0.93 (23.32)	1.00 -				
Reale	0.60 (6.62)	0.42 (4.08)	0.61 (6.85)	0.81 (12.30)	0.86 (14.97)	0.79 (11.69)	0.79 (11.40)	0.74 (9.85)	0.73 (9.40)	0.79 (11.45)	0.82 (12.93)	0.91 (19.64)	1.00 -			
FinSer	0.89 (17.20)	0.40 (4.32)	0.68 (8.29)	0.83 (13.06)	0.86 (14.86)	0.74 (9.71)	0.67 (7.99)	0.62 (6.99)	0.77 (10.62)	0.77 (10.75)	0.83 (13.29)	0.85 (14.63)	0.79 (11.32)	1.00 -		
Soft	0.92 (21.82)	0.38 (3.64)	0.73 (9.59)	0.89 (17.47)	0.89 (17.67)	0.74 (9.85)	0.72 (9.27)	0.69 (8.57)	0.79 (11.41)	0.85 (14.37)	0.85 (14.25)	0.89 (17.28)	0.86 (15.07)	0.81 (12.25)	1.00 -	
Hard	0.89 (17.30)	0.26 (2.45)	0.73 (9.64)	0.79 (11.32)	0.83 (13.12)	0.70 (8.73)	0.67 (7.96)	0.75 (10.05)	0.73 (9.50)	0.74 (9.69)	0.77 (10.88)	0.84 (13.60)	0.83 (13.14)	0.79 (11.57)	0.90 (19.13)	1.00 -

…	Mkt	O&g	Chem	Basic	Const	Aero	Genind	Elet	Indeng	Indtra	Auto	Bev	Food	House	Leisure	Person
Tobac	0.62	0.61	0.56	0.61	0.56	0.48	0.55	0.55	0.58	0.56	0.56	0.61	0.45	0.61	0.48	0.50
	(7.10)	(6.76)	(6.06)	(6.82)	(6.03)	(4.90)	(5.84)	(5.79)	(6.33)	(6.07)	(6.05)	(6.88)	(4.44)	(6.81)	(4.80)	(5.16)
Health	0.32	**0.15**	0.33	0.22**	0.32	0.28**	0.30	0.31	0.32	0.35	0.32	0.31	0.19***	0.35	0.23**	0.31
	(2.97)	(**1.40**)	(3.13)	(2.04)	(2.94)	(2.58)	(2.80)	(2.93)	(2.99)	(3.30)	(2.98)	(2.86)	(1.77)	(3.37)	(2.10)	(2.87)
Pharm	0.80	0.63	0.77	0.71	0.73	0.54	0.64	0.75	0.74	0.72	0.60	0.73	0.87	0.77	0.79	0.76
	(11.87)	(7.26)	(10.63)	(8.96)	(9.27)	(5.57)	(7.34)	(10.23)	(9.80)	(9.09)	(6.70)	(9.40)	(15.85)	(10.69)	(11.45)	(10.44)
Retail	0.91	0.75	0.89	0.86	0.88	0.74	0.85	0.90	0.87	0.87	0.84	0.84	0.76	0.87	0.84	0.91
	(20.38)	(10.19)	(17.29)	(14.96)	(16.55)	(9.64)	(14.16)	(18.83)	(16.12)	(15.61)	(14.01)	(13.83)	(10.30)	(15.47)	(13.75)	(20.34)
Media	0.93	0.80	0.89	0.87	0.90	0.83	0.87	0.89	0.93	0.87	0.87	0.90	0.73	0.89	0.78	0.88
	(24.02)	(12.04)	(18.01)	(16.00)	(18.20)	(12.90)	(15.29)	(17.25)	(22.43)	(15.70)	(15.71)	(18.19)	(9.51)	(17.58)	(11.00)	(16.58)
Air	0.76	0.68	0.73	0.74	0.81	0.82	0.83	0.75	0.79	0.83	0.85	0.76	0.44	0.73	0.61	0.73
	(10.33)	(8.22)	(9.43)	(9.85)	(12.54)	(12.70)	(13.14)	(9.94)	(11.62)	(13.39)	(14.23)	(10.55)	(4.30)	(9.58)	(6.87)	(9.45)
Gamb	0.71	0.59	0.65	0.63	0.73	0.67	0.72	0.69	0.66	0.72	0.73	0.67	0.42	0.70	0.57	0.63
	(8.87)	(6.54)	(7.51)	(7.16)	(9.56)	(7.93)	(9.17)	(8.39)	(7.71)	(9.33)	(9.38)	(8.09)	(4.15)	(8.82)	(6.22)	(7.22)
Hosp	0.71	0.67	0.63	0.68	0.75	0.85	0.78	0.70	0.73	0.75	0.76	0.75	0.37	0.65	0.52	0.63
	(8.99)	(8.06)	(7.14)	(8.34)	(10.25)	(14.17)	(10.96)	(8.61)	(9.61)	(10.24)	(10.43)	(10.17)	(3.59)	(7.50)	(5.38)	(7.21)
Telec	0.88	0.77	0.89	0.79	0.84	0.63	0.78	0.82	0.80	0.79	0.79	0.78	0.79	0.82	0.75	0.88
	(16.56)	(10.69)	(17.53)	(11.64)	(13.65)	(7.13)	(10.96)	(12.70)	(11.91)	(11.60)	(11.45)	(11.25)	(11.38)	(12.69)	(10.18)	(17.07)
Uti	0.89	0.76	0.87	0.84	0.87	0.69	0.79	0.86	0.84	0.81	0.81	0.81	0.78	0.86	0.82	0.88
	(17.8)	(10.45)	(16.05)	(13.72)	(15.48)	(8.53)	(11.34)	(14.96)	(13.79)	(12.51)	(12.28)	(12.28)	(11.18)	(14.91)	(12.64)	(16.58)
Bank	0.91	0.85	0.88	0.88	0.89	0.83	0.90	0.88	0.89	0.88	0.94	0.85	0.58	0.81	0.69	0.86
	(19.28)	(14.26)	(16.73)	(16.57)	(18.03)	(13.28)	(18.78)	(16.57)	(17.96)	(16.22)	(24.51)	(14.74)	(6.28)	(12.24)	(8.55)	(15.12)
Insur	0.94	0.88	0.89	0.90	0.937	0.86	0.93	0.91	0.91	0.92	0.94	0.89	0.63	0.86	0.73	0.88
	(26.21)	(16.40)	(17.51)	(18.40)	(23.50)	(15.09)	(22.63)	(19.21)	(20.06)	(22.08)	(24.64)	(17.28)	(7.14)	(14.94)	(9.54)	(16.75)
Reale	0.88	0.81	0.84	0.81	0.91	0.86	0.88	0.84	0.84	0.89	0.86	0.86	0.59	0.87	0.72	0.83
	(16.27)	(12.23)	(13.86)	(12.33)	(20.06)	(15.04)	(16.44)	(13.98)	(13.80)	(17.61)	(15.36)	(15.34)	(6.56)	(15.67)	(9.34)	(13.16)
FinSer	0.89	0.76	0.87	0.81	0.83	0.73	0.84	0.85	0.89	0.82	0.85	0.81	0.69	0.81	0.68	0.85
	(17.29)	(10.39)	(15.82)	(12.25)	(13.25)	(9.39)	(13.71)	(14.22)	(17.36)	(12.98)	(14.20)	(12.23)	(8.58)	(12.11)	(8.28)	(14.59)
Soft	0.92	0.83	0.90	0.89	0.93	0.81	0.91	0.93	0.91	0.91	0.88	0.85	0.70	0.87	0.87	0.89
	(21.82)	(13.32)	(18.57)	(17.14)	(22.16)	(12.49)	(19.95)	(23.14)	(20.37)	(19.36)	(16.96)	(14.75)	(8.77)	(15.81)	(15.73)	(17.79)
Hard	0.89	0.81	0.86	0.84	0.81	0.80	0.88	0.88	0.87	0.88	0.84	0.85	0.67	0.80	0.79	0.85
	(17.30)	(12.51)	(15.24)	(13.76)	(17.23)	(11.79)	(16.99)	(16.94)	(16.05)	(16.29)	(13.68)	(14.52)	(8.10)	(11.70)	(11.68)	(14.52)

Notes: The table shows the correlation matrix between the returns of the sectors from 21 February 2020 to 12 June 2020. The t-statistic for ordinary Pearson coefficients is reported in parentheses. The econometric specification is reported in Appendix E. **, and *** indicates significance at 5 and 10%, respectively. The bold values are not statistically significant, and the other values that do not have any symbol are significant at 1%. To maintain an appealing layout were only utilized two decimal places.