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## CONTENTS

**Editorial introduction**
*Ida Musiałkowska, Paweł Niszczota*

**ARTICLES**

**World capital markets facing the first wave of COVID-19: Traditional event study versus sensitivity to new cases**
*Pedro Luis Angosto-Fernández, Victoria Ferrández-Serrano*

**Corporate governance, excess-cash and firm value: Evidence from ASEAN-5**
*Tahir Akhtar*

**Examining the effect of credit on monetary policy with Markov regime switching: Evidence from Turkey**
*Ali İlhan*

**Wage determination, Global Value Chains and role played by wage bargaining schemes: The case of Poland**
*Dagmara Nikulin, Joanna Wolszczak-Derlacz*

**Stock returns and liquidity after listing switch on the Warsaw Stock Exchange**
*Dorota Podedworna-Tarnowska, Daniel Kaszyński*

**Who is talent? Implications of talent definitions for talent management practice**
*Agnieszka Skuza, Habte G. Woldu, Shawn Alborz*

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# World capital markets facing the first wave of COVID-19: Traditional event study versus sensitivity to new cases[1]

***Pedro Luis Angosto-Fernández*[2], *Victoria Ferrández-Serrano*[3]**

**Abstract:** The aim of the paper is to analyse the impact of the new coronavirus on financial markets. The sample comprises returns from 80 countries, across all regions and incomes for the period known as the first wave. By combining event study methodology and time series analysis of new COVID-19 cases it is found that the negative price effect is widespread but unequal across regions. It is also noted that the distribution of the impact is also uneven with a high concentration in the week after the first local case but especially in the weeks around the pandemic declaration. Finally, it has been shown at different levels how the markets most affected by the crisis are not necessarily the most sensitive to the virus.

**Keywords:** financial markets, event study, COVID-19, coronavirus, stock returns.

**JEL codes:** G01, G14, G15, F65, C32.

## Introduction

On 31 December 2019 China reported the first case of the new coronavirus and since then the world has experienced an unprecedented situation. It is neither the first nor the worst pandemic suffered by humanity, but it is the most important one to have existed in the last century. Above all this pandemic is different because it has occurred in a highly globalised and interdependent world economy. As a result, not only has the virus spread rapidly, but the measures taken to contain it and the respective consequences have also turned this health crisis into a political and economic one. During the period covered, from 31 December to 1 June 2020, the virus rapidly infected equity markets causing cumulative declines of more than a quarter of total capitalisation in Austria,

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Brazil, Egypt, or Indonesia, among others, and causing daily falls in prices that were higher than those during the global financial crisis.

Academic studies on COVID-19 and capital markets have been published continuously since the mid-2020s (Ashraf, 2020, 2021; Baker et al., 2020; Gormsen & Koijen, 2020; Spatt, 2020; Ramelli & Wagner, 2020; Rizwan, Ahmad, & Ashraf, 2020; Zaremba, Kizys, Aharon, & Demir, 2020). They report the statistically negative effect on asset returns and positive effect on volatility, examine the effect of government measures with controversial results and try to explain the different levels of risk exposure at country and firm level.

This paper contributes to this recent literature in several ways. A global study of the short- and medium-term effects of the first wave of the pandemic on equity markets with a sample of 80 countries divided into eight regions is presented. This experiment is based on two approaches that have been the order of the day in finance research: event study and analysis of daily case time series and their influence on markets. Both approaches are treated by regressing the time series of index returns under a system of simultaneous equations called seemingly unrelated equations (Zellner, 1962; Karafiath, 1988) and using an extended market model and the 3-factor model by Fama and French (1993).

The former is divided into two distinct events: from the day each country detected its first infection and from the day the WHO declared COVID-19 a pandemic. This makes it possible to assess the significance of these events and their evolution over time. The latter evaluates the sensitivity of investors in each country to the information provided by the health authorities as well as being an experiment to assess the effect of information about the pandemic on each country and the efficiency of markets in general. The comparison of both methodologies and the level of disaggregation provided makes it possible to present a very detailed and comprehensive study of the first months of the pandemic.

From the results the overall significant negative effect on equity markets and its concentration around the days when the pandemic was declared are highlighted. Especially in the regions of Europe, Eastern Europe and South America and the Caribbean. The inverse relationship between case growth and index returns is also proven which is significant in 56 out of 80 markets. Notably, the comparison of the two experiments shows an avenue for future research, namely that the countries with the lowest cumulative abnormal returns are not the countries most affected by a growth in cases.

The paper continues with Section 1, a review of the literature where a link between this event and the effect of natural disasters and unexpected events in general on equity markets is established. In the same section there is a discussion of the main findings of the emerging literature on COVID-19 and stock markets. Subsequently, the methodology of the two experiments is presented in detail in Section 2, the first being a classical event study approach and the second the application of a time series model where daily returns are related to the growth of the cases. Despite the notable differences both experiments are conducted through the use of simultaneous equation models. After that, the main results of the research are presented in Section 3, with special emphasis on the comparison of the two methods and finally in Section 4, some conclusions and their policy implications are highlighted.

## 1. Literature review and research questions

Unanticipated events affect stock markets and research in this area has been prolific in recent years. The level of uncertainty may affect both future dividends (negatively) and the expected rate of returns (positively) at least until the contingency is resolved and uncertainty disappears (Brown, Harlow, & Tinic, 1988). There is already evidence that the current crisis has affected equities through both channels (Gormsen & Koijen, 2020).

One of the most widely recognised contributions in this field is the one by Baker, Bloom and Davies (2016) who developed an index capturing moments of high economic policy uncertainty. During the first wave of COVID-19 this index reached an all-time global peak in April (Economic Policy Uncertainty, n.d.). It is a perfect tool for directly studying the relationship between uncertainty and stock markets, but it is on a monthly basis and the sample of countries is still reduced. Thanks to this index and other indicators, Baker and others (2020) found that the uncertainty generated by this pandemic is unprecedented. They hypothesise that this reaction is caused by the restrictions implemented by the governments and the preventive behaviour of individuals themselves as this occurred once the virus was detected in each country and not before.

In the event literature a division could be made between events that are more related to natural disasters and those that are more politically induced. Obviously, this line is blurred, and coronavirus is the best proof of this; it belongs to the first category by definition, but its duration and its effect on the measures taken by countries also make it a political event. In a theoretical and empirical work Barro (2006) developed a model which explains that despite the low probability of rare disasters (such as wars) they are able to explain the high equity premium during the twentieth century.

With respect to natural disasters and their effects on stock markets Bourdeau-Brien and Kryzanowski (2017) found that only few events cause significant effects on returns and volatility in USA markets. They also discovered that the most adverse effects on the stock market are felt two to three months after the peak of media coverage. Valizadeh, Karali and Ferreira (2017) showed how a disaster, such as the Japan earthquake of 2011, not only affects the national stock market, but it also rapidly extends to related markets and its negative impact partly remains in the long run. In the same vein Papakyriakou, Sakkas and Taoushianis (2019) found that countries which experienced higher stock declines after terrorist attacks also experienced higher economic losses. More recently, on this connection to the real economy, Iheonu and Ichoku (2022) found that terrorism in Africa has a negative effect on domestic investment but even more so on FDI. As a final example Kaplanski and Levy (2010) found that the stock market reacts negatively to aircraft crashes with increases in volatility and decreases in returns. In addition, they found that the market reaction, measured as capital loss can be as much as sixty times the actual economic loss.

Special attention should be given to a paper published previous to the current pandemic by Donadelli, Kizys and Riedel (2017). They studied the pharmaceutical stock reactions to official WHO announcements and found that in a first stage there is a fall in prices caused by fear and over-information, but there is also a second stage of growth induced by government intervention and investment opportunities. They also report an abnormal and persistent growth in volatility. While these are interesting results the experiment only sampled pharmaceutical companies where extraordinary returns can be obtained due to potential vaccines or treatments.

In the second group, articles analysing unexpected outcomes from elections (Goodell & Vähämaa, 2013; Wagner, Zeckhauser, & Ziegler, 2018), referendums (Angosto-Fernández & Ferrández-Serrano, 2020; Schiereck, Kiesel, & Kolaric, 2016) and other political events (He, Nielsson, & Wang, 2017; Liu, Shu, & Wei, 2017; Hillier & Loncan, 2019) are found. The literature regarding uncertain political events presents key findings that can be extended to neighbouring disciplines (Brooks, Patel, & Su, 2003). First, there is a negative relationship between uncertainty and returns (Angosto-Fernández & Ferrández-Serrano, 2020; He et al., 2017; Schiereck et al., 2016). Second, there is a positive relationship between uncertainty and volatility (Goodell & Vähämaa, 2013; Smales, 2016; Chiang, 2019), and finally, there is a high dispersion on returns showing that the effects of uncertainty are not homogeneous among firms or countries (Davies & Studnicka, 2018; Shahzad, Rubbaniy, Lensvelt, & Bhatti, 2019).

Additionally, and not surprisingly, academic work on the influence of COVID-19 on the stock market has been booming for some months now (Ashraf, 2020, 2021; Ramelli & Wagner, 2020; Zhang, Hu, & Ji, 2020; Zaremba et al., 2020, among others). As in the literature on unanticipated events many researchers report abnormal negative returns (Ashraf, 2021; Heyden & Heyden, 2021; Pandey & Kumari, 2021; Ramelli & Wagner, 2020) and others report an unusual increase in volatility and market contagion (Baker et al., 2020; Contessi & De Pace, 2021; Li et al., 2022; Liu, Wei, Wang, & Liu, 2022; Samitas, Kampouris, & Polyzos, 2022; Zhang et al., 2020; Zaremba et al., 2020). In Liu and others (2022) they find that the cross-market contagion effect caused by the pandemic lasted between six and eight months, which is important in determining which model and methods to use to conduct any research on returns and/or volatility. Finally, in one of the most interesting papers as it will open the door to future debates within the field, Uddin, Chowdhury, Anderson and Chaudhuri (2021) find that the level of economic strength of the country helps to mitigate the effects of COVID-19 on market volatility.

Regarding this experiment there is previous evidence of the negative and significant influence of the growth in cases on stock prices worldwide (Ashraf, 2020a; Seven & Yilmaz, 2020; Pandey & Kumari, 2020). In this respect the papers by Ashraf (2021) and Fernández-Peréz, Gilbert, Indriawan and Nguyen (2021) relate the sensitivity of caseload growth to a national cultural effect because countries with a higher degree of risk aversion seem to be more affected by the increased incidence of the virus. These results are maintained after the introduction of control variables and other robustness checks. As well as other researchers O'Donnell, Shannon and Sheehan (2021) found a significant relationship between the cases and the returns of six of the world's major indices, but they also found that after controlling for some of the variables that most influence capital markets that two of these relationships were no longer significant (the one for the Chinese index and the one for the world market). More recently Alkhatib, Almahmood, Elayan and Abualigah (2022) confirmed the negative relationship between the increase in COVID-19 cases and the stock market points of the GCC countries and they used the coefficients obtained from the time series models to determine which markets are most affected although, as will be seen throughout this article, using only this indicator may be limiting when determining the total effect. Finally, Yu, Xiao and Liu (2022) construct their own indices from information on new cases and deaths. It is a study with a longer time span which is probably why they find that this relationship is volatile, and that it becomes very weak especially after the first announcement of the vaccine.

With regard to event studies, Narayan, Khan and Liu (2021) used daily dummies to control for lockdowns, government stimulus and border closures in G7 countries and found that lockdowns are the events that most severely affect stock markets. In some cases, there are mixed signs, but there is an overall positive effect in returns while the effect of stimulus is only positive and significant in three countries. Pandey and Kumari (2020) took a sample of forty-nine markets and confirmed the evidence regarding lockdowns. They also presented additional evidence of the negative effect on returns from the declaration of a public health emergency (pre-pandemic) by the WHO (three and seven days later), with Asia being the most affected region. Interestingly, developed countries appear to have anticipated the declaration with significant abnormal returns prior to the event.

Heyden and Heyden (2021) focus on four different events in the USA and EU countries: first case, first death, fiscal stimulus and monetary stimulus. They found negative abnormal returns for first death and for fiscal stimulus while monetary stimulus provided positive abnormal returns. This result is contradicted by Seven and Yilmaz (2020) where fiscal stimulus is related to stock market rallies while all other interventions have no significant effect. In the latter study, the sample comprises seventy-eight countries, so it seems that there are notable differences in the effect of stimulus around the world which is an ambiguity also suggested by Narayan and others (2021).

The present research seeks to complement the information provided by these investigations. Thus, the main objective of this research could be defined as the quantification of the impact of the first wave of COVID-19 on global capital markets and the comparative analysis of two different methods to do so. To this end, a series of questions are proposed:

– Are the accumulated losses in global capital markets significant and are they significant in all regions and countries? How significant are price declines after discounting for expected asset returns?
– How are markets affected by the evolution of the pandemic? In which weeks are the bulk of losses concentrated?
– Are markets sensitive to new epidemiological information and are there geographical differences?
– What information could be obtained from the event study methodology that is not obtainable from studying the time series of growth in cases and its influence on stock market indices?

Some of these questions have been addressed in previous articles, but this research brings new elements to the debate. First, to answer these questions stock market data are collected from major indices from eighty countries for an event window from 31 December to 1 June. One of the longest samples and study periods to date. In addition, the sample selected includes countries such as Iraq, Ghana, Tanzania, Myanmar and Jamaica, whose markets are considered "underdeveloped" and are often excluded by default in other studies.

Second, the event period is different for each country as it starts from the day the first case was detected. This permits testing for abnormal returns for those days and also observe the evolution of the pandemic over weeks thereby detecting where the bulk of the losses are globally and regionally. Additionally, another event study is carried out, starting from the week when the WHO declared COVID-19 a pandemic which allows an insight into the singularity of this unique political and economic event.

Third, the event study is based on a multivariate equation system and not on global indices or different panel study methods. This method provides an interesting level of disaggregation to observe what proportion of national equity markets actually suffered significant effects. In the same vein, regional data at eight levels is presented: Africa, Asia, North America, South America and the Caribbean, Europe, Eastern Europe, MENA (Middle East & North Africa), and Oceania.

Fourth, building on the research by Ashraf (2020), an additional experiment is incorporated to observe which investors at country and regional level are more sensitive to growth in COVID-19 cases. The data is also comprehensively explained and directly comparable to the event study with the intention of comparing both methodologies and finding similarities and differences at all levels. This comparison also enriches the literature on the role of culture and its effects on the stock market as it is directly observable that the markets most affected by the pandemic are not necessarily those that react the most to an increase in the rate of infection and vice versa.

## 2. Data and event description

Table 1 lists the different countries in the sample and their indices including other important details to better understand this research. The experiment is split into two parts: a traditional event study and an analysis of the sensitivity of returns to increases in cases. The objective is to answer a single question in two ways: How significant was the first wave of the pandemic with respect to the capital markets of the different countries in the world?

To do so, the daily quotations of the stock market indices are collected (one per country) provided that there were data from at least one hundred sessions before 31 December 2019, the day when the first case was detected. Then, they are used to compound logarithmic returns. The data was obtained from Investing (Investing, 2022), and by asking each stock exchange individually when the data was not on the website. This procedure gives a preliminary sample of more than ninety countries, but after applying the requirement that no more than 25% of their returns should be 0, the sample was reduced to eighty countries, ten of them being traditionally Jewish or Muslim where the business week goes from Sunday to Thursday.

These details can be seen in Table 1. As is well known the first case occurred in China and the country that was the last to detect its first case was Myanmar (also known as Burma) on 24 March 2020. Counting from 31 December the country that experienced the greatest stock market decline was Cyprus with –41.12%, but Sri Lanka followed very closely behind. Conversely, Zimbabwe and Venezuela experienced a stock market growth higher than 100% mainly driven by hyperinflation. If it is determined that the outbreak occurred when the first national case appeared Sri Lanka is clearly the most damaged while the winners are exactly the same. Finally, considering the loss of capital per day, Colombia is the most affected with a daily fall of more than 0.52%.

Logarithmic returns are used in both experiments. Additionally, the MSCI World Index is the benchmark index of the world and the SMB (Small Minus Big market capitalization) and HML (High Minus Low book-to-market ratio) are risk factors collected from the Kenneth French website (Kenneth R. French, 2022). Finally, the number of cases by country and date were collected from the European Union Open Data Portal (European Union Open Data Portal, 2020).

**Table 1. Average and accumulated raw returns of the sample indices**

| Country | Index | Special week | 1st case | Accumulated (31st DEC) | Average daily return (31st DEC) | Accumulated (1st case) | Average daily return (1st case) | Region |
|---|---|---|---|---|---|---|---|---|
| Argentina | S&P Merval | No | 03/03/2020 | −7.0850 | −0.0668 | 6.8440 | 0.1104 | SA&C |
| Australia | S&P ASX 200 | No | 25/01/2020 | −10.5114 | −0.0992 | −14.6230 | −0.1662 | O |
| Austria | ATX | No | 26/02/2020 | −35.6028 | −0.3359 | −28.5620 | −0.4328 | E |
| Bahrain | BAX | Yes | 24/02/2020 | −23.6265 | −0.2229 | −27.3110 | −0.4016 | M |
| Bangladesh | DESEX | Yes | 09/03/2020 | −10.7476 | −0.1014 | −6.9510 | −0.1198 | AS |
| Belgium | BEL20 | No | 04/02/2020 | −19.3868 | −0.1829 | −18.4266 | −0.2247 | E |
| Brazil | Ibovespa | No | 26/02/2020 | −27.3580 | −0.2581 | −26.3786 | −0.3997 | SA&C |
| Bulgaria | SOFIX | No | 08/03/2020 | −20.8840 | −0.1970 | −13.9217 | −0.2400 | EE |
| Cambodia | CSX | No | 28/01/2020 | 5.5072 | 0.0520 | 6.6239 | 0.0761 | AS |
| Canada | S&P TSX | No | 26/01/2020 | −9.7988 | −0.0924 | −12.4917 | −0.1420 | NA |
| Chile | S&P IPSA | No | 04/03/2020 | −24.6290 | −0.2323 | −16.1310 | −0.2644 | SA&C |
| China | SZSE Component | No | 31/12/2019 | 9.1806 | 0.0866 | 9.1806 | 0.0866 | AS |
| Colombia | COLCAP | No | 07/03/2020 | −40.3364 | −0.3805 | −30.2446 | −0.5215 | SA&C |
| Côte d'Ivore | BRVM Composite | No | 12/03/2020 | −15.3238 | −0.1446 | −7.6679 | −0.1394 | A |
| Cyprus | CYMAIN | No | 10/03/2020 | −41.1177 | −0.3879 | −21.7709 | −0.3819 | E |
| Czech Republic | PX | No | 02/03/2020 | −20.6349 | −0.1947 | −7.3773 | −0.1171 | EE |
| Denmark | OMX-C20 | No | 27/02/2020 | 9.2665 | 0.0874 | 4.8471 | 0.0746 | E |
| Egypt | EGX 30 | Yes | 02/03/2020 | −30.9497 | −0.2920 | −17.8220 | −0.2829 | M |

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|---|---|---|---|---|---|---|---|---|
| Finland | OMX-H25 | No | 30/01/2020 | −5.4207 | −0.0511 | −7.6095 | −0.0895 | E |
| France | CAC 40 | No | 25/01/2020 | −22.7960 | −0.2151 | −23.4963 | −0.2670 | E |
| Germany | DAX | No | 28/01/2020 | −13.4052 | −0.1265 | −13.0707 | −0.1502 | E |
| Ghana | GSE Composite | No | 13/03/2020 | −14.2610 | −0.1345 | −13.0362 | −0.2414 | A |
| Greece | ATG | No | 27/02/2020 | −33.2232 | −0.3134 | −20.8950 | −0.3215 | E |
| Hong Kong | HSI | No | 23/01/2020 | −17.8151 | −0.1681 | −17.8915 | −0.1988 | AS |
| Hungary | SE | No | 05/03/2020 | −25.0380 | −0.2362 | −18.8737 | −0.3146 | EE |
| Iceland | ICEX Main | No | 29/02/2020 | −3.6588 | −0.0345 | 5.1202 | 0.0813 | E |
| India | BSE Sensex | No | 30/01/2020 | −18.2949 | −0.1726 | −17.2998 | −0.2035 | AS |
| Indonesia | IDX Composite | No | 02/03/2020 | −27.6139 | −0.2605 | −13.1774 | −0.2092 | AS |
| Iraq | ISX 60 | Yes | 25/02/2020 | −15.0737 | −0.1422 | −9.0080 | −0.1344 | M |
| Ireland | ISEQ Overall | No | 01/03/2020 | −18.1012 | −0.1708 | −6.5153 | −0.1034 | E |
| Israel | TA125 | Yes | 24/02/2020 | −15.1277 | −0.1427 | −15.8570 | −0.2332 | M |
| Italy | FTSE MIB | No | 31/01/2020 | −23.8220 | −0.2247 | −24.9840 | −0.2974 | E |
| Jamaica | JSE All Index | No | 12/03/2020 | −29.1257 | −0.2748 | −10.1079 | −0.1838 | SA&C |
| Japan | Nikkei 225 | No | 15/01/2020 | −2.5162 | −0.0237 | −4.0621 | −0.0423 | AS |
| Jordan | SE All Share | Yes | 03/03/2020 | −14.8670 | −0.1403 | −11.6800 | −0.1884 | M |
| Kazakhstan | KASE | No | 15/03/2020 | −3.8191 | −0.0360 | 9.2898 | 0.1753 | AS |
| Kenya | NASI | No | 14/03/2020 | −18.7256 | −0.1767 | 2.5630 | 0.0484 | A |
| Malaysia | KLCI | No | 25/01/2020 | −7.0805 | −0.0668 | −4.3920 | −0.0499 | AS |
| Malta | MSE | No | 07/03/2020 | −17.3032 | −0.1632 | −14.1092 | −0.2433 | E |
| Mauritius | Semdex | No | 20/03/2020 | −30.5445 | −0.2882 | 1.9864 | 0.0405 | A |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mexico | IPC | No | 29/02/2020 | −16.7301 | −0.1578 | −11.2377 | −0.1784 | NA |
| Morocco | MASI | No | 03/03/2020 | −21.4104 | −0.2020 | −21.3721 | −0.3447 | M |
| Myanmar | Myanpix | No | 24/03/2020 | 0.0545 | 0.0005 | 0.4657 | 0.0099 | AS |
| Namibia | FTSE NSX Overall | No | 15/03/2020 | −27.7432 | −0.2617 | 2.1981 | 0.0415 | A |
| Netherlands | AEX | No | 28/02/2020 | −11.5882 | −0.1093 | −3.7184 | −0.0581 | E |
| New Zealand | NZSX 50 | No | 28/02/2020 | −4.6577 | −0.0439 | −4.1803 | −0.0653 | O |
| Nigeria | NSE All Share | No | 28/02/2020 | −4.9617 | −0.0468 | −5.7064 | −0.0892 | A |
| Norway | OBX | No | 27/02/2020 | −16.2236 | −0.1531 | −10.8240 | −0.1665 | E |
| Oman | MSM 30 | Yes | 25/02/2020 | −11.6506 | −0.1099 | −16.1940 | −0.2417 | M |
| Pakistan | Karachi All Share | No | 27/02/2020 | −15.8590 | −0.1496 | −6.2798 | −0.0966 | AS |
| Peru | S&P Lima | No | 07/03/2020 | −30.1284 | −0.2842 | −18.2753 | −0.3151 | SA&C |
| Philippines | PSEi | No | 30/01/2020 | −29.4035 | −0.2774 | −24.7822 | −0.2916 | AS |
| Poland | WIG20 | No | 04/03/2020 | −21.5356 | −0.2032 | −8.6248 | −0.1414 | EE |
| Portugal | PSI-20 | No | 03/03/2020 | −16.8206 | −0.1587 | −8.4504 | −0.1363 | E |
| Qatar | QE General | Yes | 01/03/2020 | −14.7193 | −0.1389 | −5.0840 | −0.0794 | M |
| Romania | BET | No | 27/02/2020 | −15.7892 | −0.1490 | −13.0203 | −0.2003 | EE |
| Russia | RTS | No | 01/02/2020 | −18.9560 | −0.1788 | −16.8783 | −0.2034 | EE |
| Saudi Arabia | TASI | Yes | 03/03/2020 | −26.7662 | −0.2525 | −14.4220 | −0.2326 | M |
| Serbia | Belex 15 | No | 07/03/2020 | −17.1791 | −0.1621 | −15.9967 | −0.2758 | EE |
| Singapore | FTSE Singapur | No | 24/01/2020 | −21.8902 | −0.2065 | −22.8759 | −0.2570 | AS |
| South Africa | SWIX | No | 06/03/2020 | −16.2334 | −0.1531 | −7.6838 | −0.1302 | A |
| South Korea | KOSPI | No | 20/01/2020 | −5.6521 | −0.0533 | −8.0307 | −0.0864 | AS |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spain | IBEX 35 | No | 01/02/2020 | −28.6026 | −0.2698 | −26.0240 | −0.3135 | E |
| Sri Lanka | S&P Sri Lanka 20 | No | 28/01/2020 | −41.0538 | −0.3873 | −37.0945 | −0.4264 | AS |
| Sweden | OMXS30 | No | 01/02/2020 | −7.1625 | −0.0676 | −7.8044 | −0.0940 | E |
| Switzerland | SMI | No | 26/02/2020 | −7.6860 | −0.0725 | −6.3736 | −0.0966 | E |
| Taiwan | Taiwan Weighted | No | 21/01/2020 | −8.2292 | −0.0776 | −8.7698 | −0.0953 | AS |
| Tanzania | DSE ASI | No | 17/03/2020 | −12.9610 | −0.1223 | −9.3440 | −0.1797 | A |
| Thailand | SETI | No | 13/01/2020 | −17.6959 | −0.1669 | −17.7459 | −0.1811 | AS |
| Trinidad and Tobago | TTSE Composite | No | 13/03/2020 | −13.8106 | −0.1303 | −14.3146 | −0.2651 | SA&C |
| Tunisia | TUNINDEX | No | 03/03/2020 | −8.9901 | −0.0848 | −10.0041 | −0.1614 | M |
| Turkey | BIST 100 | No | 12/03/2020 | −7.2494 | −0.0684 | 5.5510 | 0.1009 | M |
| Uganda | Uganda All Share | No | 22/03/2020 | −28.2914 | −0.2669 | −7.5805 | −0.1579 | A |
| United Kingdom | FTSE 100 | No | 31/01/2020 | −18.3636 | −0.1732 | −15.6232 | −0.1860 | E |
| United Arab Emirates | ADX General | Yes | 27/01/2020 | −19.9507 | −0.1882 | −22.6320 | −0.2572 | M |
| Uruguay | BVM | No | 15/03/2020 | −2.2646 | −0.0214 | 0.3362 | 0.0063 | SA&C |
| United States | S&P 500 | No | 21/01/2020 | −1.4147 | −0.0133 | −4.7223 | −0.0513 | NA |
| Venezuela | IBC | No | 15/03/2020 | 112.6701 | 1.0629 | 96.8292 | 1.8270 | SA&C |
| Vietnam | VN | No | 24/01/2020 | −10.0905 | −0.0952 | −12.7925 | −0.1437 | AS |
| Zimbabwe | Zimbabwe Industrial | No | 21/03/2020 | 171.3466 | 1.6165 | 96.6448 | 2.0134 | A |

Notes: Returns are multiplied by 100. Special week means that trading days go from Sunday to Thursday. The names of the indices appear as in Investing (Investing, 2022). A is Africa, AS is Asia, E is Europe, EE is Eastern Europe, M is MENA, NA is North America, SA&C is South America & Caribbean, and O is Oceania.

Source: Own elaboration on the basis of Investing (Investing, 2022).

### 2.1. Classic event study

The event period covers from 4 August 2019 until 1 June 2020. The return series are estimated all together using a multivariate system called seemingly unrelated regressions (Zellner, 1962; Karafiath, 1988). This methodology permits abnormal returns to be obtained in a single step with no difference between estimation and event window and it considers contemporaneous dependence on disturbances by taking into consideration one of the main problems of clustered events: cross-sectional correlation. Therefore, *dummy* variables are used to estimate these abnormal returns and each *dummy* coefficient corresponds to one week and its value is the daily average abnormal return of that week. This was done in response to the specific length of this event to make the data easier to handle and interpret.

Furthermore, as zero moment has been established in the week in which the first COVID-19 case was detected in each country the length of the event varies according to the country. As an example, China has twenty-two weeks of abnormal returns while Myanmar has only ten. It was carried out in this way with the intention of assessing the direct effect of the virus in each country assuming that at national level investors would act as the virus permeated each particular region (Baker et al., 2020). This decision was based on previous papers and observation of the data because initially no one had given any importance to the information and the various control measures were only taken once the virus had permeated the country in question.

The model used to describe the normal path of returns is an extended version of the market model. This extended version considers the autocorrelation of the returns for each country and a lag of the market variable. This modification has been made to describe the usual evolution of returns in the best possible way and after various tests the explanatory power of this model was much higher in the vast majority of countries than the traditional market model. For each country:

$$r_{it} = \alpha_{i0} + \alpha_{i1} * r_{it-1} + \beta_{i1} * r_{WORLDt} + \beta_{i2} * r_{WORLDt-1} + \sum_{j=0}^{N=Y} \delta_{ij} * D_j + \varepsilon_{it} \quad (1)$$

$r_{it}$ is the logarithmic return of the index (country) *i* on day *t*; $\alpha_{i0}$ is the constant of the model for the index *i*; $r_{it-1}$, $r_{WORLDt}$ and $r_{WORLDt-1}$ are the autocorrelation of $r_{it}$, the logarithmic return of the world market index on day *t* and its lag, respectively. $\alpha_{i1}$, $\beta_{i1}$ and $\beta_{i2}$ are their associated coefficients. $\delta_{ij}$ is the average daily abnormal return for index *i* over week *j*, $D_j$ is a binary variable that takes the value of one in any of the days of week *j* of the event, and $\varepsilon_{it}$ is the disturbance term. The weeks of the event are defined as *Y* since they take different values depending on the country.

These coefficients ($\delta_{ij}$) are used to perform joint tests on the global significance of the returns and to analyse the evolution of the pandemic in markets worldwide from the start to the end of the first wave in each country. It also allows an estimation of the abnormal loss accumulated during this period and its statistical significance. Additionally, the traditional cross-sectional *t*-test for global and regional significance was performed. As a robustness check, the Fama and French 3-factor model (1993) is also used by adding the SMB and HML factors to verify whether these risk factors are capable of absorbing and explaining the effect of the pandemic on listed companies. For each country:

$$r_{it} = \alpha_{i0} + \beta_{i1} * r_{WORLDt} + \varphi_{i1} * SMB_t + \varphi_{i2} * HML_t + \sum_{j=0}^{N=Y} \delta_{ij} * D_j + \varepsilon_{it} \qquad (2)$$

$SMB_t$ and $HML_t$ being the risk factors Small Minus Big and High Minus Low related to the premium associated with small and value companies respectively. $\varphi_{i1}$ and $\varphi_{i2}$ are the coefficients of each factor for each index *i*.

## 2.2. Market sensitivity to new cases

As the information on new daily cases is available almost worldwide another way of testing on financial markets arises. This is basically an analysis of whether the stock market indices were sensitive to the new information given by health authorities it being understood that an increase in the number of cases should have a negative impact on index returns. Carrying out this analysis serves as a robustness check of the event study as well as a study of market efficiency in the face of new daily information. It also permits an estimate as to which countries and regions were more sensitive to the pandemic with a single indicator. In summary, this is a mean model, but a coefficient is added for daily increases in cases. For each country:

$$r_{it} = \theta_i + \gamma_i * \Delta \text{Cases}_{it} + \varepsilon_{it} \qquad (3)$$

$r_{it}$ has been defined above; $\theta_i$ is the constant of the model or the average daily return when there is zero growth in cases; $\gamma_i$ is the sensitivity of the index to growth in new cases; $\Delta \text{Cases}_{it}$ is the growth in cases: $\frac{Cases_t - Cases_{t-1}}{Cases_{t-1}}$. Cases being the accumulated cases of a given country on day *t* or *t*–1. Once again, $\varepsilon_{it}$ is the disturbance term. This equation is also extended as a robustness check including first the extended market model and then likewise the 3-factor model as explained in the previous section. This allows the identification of which nations and regions are still sensitive to an increase in cases after discounting all these risk factors.

**Table 2. Returns by region and other descriptive statistics of indices**

| | *n* | Mean | SD | Min | Q1 | Median | Q3 | Max | Kurtosis | Asym-metry |
|---|---|---|---|---|---|---|---|---|---|---|
| Europe | 4.009 | −0.0551 | 1.8672 | −18.5411 | −0.5945 | 0.0438 | 0.7752 | 10.4143 | 14.0898 | −1.8048 |
| Eastern Europe | 1.477 | −0.0665 | 1.7733 | −14.2456 | −0.5118 | 0.0108 | 0.6035 | 8.8251 | 14.0214 | −1.8984 |
| South America & Caribbean | 1.899 | 0.0399 | 2.7256 | −47.6922 | −0.5573 | 0.0000 | 0.6378 | 15.5390 | 56.8139 | −2.9799 |
| North America | 633 | −0.0118 | 2.0050 | −13.1758 | −0.4628 | 0.0489 | 0.6349 | 11.2945 | 12.4726 | −1.0445 |
| Asia (Not MENA) | 3.794 | −0.0384 | 1.5842 | −14.3224 | −0.5369 | 0.0000 | 0.5527 | 9.7984 | 11.7185 | −0.9488 |
| MENA | 2.496 | −0.0716 | 1.5061 | −28.7827 | −0.3658 | 0.0000 | 0.3727 | 21.4684 | 76.6867 | −2.5485 |
| Africa (Not MENA) | 2.110 | 0.0229 | 1.6985 | −14.5260 | −0.4473 | 0.0000 | 0.4291 | 15.3517 | 18.8995 | 0.7590 |
| Oceania | 422 | −0.0227 | 1.6322 | −10.2030 | −0.4377 | 0.0700 | 0.6133 | 6.9366 | 9.3494 | −1.1878 |
| World Index | 211 | 0.0109 | 1.8826 | −10.4412 | −0.3800 | 0.0944 | 0.6229 | 8.4062 | 10.7265 | −1.2267 |
| SMB | 211 | −0.0160 | 0.6852 | −5.3700 | −0.2350 | 0.0100 | 0.2800 | 2.0500 | 17.5090 | −2.3785 |
| HML | 211 | −0.1123 | 0.6883 | −2.7900 | −0.4150 | −0.1200 | 0.2150 | 2.3800 | 3.5084 | −0.1669 |

Notes: Statistics multiplied by 100 (except kurtosis and asymmetry). Kurtosis is the excess of kurtosis. The number of observations change according to the number of countries included.

Source: Own elaboration.

Table 2 shows the main statistics for returns by region and for the MSCI World Index, and the Fama and French risk factors. The sample is characterized by negative returns in mean (not in median), which may suggest a high concentration of losses due to a relatively high volatility and fat tails.

## 3. Results

The most relevant results of the research are presented below. The first point will present the results of the event study divided into the study originating from the first local case of coronavirus and the one originating from the declaration of a pandemic. The second will present the results of the time series analysis taking into account the different performance models used for this purpose. Finally, a brief comparison of the two methods will be presented highlighting which markets are winners and losers. Throughout the section the results are presented at a global level and subdivided by region in order to have a better view of the differences between countries. Also, in each table the significance of the global (and regional) average for each of the periods and coefficients is tested, as well as a detailed analysis of the negative cases.

### 3.1. Traditional event study

In this section, the average abnormal return of week $T$ is defined as AR($T$) and the accumulated abnormal returns between time 0 and week $T$ as CAR(0,$T$). Firstly, the question of how to interpret the data needs to be clarified as each country has a different event period. Two different approaches are taken. One is to take the week of the first case in each country as zero moment and accumulate the respective abnormal returns in the same way. Thus, the AR(0) for Cambodia is directly comparable to the AR(0) for Denmark although the former corresponds to the week of 27 January and the latter to the week of 24 February. In the corresponding tables only the first twelve weeks are shown because after that the sample drops dramatically. The other is to establish another reference point this being the week when the WHO declared the new coronavirus a pandemic as this was the most outstanding event to analyse. To do this it is necessary to order the data chronologically. That is to say that the zero moment is defined as 31 December 2019 and the weeks surrounding the declaration made on 11 March are analysed. It was during that same week in March when the highest number of lockdowns by country occurred (especially in Europe), so in addition to the effect recorded in reaction to the announcement is the effect of lockdown on investors' expectations.

Table 3 shows the abnormal returns for the first approach. Apart from the $F$-test to verify the joint hypothesis of global significance (abnormal returns different from zero), of particular interest is the number of individually negative as well as negative and significant countries. In the view of the authors, these indicators provide an overview of the number of countries affected.

Firstly, the daily average AR during week zero was −0.43%. This represents an important abnormal loss, where a country with a loss of 3 standard deviations above the mean would have suffered a daily fall of 3.39%. This bad performance is also verifiable through the number of countries with positive abnormal returns, just 28 out of 80. During weeks zero and one there is a concentration of nineteen national minimums, which is higher than the number that would be reached if they were equally distributed during the pandemic. This makes sense if weekly developments are observed. It is true that cumulative abnormal returns continue to decline throughout the event, but not at the same rate. During the first two weeks 34.21% of total accumulated returns had already been lost which is also much higher than the corresponding figure if the loss were accumulated equally. This means that a very significant part of the information that investors considered was present as the virus appeared in the different countries.

At the end of the period studied the global average CAR is −11.64%. Here a country with a loss of three standard deviations represented an abnormal loss of 53.38%. The number of countries with a negative performance increased consistently with only eleven countries above zero at the end and with more than 40% of CARs being negative and statistically significant. As shown in the rest of the panels abnormal performance is not equally distributed among the regions. Europe, Eastern Europe, and South America and the Caribbean worse than average data in all respects with Eastern Europe being the worst performer in the sample. Conversely, North America, Asia, MENA region, Africa and Oceania present better data than the global average. Nevertheless, North America and Oceania are the only ones with positive averages at some point during the event period.

Finally, the number of negative and significant coefficients may be misleading and appear small, but this is because it represents which countries had significant falls in that particular cumulative week or weeks. Taking the entire event period, it is observable that 92.50% of the countries had at least one week of significant negative abnormal returns, and 73.75% had at least two. The significance and generality of these poor results at the global level is in line with the results obtained by Ashraf (2021), Heyden and Heyden (2021), Pandey and Kumari (2021), or Ramelli and Wagner (2020), among others.

As the results using the 3-factor model do not alter the extended market model results to any great extent, the details are not reported here, but the graph illustrating the main difference (the average abnormal returns) is. Figure 1 shows that CARs in the 3-factor model are always higher than the extended market model, so the risk factors related to the size and book value explain a little more about loss due to the first wave of COVID-19. Overall, the results are still negative and statistically equally significant, but their economic significance is lower.

**Table 3. Abnormal and cumulative abnormal returns. First case week as week zero**

| | Panel A: World | | | | | | Panel B: Europe | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AR/CAR | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) |
| Sample | 80 | 80 | 80 | 80 | 77 | 70 | 19 | 19 | 19 | 19 | 19 | 19 |
| Mean | −0.429 | −3.982 | −4.420 | −8.895 | −10.292 | −11.641 | −0.649 | −4.829 | −5.631 | −9.322 | −12.724 | −13.884 |
| SD | 0.987 | 7.455 | 7.824 | 13.967 | 14.260 | 13.912 | 0.930 | 7.191 | 9.164 | 8.842 | 9.731 | 9.479 |
| Negative (%) | 65.0 | 72.5 | 73.8 | 77.5 | 81.8 | 84.3 | 73.7 | 84.2 | 78.9 | 84.2 | 94.7 | 94.7 |
| Negative & significant (%) | 36.3 | 38.8 | 32.5 | 37.5 | 40.3 | 41.4 | 57.9 | 42.1 | 47.4 | 31.6 | 52.6 | 52.6 |
| Avg Adj R2 | 0.435 | | | | | | 0.645 | | | | | |
| *F*-test | 4.383*** | 5.976*** | 6.153*** | 4.725*** | 4.604*** | 4.494*** | | | | | | |
| CS *t*-test | −3.886*** | −4.777*** | −5.052*** | −5.696*** | −6.333*** | −7.001*** | −3.045*** | −2.927*** | −2.678** | −4.595*** | −5.699*** | −6.384*** |
| | **Panel C: Eastern Europe** | | | | | | **Panel D: South America and the Caribbean** | | | | | |
| AR/CAR | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) |
| Sample | 7 | 7 | 7 | 7 | 7 | 7 | 9 | 9 | 9 | 9 | 9 | 7 |
| Mean | −1.214 | −10.652 | −10.290 | −18.905 | −20.005 | −20.340 | −0.941 | −9.381 | −8.561 | −8.848 | −8.627 | −14.179 |
| SD | 0.444 | 6.869 | 9.656 | 7.749 | 9.939 | 9.614 | 0.853 | 9.707 | 7.760 | 22.463 | 25.608 | 23.403 |
| Negative (%) | 100.0 | 100.0 | 85.7 | 100.0 | 100.0 | 100.0 | 88.9 | 88.9 | 88.9 | 77.8 | 77.8 | 85.7 |
| Negative & significant (%) | 85.7 | 85.7 | 71.4 | 57.1 | 57.1 | 57.1 | 33.3 | 44.4 | 44.4 | 44.4 | 44.4 | 57.1 |
| Avg Adj R2 | 0.511 | | | | | | 0.407 | | | | | |
| CS *t*-test | −7.227*** | −4.103*** | −2.819** | −6.455*** | −5.325*** | −5.597*** | −3.309*** | −2.899** | −3.309*** | −1.182 | −1.011 | −1.602 |

| | Panel E: North America | | | | | | Panel F: Asia | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AR/CAR | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) |
| Sample | 3 | 3 | 3 | 3 | 3 | 3 | 18 | 18 | 18 | 18 | 17 | 16 |
| Mean | 0.000 | 1.150 | 0.078 | −4.321 | −6.446 | −7.916 | −0.194 | −1.133 | −1.188 | −8.500 | −8.228 | −8.180 |
| SD | 0.389 | 1.861 | 2.931 | 10.762 | 12.161 | 13.747 | 1.001 | 6.302 | 4.845 | 17.058 | 15.665 | 16.382 |
| Negative (%) | 66.7 | 33.3 | 33.3 | 33.3 | 66.7 | 66.7 | 55.6 | 66.7 | 66.7 | 66.7 | 70.6 | 68.8 |
| Negative & significant (%) | 0.0 | 0.0 | 0.0 | 33.3 | 33.3 | 33.3 | 16.7 | 22.2 | 5.6 | 33.3 | 35.3 | 31.3 |
| Avg Adj R2 | 0.789 | | | | | | 0.314 | | | | | |
| CS *t*-test | −0.002 | 1.069 | 0.046 | −0.695 | −0.918 | −0.997 | −0.821 | −0.763 | −1.040 | −2.114** | −2.166** | −1.997* |
| | **Panel G: MENA** | | | | | | **Panel H: Africa** | | | | | |
| AR/CAR | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) |
| Sample | 12 | 12 | 12 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 8 | 4 |
| Mean | 0.056 | −1.997 | −4.233 | −9.664 | −8.865 | −9.781 | −0.306 | −3.495 | −2.982 | −2.914 | −6.629 | −6.458 |
| SD | 0.504 | 3.073 | 5.334 | 7.498 | 8.006 | 8.524 | 1.343 | 6.614 | 7.318 | 12.770 | 8.681 | 8.147 |
| Negative (%) | 41.7 | 66.7 | 83.3 | 91.7 | 83.3 | 91.7 | 60.0 | 60.0 | 70.0 | 70.0 | 75.0 | 75.0 |
| Negative & significant (%) | 16.7 | 33.3 | 41.7 | 58.3 | 25.0 | 25.0 | 30.0 | 30.0 | 20.0 | 20.0 | 25.0 | 25.0 |
| Avg Adj R2 | 0.286 | | | | | | 0.285 | | | | | |
| CS *t*-test | 0.388 | −2.251** | −2.749** | −4.465*** | −3.836*** | −3.975*** | −0.720 | −1.671 | −1.289 | −0.722 | −2.160* | −1.585 |

| | Panel I: Oceania | | | | | |
|---|---|---|---|---|---|---|
| AR/CAR | (0) | (0.1) | (0.2) | (0.9) | (0.10) | (0.11) |
| Sample | 2 | 2 | 2 | 2 | 2 | 2 |
| Mean | 0.440 | 4.035 | 2.132 | −5.736 | −7.195 | −5.796 |
| SD | 0.396 | 3.068 | 1.098 | 7.523 | 10.322 | 10.953 |
| Negative (%) | 0.0 | 0.0 | 0.0 | 50.0 | 50.0 | 50.0 |
| Negative & significant (%) | 0.0 | 0.0 | 0.0 | 0.0 | 50.0 | 50.0 |
| Avg Adj R2 | 0.519 | | | | | |
| CS *t*-test | 1.571 | 1.860 | 2.745 | −0.985 | −0.748 | −1.203 |

Notes: Abnormal returns and standard deviations multiplied by 100. Average data from the cross-section. F-test critical values for the joint hypothesis of global significance. CS test is the cross-sectional critical values for the global and regional significance hypothesis. ***, ** and * means significant at 1%, 5% and 10%, respectively.

Source: Own elaboration.

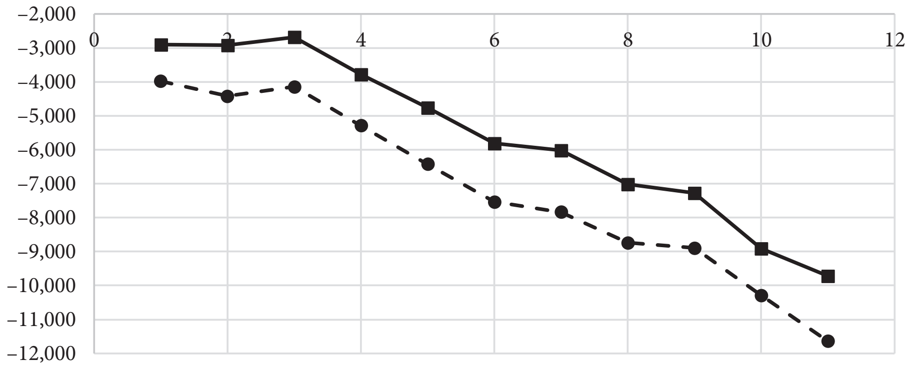


**Figure 1. Extended market model (dashed) vs. 3-factor model (solid)**
Notes: Average CAR (0,1) to CAR (0,11). All multiplied by 100.
Source: Own elaboration.

Table 4 shows the results regarding the weeks surrounding the pandemic declaration by the WHO. In this case four reference weeks are taken, from one week before the declaration to two weeks after. The reason for taking the previous week is because of the high concentration of minimums during that week which may lead the reader to suspect a certain anticipation on the part of economic agents. This would be consistent with the findings of Pandey and Kumari (2020) when they similarly analysed the announcement of a health emergency prior to the announcement of a pandemic. 59 out of 80 local minimums are concentrated in these four weeks and the high level of negative and negative and significant cases support this view as well. After analysing the full sample of the first wave of the pandemic, the worst weeks for the stock market worldwide are located—from 2 March 2 up to 27 March. These findings do not quite fit with those obtained by Narayan and others (2021) since it is in these weeks where the bulk of lockdowns are concentrated, a measure that according to that research is related to positive abnormal returns. Although it is possible that two opposite effects coexist (a positive one derived from the lockdowns and a negative one due to the announcement) and that depending on the sample, one predominates.

It is noteworthy that the most striking results correspond to week two after the pandemic announcement. It is the worst week globally and in five out of eight regions a maximum of 90% negative cases is reached with a maximum of almost 50% of the cases being statistically significant. The mean for this week implies an average additional loss of −0.86% daily during that week (−4.30% accumulated), with seventeen countries exceeding the −1.5% figure. This is especially true for the Europe panel. Meanwhile, the week corresponding to the announcement has an average of −0.61%, which in the case of Eastern Europe is almost three times lower and with a relatively low standard devia-

**Table 4. Abnormal and cumulative abnormal returns. Pandemic announcement as week zero**

| | Panel A: World | | | | | Panel B: Europe | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AR/CAR | (−1) | (0) | (2) | (−1,2) | (0,2) | (−1) | (0) | (2) | (−1,2) | (0,2) |
| Sample | 58 | 70 | 80 | 80 | 80 | 17 | 19 | 19 | 19 | 19 |
| Mean | −0.536 | −0.612 | −0.861 | −8.500 | −6.559 | −1.114 | −0.825 | −1.281 | −5.394 | −0.411 |
| SD | 0.790 | 1.113 | 1.087 | 8.433 | 8.148 | 0.377 | 1.212 | 0.673 | 7.699 | 8.306 |
| Negative (%) | 72.4 | 74.3 | 90.0 | 85.0 | 76.3 | 100.0 | 84.2 | 100.0 | 84.2 | 47.4 |
| Negative & significant (%) | 48.3 | 42.9 | 48.8 | 55.0 | 45.0 | 94.1 | 68.4 | 78.9 | 57.9 | 15.8 |
| Avg Adj R2 | 0.435 | | | | | 0.645 | | | | |
| *F*-test | 8.546*** | 12.497*** | 14.210*** | 10.335*** | 8.769*** | | | | | |
| CS *t*-test | −5.161*** | −4.602*** | **−7.085***** | −9.015*** | −7.200*** | −12.178*** | −2.967*** | −8.292*** | −3.053*** | −0.216 |
| | Panel C: Eastern Europe | | | | | Panel D: South America and the Caribbean | | | | |
| AR/CAR | (−1) | (0) | (2) | (−1,2) | (0,2) | (−1) | (0) | (2) | (−1,2) | (0,2) |
| Sample | 5 | 7 | 7 | 7 | 7 | 3 | 7 | 9 | 9 | 9 |
| Mean | −0.819 | −1.655 | −0.997 | −16.070 | −13.144 | −0.766 | −0.366 | −0.717 | −13.913 | −12.636 |
| SD | 0.890 | 0.684 | 0.742 | 8.340 | 7.796 | 0.929 | 0.918 | 1.773 | 5.725 | 4.667 |
| Negative (%) | 80.0 | 100.0 | 100.0 | 100.0 | 85.7 | 66.7 | 71.4 | 77.8 | 100.0 | 100.0 |
| Negative & significant (%) | 60.0 | 71.4 | 42.9 | 85.7 | 57.1 | 33.3 | 14.3 | 33.3 | 77.8 | 77.8 |
| Avg Adj R2 | 0.511 | | | | | 0.407 | | | | |
| CS *t*-test | −2.058* | −6.405*** | −3.558** | −5.098*** | −4.460*** | −1.428 | −1.054 | −1.213 | −7.291*** | −8.122*** |

| | Panel E: North America | | | | | Panel F: Asia | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AR/CAR | (−1) | (0) | (2) | (−1,2) | (0,2) | (−1) | (0) | (2) | (−1,2) | (0,2) |
| Sample | 3 | 3 | 3 | 3 | 3 | 15 | 16 | 18 | 18 | 18 |
| Mean | −0.264 | 0.248 | −1.087 | −7.438 | −6.119 | −0.163 | −0.181 | −0.679 | −8.295 | −7.616 |
| SD | 0.389 | 0.515 | 0.832 | 7.601 | 5.844 | 0.757 | 1.273 | 1.455 | 9.727 | 8.232 |
| Negative (%) | 66.7 | 33.3 | 100.0 | 66.7 | 66.7 | 46.7 | 56.3 | 77.8 | 77.8 | 77.8 |
| Negative & significant (%) | 33.3 | 0.0 | 66.7 | 66.7 | 66.7 | 20.0 | 31.3 | 44.4 | 44.4 | 44.4 |
| Avg Adj R2 | | | 0.789 | | | | | 0.314 | | |
| CS *t*-test | −1.174 | 0.835 | −2.263 | −1.695 | −1.814 | −0.834 | −0.570 | −1.981* | −3.618*** | −3.925*** |
| | Panel G: MENA | | | | | Panel H: Africa | | | | |
| AR/CAR | (−1) | (0) | (2) | (−1,2) | (0,2) | (−1) | (0) | (2) | (−1,2) | (0,2) |
| Sample | 11 | 12 | 12 | 12 | 12 | 2 | 4 | 10 | 10 | 10 |
| Mean | −0.287 | −0.689 | −0.375 | −7.712 | −6.398 | 0.719 | −0.348 | −0.895 | −4.870 | −5.589 |
| SD | 0.548 | 0.722 | 0.567 | 5.606 | 5.097 | 0.536 | 0.747 | 0.440 | 5.800 | 5.313 |
| Negative (%) | 81.8 | 83.3 | 83.3 | 91.7 | 91.7 | 0.0 | 50.0 | 100.0 | 70.0 | 80.0 |
| Negative & significant (%) | 27.3 | 41.7 | 25.0 | 50.0 | 50.0 | 0.0 | 25.0 | 40.0 | 30.0 | 40.0 |
| Avg Adj R2 | | | 0.286 | | | | | 0.285 | | |
| CS *t*-test | −1.735 | −3.307*** | −2.293** | −4.765*** | −4.348*** | 1.899 | −0.931 | −6.440*** | −2.656** | −3.327*** |

| | **Panel I: Oceania** | | | | |
|---|---|---|---|---|---|
| AR/CAR | (−1) | (0) | (2) | (−1,2) | (0,2) |
| Sample | 2 | 2 | 2 | 2 | 2 |
| Mean | −0.393 | −0.616 | −1.084 | −13.479 | −11.516 |
| SD | 0.977 | 0.159 | 0.463 | 8.681 | 3.795 |
| Negative (%) | 50.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Negative & significant (%) | 50.0 | 0.0 | 50.0 | 50.0 | 100.0 |
| Avg Adj R2 | 0.519 | | | | |
| CS *t*-test | −0.568 | −5.484 | −3.313 | −2.196 | −4.292 |

Notes: See Table 3.

Source: Own elaboration.

tion. Compared with the previous table any one of these three weeks represents lower abnormal returns than those estimated using the week of the first infections as week zero.

With respect to the CARs, the global minimum corresponds to the estimate including week minus one. During these weeks a country with a CAR three standard deviations below the average obtained a result of –33.80%, a loss of one third of its total value. Once again, this underperformance is not equally distributed and is particularly negative for Eastern Europe, South America and the Caribbean and Oceania. To illustrate the economic importance of these results it is observable that the size of the CARs associated with these three to four weeks are very similar to those accumulated over ten weeks starting from the first local contagion. For instance, if the previous CAR (0,11) represents the total abnormal loss associated with this period, 73% of it occurred during these four weeks. It should be remembered that the majority of total lockdowns also took place during these weeks.

Finally, these data show that three months after the first global contagion in China, investors were still discounting the effects of the pandemic and the measures taken to deal with it illustrating that the severity of the pandemic could not have been foreseen in the financial markets at the outset. As discussed previously, it is not the first time that such a sustained reaction over time to an extreme event is documented and in fact Bourdeau-Brien and Kryzanowski (2017) showed that the worst effects of natural disasters were noticeable in the market up to two and three months after the tragedy.

## 3.2. Market sensitivity to new cases

The following section shows and discusses the results for the sensitivity of stock market indices to the daily increase in Coronavirus cases. This part of the research has a major advantage over the traditional estimation of the event study in that it provides a single indicator of how this health, economic and political crisis affected the stock market. However, it also has two drawbacks to consider in order to interpret the data correctly. First, the evolution of the pandemic over time cannot be observed as it summarises the whole period in a single coefficient and second, the coefficient obtained is directly related to daily growth data. This is not to say that it is not relevant data in itself, but in order to know the real daily infection growth it is also necessary to know the average daily growth of cases.

Table 5 shows the results for the mean model just including a constant. The mean is the cross-sectional average of the $\gamma_i$ coefficient, the standard deviation of these coefficients is also shown as well as the same relevant figures presented in the traditional event study: negative cases, negative and significant cases, the average adjusted *R*-square and the *F*-test for global significance. The sample is the same as in the event study.

**Table 5. Sensitivity to new cases**

| | World | Europe | Eastern Europe | South America and the Caribbean | North America | Asia | MENA | Africa | Oceania |
|---|---|---|---|---|---|---|---|---|---|
| Mean | –0.887 | –0.934 | –1.287 | –1.436 | –0.393 | –0.664 | –0.492 | –0.766 | –2.294 |
| SD | 0.864 | 0.684 | 0.599 | 0.866 | 0.320 | 0.620 | 0.638 | 1.233 | 1.186 |
| Negative (%) | 88.8 | 94.7 | 100.0 | 100.0 | 66.7 | 88.9 | 75.0 | 80.0 | 100.0 |
| Negative & Significant (%) | 70.0 | 94.7 | 100.0 | 66.7 | 66.7 | 55.6 | 41.7 | 60.0 | 100.0 |
| Avg Adj R2 | 0.061 | 0.071 | 0.101 | 0.087 | 0.025 | 0.034 | 0.067 | 0.040 | 0.070 |
| *F*-test | 25.075*** | | | | | | | | |
| CS *t*-test | –9.179*** | –5.953*** | –5.685*** | –4.974*** | –2.126 | –4.543*** | –2.669** | –1.964* | –2.736 |

Notes: Coefficients multiplied by 100. See Table 3.

Source: Own elaboration.

The global sensitivity to new cases is about –0.89% which means that for an increase of 1% in daily cases the average world returns declined by 0.0089%. Considering the average increase in cases during the pandemic (19.98%) the average daily decline of world stock indices is 0.1778%. This number is impressive considering that it is a daily figure and that the local minimum number of months in the sample is about three. This high incidence can also be seen in almost the entire sample with only nine countries obtaining a positive coefficient and 56 obtaining a negative and significant coefficient. It should also be borne in mind that individual significance takes into account the volatility of each stock index and it is very high in a large proportion of the sample. As an example, it is 2.98% in Brazil and 0.78% in Malta and it is significant in both countries.

As in the event study there are large differences across regions. As the whole event is concentrated in one data point there are no positive coefficients here, but North America, Asia, the MENA region and Africa are above average in all indicators, especially North America. Previously, Oceania was one of the best performing regions in terms of abnormal performance, but now it is the one with the highest negative sensitivity. It should not be forgotten that it contains only two countries and although a country may have obtained a very high sensitivity to new COVID cases if few new cases occur the overall effect (which is observable through the ARs) is still small.

Compared to the previous tables the first thing that stands out is the low standard deviations in relation to their mean. The coefficient of variation of the global sensitivity coefficient is –0.97 while for the AR (0) it was –2.30, or –1.20 for the CAR (0,11). The level of negative cases which exceeds 80% in six regions is also a notable difference as is the increase in the number of these cases being statistically significant in some instances as much as double the number of abnormal returns. The explanatory power of this model is small compared to the figures of over 30% in the event study where at most 10% (Eastern Europe) is explained. This was to be expected taking into consideration that the model only includes the constant and the growth variable and leaves out the market index.

In summary, this all fits with the fact that the entire pandemic is reduced to one indicator per country; it produces more uniform results and makes it easier to determine the negative global incidence of COVID-19. Although the model is not very explanatory its statistical significance is robust and economic significance is of large effect for any of the coefficients. Overall, these data support those found by Ashraf (2020) or Seven and Yilmaz (2020) but without forgetting that there are large differences across regions which is also often detected in the stock market after extreme events (Davies & Studnicka, 2018; Shahzad et al., 2019; Angosto-Fernández & Ferrández-Serrano, 2020).

Table 6 presents the results of the regression incorporating the extended market model. While the above model proves that most capital markets reacted to new information about the pandemic it is also informative to test whether

**Table 6. Sensitivity to new cases (extended market model)**

| | World | Europe | Eastern Europe | South America and the Caribbean | North America | Asia | MENA | Africa | Oceania |
|---|---|---|---|---|---|---|---|---|---|
| Mean | −0.477 | −0.460 | −0.458 | −0.663 | 0.197 | −0.526 | −0.335 | −0.461 | −1.911 |
| SD | 0.618 | 0.500 | 0.808 | 0.562 | 0.337 | 0.477 | 0.560 | 0.775 | −0.809 |
| Negative (%) | 82.5 | 100.0 | 85.7 | 88.9 | 66.7 | 83.3 | 58.3 | 70.0 | 100.0 |
| Negative & Significant (%) | 51.3 | 73.7 | 57.1 | 55.6 | 0.0 | 44.4 | 33.3 | 40.0 | 100.0 |
| Avg Adj R2 | 0.404 | 0.592 | 0.468 | 0.349 | 0.778 | 0.290 | 0.287 | 0.268 | 0.482 |
| *F*-test | 11.127*** | | | | | | | | |
| CS *t*-test | −7.862*** | −4.622*** | −1.967* | −5.762*** | 0.924 | −4.156*** | −2.408** | −2.162* | −3.553 |

Notes: Coefficients multiplied by 100. See Table 3.

Source: Own elaboration.

the variables incorporated in this model (related to the global market and to domestic performance) are able to absorb the shock.

The mean sensitivity coefficient increases considerably across the sample with the exception of Oceania, which is quite similar. For example, the second lowest coefficient (-0.66) falls short of the global average above. Above all, North America led by Mexico has a positive performance. The levels of negative coefficients in the sample remain very close to the previous model, but the proportion of significant data does fall considerably. This makes sense because some of this variability is now explained by the relationship of firms in that country with the world market. Despite this fact which may suggest a certain predictability of returns the coefficients are still of great statistical and economic significance for most of the sample. The world average increase in cases was penalised with a returns' decline of 0.095 daily.

These data which are more comparable with the event study do not present major changes with respect to what was previously discussed with the exception of the substantial change in the coefficients of determination. They are even lower than those obtained in the abnormal returns model (the world average is 40.37% vs. 43.52% and is only higher for the MENA region). Therefore, providing a model that incorporates weekly abnormal returns and allowing for temporal evolution is more descriptive. This makes sense, but neither are these coefficients very high for the amount of additional information they incorporate. On average the results obtained show that sensitivity to the increase in cases explains 93% of what the traditional event study is capable of explaining. The results regarding the 3-factor model are not reported because they do not alter the results shown in this table except for slight increases in the coefficients and positive cases and slight decreases in the coefficients of determination.

### 3.3. Winners and losers: Model comparison:

The next two tables present the countries most affected during the first wave of the pandemic. The first table shows the countries with the lowest and the highest cumulative returns. To do so the CAR (0,9) is taken because it is the last figure that contains the full sample (80 countries) and only those CARs that are statistically significant at 10% are reported. Both Venezuela and Zimbabwe have CARs higher than 30%, but they are excluded since they reported inflation rates higher than 500%. Table 7 shows the overall negative effect with only three countries showing significant positive data (five if the high-inflation countries are included) and interestingly, one of them is the country where the first outbreak of the virus was detected. Observable is also the dispersion of Asian data which tops the list of gainers and losers with figures exceeding –40%, an abnormal loss of close to half the value of the index in just ten weeks.

In Table 8 again winners and losers are compared, but according to the size of the sensitivity coefficient obtained in the mean model. In addition, panel B

**Table 7. Largest cumulative abnormal returns (extended market model)**

| Lowest | | Highest | |
|---|---|---|---|
| Sri Lanka | –45.211 | Thailand | 20.209 |
| Cambodia | –40.185 | China | 18.233 |
| Brazil | –37.520 | Argentina | 15.674 |
| Colombia | –34.541 | Jordan | –8.092 |
| Greece | –33.505 | Tunisia | –8.355 |

Notes: Using CAR (0,9) multiplied by 100. Only significant abnormal returns.

Source: Own elaboration.

considers the economic effect and corrects these coefficients for the mean of the independent variable data. Among the countries most sensitive to the increase in caseloads are Namibia and Australia which disappear in panel B. This is due to a much lower economic effect because the increases in caseloads were very low with relatively low total caseloads. However, the column of winners remains almost unchanged. This is consistent with the explanation that cultural factors, such as fear, have a significant influence on the financial market (Ashraf, 2021; Fernández-Pérez et al., 2021). Some countries are highly sensitive to the increase in cases despite having few cases compared to other countries.

With respect to the above table there is no comparison whatsoever with countries with higher values. This can be explained by the delay in registering the first case in each country as the results of this second table depend directly on this fact and it is not the same to have cases concentrated in three weeks as in ten weeks. Moreover, it should be remembered that data that are statistically significant in one model do not necessarily have to be significant in another. The

**Table 8. Most sensitive countries (mean model)**

| Panel A: Largest coefficients | | | | Panel B: Mean adjusted coefficients | | | |
|---|---|---|---|---|---|---|---|
| Lowest | | Highest | | Lowest | | Highest | |
| Namibia | –3.758 | Netherlands | –0.048 | Brazil | –0.808 | Netherlands | –0.018 |
| Australia | –3.480 | Italy | –0.082 | Colombia | –0.799 | Italy | –0.052 |
| Brazil | –2.886 | Cote d'Ivore | –0.274 | Greece | –0.541 | Cote d'Ivore | –0.064 |
| Colombia | –2.838 | Germany | –0.318 | Morocco | –0.493 | Germany | –0.065 |
| Greece | –2.760 | Egypt | –0.375 | South Africa | –0.485 | Sri Lanka | –0.074 |

Notes: Only significant coefficients. Largest coefficients are the $\gamma i$ from the mean model equation. Mean adjusted coefficients are the $\gamma i$ from the mean model equation multiplied by the average daily growth in cases. All coefficients multiplied by 100.

Source: Own elaboration.

disappearance of Sri Lanka and Cambodia is explained by the fact that their stock indices fell significantly in the first ten weeks, despite having a very low incidence of cases (1633 and 125 respectively as of 1 June); hence the sensitivity coefficient is very small or not significant. In the view of the authors the excessive incidence in these countries in relation to the few reported cases may be due to an interdependent relationship which would be consistent with the contagion effect found after the Japan earthquake (Valizadeh et al., 2017), for example, with more affected countries and/or to investors estimating a higher number of infections than the authorities. Furthermore, this limits the ability of the coefficients associated with the cases as estimators of COVID-19 impact, as they are used in the research of Alkhatib and others (2022).

The next two figures (maps) are presented below to allow an appreciation of the difference between markets most affected in terms of capitalisation loss (Figure 2) and those most case-sensitive (Figure 3). The first corresponds to the abnormal performance during the four weeks around the pandemic declaration and the second shows the coefficients of sensitivity to the model of mean cases. In both maps black represents non-significant coefficients and grey countries are out of the sample.

The vast majority of markets are sensitive to the increase in cases while in the case of CARs (–1,2) a higher amount of non-significant data is observable including important markets such as the USA, the UK, China or India. It is particularly striking that China and part of Southeast Asia are not significant in either case. This could be because the estimation period for these countries is too long (from the first case to 1 June); however, this is not the case as changes to the event period were implemented reducing it to 1 April and virtually all

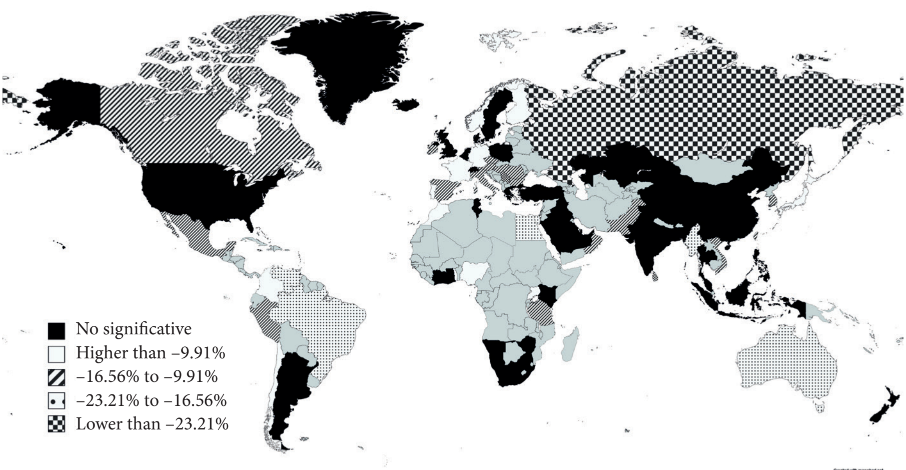


**Figure 2. Cumulative Abnormal Returns from week –1 to 2 (CAR (–1, 2)). Pandemic week. Full sample**

Source: Own elaboration based on regression data. Thanks to mapchart.net.

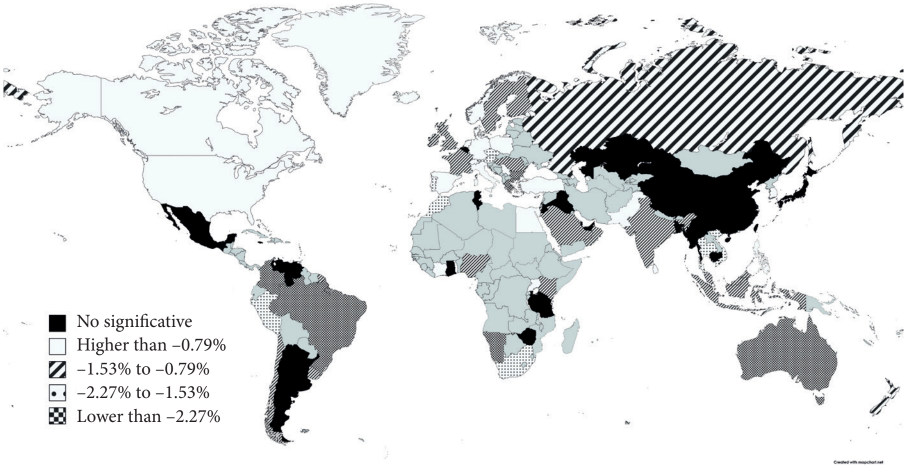


**Figure 3. Returns sensitivity coefficient to new cases (Mean model). Full sample**
Source: Own elaboration based on regression data. Thanks to mapchart.net.

results prevail. In summary, investor fear of the pandemic is widespread globally with a sample covering more than 98% of global capitalisation, but there are large regional differences and notable country exceptions.

## Conclusions

The current epidemic is unheard of for most of us and is not only causing a global health crisis, but also a political and economic one which is why it needs to be investigated in all disciplines including finance. In this regard, this paper tries to contribute to the research about the effect of this crisis on financial markets.

The two experiments presented here show evidence of the negative effect of COVID-19 on the global stock market but find notable differences between countries and regions. The study of the event highlights the particularly negative influence in the regions of Europe, Eastern Europe and South America and the Caribbean with countries having negative abnormal returns of more than 30%. It is also notable that the largest proportion of losses were concentrated in the weeks around the WHO announcement. The analysis of the growth in cases illustrates the negative and significant relationship with returns almost everywhere in the world and it is robust to the introduction of different return models. The economic effect of the growth in cases is enormous. Comparing the different experiments two findings stand out: the striking differences between the countries with the worst abnormal returns and those with the highest negative sensitivity to growth in cases; and the absence of statistical significance in countries that would have been preliminarily included among the most affected.

This research complements other studies in the same direction and could be followed by further research into the underlying causes of these differences. For example, different investment cultures or interdependence between markets which could explain why some indices are so affected despite the low local incidence of the virus. Likewise, the comparison made here may help other academics to know which method to choose depending on the objective of the research. Finally, the competent authorities may also benefit from some of these results, especially those markets that, despite not having a notable increase in cases did suffer a strong negative stock market effect since they should evaluate their interdependence with other stock markets. It is also interesting to reflect on the WHO pandemic announcement since it is striking that the bulk of the losses are concentrated around that date and not around the date of the first local case. This fact has implications on how important it is for public information to be truthful and published in a timely manner.

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