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The influence of extreme events such as Brexit and Covid-19 on equity markets

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Abstract

In this article first, we show that the result that the PIIGS group had the largest negative unadjusted and abnormal returns on the day following the Brexit Referendum is robust to taking into account jointly other extreme events such as the Covid-19. Second, we provide evidence that the impact of the declaration of Covid-19 to be a global pandemic by the WHO – when global markets fell by nearly 15% – had a total different reaction in the financial markets to the one following the Brexit Referendum, impacting more negatively in countries where quarantine lockdowns were announced that day (i.e. Austria, Belgium, Brazil, Canada, Italy and Spain), independently on their debt-to-GDP ratio. We also show that the day after Covid-19 was declared as a global pandemic, China and Japan (countries that already implemented lockdowns in the previous months) were the only analyzed countries that did not experience any evidence of abnormal returns in their financial markets. Moreover, during the three following days, the US was the only analyzed country showing no evidence of negative abnormal returns due to the declaration of the national emergency. These results suggest that government policies must take into account and monitor specially health-related news at global level, since they can have enormous impacts on portfolio allocations on stock markets, in order to take more informed decisions.

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1. Introduction

Jouini (2013), studying data for Saudi Arabia over the weekly period from January 10, 2007 until September 28, 2011, and Cevik et al. (2020), analyzing weekly data for Turkey from 1990 until 2017, concluded that crude oil prices have significant effects on stock market returns; and therefore government policies must take into account risk spillover effects between markets and that investors are better off monitoring crude oil markets in portfolio allocation decisions. This is a very clear example of the great relevance, from the policy point of view, of studying how different types of news can impact stock markets, in order for policy makers, market participants and investors to take more informed decisions.

There is a very well established literature about how different types of news can impact stock markets. We can start with a seminal paper of Mitchell and Mulherin (1994) where they show that the number of Dow Jones announcements and stock market returns are directly related. Lekhonen and Heimonen (2015) studied the impacts of democracy and political risk on stock market for forty nine emerging markets during the period 2000–2012. Acemoglu et al. (2018) documented that more intense protests during Mubarak’s government in Egypt were associated with lower stock market valuations for firms connected to the group currently in power relative to non-connected firms, but had no impact on the relative valuations of firms connected to rival groups. Blanchard et al. (2018) analyzed the impact of the United States (US) presidential election in November 2016 in the US stock market, while Pástor and Veronesi (2020) showed that we have higher average stock market returns under Democratic presidencies in the US. And more recently, Ghasasmejed and Jahan-Parvar (2021) provided a detailed analysis of the impact of financial sanctions on publicly traded companies.

In this paper we want to focus on the evolution of stock markets in the last decade, both at global and country level, and in special, we analyze the two most important extreme events that have impacted the stock market. Graph 1 shows the evolution of daily returns from the Morgan Stanley Capital International (MSCI) global price index (RMSCI) from 2012 to 2021, and it is evident that there are only two events that generated a fall of global equity markets of more than 5% in the last decade: the news from the Brexit Referendum and the declaration of Covid-19 to be a global pandemic by the World Health Organization (WHO). Both extreme events can be identified if we apply well known rules such as being observations with absolute median deviations larger than three times the interquartile range (see Stock & Watson, 2005). Indeed, global equity markets fell by nearly 5% overall on June 24, 2016 following news of the Brexit Referendum (see Burdekin et al., 2018) on June 23, 2016. This was believed at that point to be the largest single-day loss in
absolute value ever experienced on world markets and Davis (2016) estimates that it also drove global economic policy uncertainty to record highs. However, on March 11, 2020 a new extreme event impacted global markets: the Covid-19 was declared as a global pandemic by the WHO (see Zhang et al., 2020), making an even larger (than with the Brexit) single-day loss when global markets fell by nearly 15% (see e.g. Barro et al., 2020; Zhang et al. 2020). This event provided evidence of the enormous impact that health-related news can have on stock markets. In this paper we want to study in more detail the impact of both extreme events (Brexit and Covid-19) in the financial markets, not only at global level, but also in different countries.

The impact of the Brexit Referendum on the stock market has already been considered in the literature by several authors. Burdekin et al. (2018) analyzed the consequences of Brexit on Global Equity Markets. Their main conclusion was that although nearly all European Union (EU) stock market indices experienced additional significantly negative abnormal returns, especially poor performance on average was registered by the debt ridden PIIGS group (Portugal, Ireland, Italy, Greece, and Spain). They found that both the unadjusted returns and the abnormal returns for those PIIGS countries confirm that result. However, Burdekin et al. (2018) only analyzed a daily sample size from January 6, 2016 through June 30, 2016. We show in this paper that their result is robust to using a much larger sample size and taking into account other extreme events jointly as the impact of Covid-19. More recently, Fisman and Zitzewitz (2019) documented positive abnormal returns in the stock market in the United States during the Brexit Referendum confirming that stock markets move following political and business news. We also confirm this result in the US in our analysis by taking jointly a second extreme event such as the Covid-19.

The second of the extreme events that we consider, the impact of Covid-19, has not been analyzed in detail in the literature under the best of our knowledge. Caggiano et al. (2020) showed the global effects of Covid-19 induced uncertainty. In this paper we show that the impact of the declaration of Covid-19 to be a global pandemic had a total different reaction in the financial markets to the one following the Brexit Referendum, impacting more negatively in those countries where quarantine lockdowns were announced that day (i.e. Austria, Belgium, Brazil, Canada, Italy and Spain), independently on their debt-to-GDP ratio. We also show that the day that Covid-19 was declared as a global pandemic, China and Japan (countries that already implemented lockdowns in the previous months) did not experience evidence of abnormal returns in their financial markets. Moreover, we provide evidence that during the three days after declaring the global pandemic, the US was the only analyzed country showing no evidence of negative abnormal returns, being therefore the only country that financial markets were trusting during those three days to provide a positive reply to the pandemic after the declaration of the national emergency on March 13, 2020 (see Ananyev et al., 2021). As shown in Salvatore (2020), since his election, President Trump has reduced U.S. taxes and regulations and increased expenditure for infrastructures and the military. These policies did increase U.S. growth but only temporarily and led to much higher budget deficits. Along the same lines, we show that during the first three days after declaring the Covid-19 a pandemic, financial markets in the US did not show evidence of negative abnormal returns, due to the declaration of the national emergency in the US. Indeed, as shown in Ananyev et al. (2021), “...From a policy standpoint, the most important implication of the national emergency was a fiscal one: it became easier for Federal Emergency Management Agency to transfer money to the states. It has freed up as much as $50 billion in financial resources. The importance of this move can also be perceived from how the stock market has reacted. Stock markets had their largest single-day gain since October 2008...” . Although also, that effect was only temporary.
The plan of the paper is as follows. Section 2 describes the data that will be used. Section 3 provides the empirical results by using the basic model and several robustness procedures, and finally Section 4 concludes. Graphs 2–4 are available in an online appendix.

2. Data

First we need to find a proxy of the global market returns, and we drew daily data on an MSCI global price index \(^1\) (denoted MSCI\(_t\)). Data for MSCI was only available from September 10, 2012 onwards and this has limited the beginning of the sample size of our analysis. We finished our database on December 15, 2021 (see Graph 1).

In relation to the selected countries, we use daily data\(^2\) of returns of a total of 24 countries that include the same eleven European countries included in Iglesias (2015) (we use the value at the moment of the closing of each daily session). Following Burdekin et al. (2018), we also add stock market indexes for the necessary countries to study the PIIGS, BRICS (Brazil, Russia, India, China, and South Africa) and some other parts of America (Brazil, Canada, Chile, United States), Asia/Oceania (Australia, India, China and Japan) and Africa (South Africa). Burdekin et al. (2018) analyzed 64 countries but only during 6 month of daily data. In our case, we selected the 24 countries where we could have access (due to data limitations), and we analyze a daily sample from 2012 to 2021.

Following Iglesias (2015), if we denote \(p_t\) the stock market index of country \(p\) at period \(t\), then we construct the return of country \(p\) at period \(t\) (denoted \(R_{p_t}\)) as

\[
R_{p_t} = \ln(p_t/p_{t-1})
\]

where \(t=1,\ldots,T\) and \(T\) is all the available sample size. We also denote \(RMSCI_t = \ln(MSCI_t/MSCI_{t-1})\).

Table 1 shows the results of some descriptive statistics, while Graphs 2–4 show the evolution of the returns for each country. From Table 1, we confirm the results of Burdekin et al. (2018), where the largest negative effects from the Brexit Referendum occurred within the EU and in special in the PIIGS group, where they had losses on June 24, 2016 of \(-7.25\%\) for Portugal, \(-8.05\%\) for Ireland, \(-13.33\%\) for Italy, \(-14.41\%\) for Greece, and \(-13.19\%\) for Spain. On the other hand, the BRICS countries Brazil, Russia, India, China and South Africa fell on average significantly less than the 5.2\% average global benchmark decline on the day after the UK Referendum. From Table 1 we see that Brazil had losses of \(-2.86\%\), \(-1.83\%\) for Russia, \(-2.26\%\) for India, \(-1.31\%\) for China and \(-11.94\%\) for South Africa. South Africa is an exception in the BRICS countries since it is the primary trading partner of the U.K. on the continent of Africa (see e.g. Fedderke et al., 2012; Boshoff & Fourie, 2017).

Graph 2 shows how for the PIIGS group, Portugal, Italy and Spain suffered a much higher loss during the Covid-19 than during the Brexit Referendum shock (following the general pattern

\(^1\) Obtained from the financial database https://stooq.com.

\(^2\) The data has been obtained from the finance.yahoo database: http://es.finance.yahoo.com and from the financial database https://stooq.com. In more detail, we use data on the German DAX, Austrian ATX, Belgium Bel20, Spanish IBEX35, French CAC40, Dutch AEX, the Irish ISEQ, the Swedish OMX Stockholm 30 Index, the Greek ATHEX Composite Index, the Italian FTSE MIB Index, the British FTSE 100, the Portuguese PSI 20, the Brazilian IBOVESPA, the Russian MOEX, the Indian BSE SENSEX, the Chinese SSE, the South-african FTSE/JSE, the Canadian S&P/TSX, the Chilean IPSA, the American S&P500, the Finish OMX, the Japanese Nikkei 225, the Australian S&P ASX 200 and the OXE from Norway.
Table 1
Descriptive statistics and unadjusted returns for three days following the Brexit Referendum and the declaration of Covid-19 as a global pandemic by the WHO.

| Returns       | Mean   | Std. Dev. | 6/24/16 | 6/27/16 | 6/28/16 | 3/12/20 | 3/13/20 | 3/16/20 |
|---------------|--------|-----------|---------|---------|---------|---------|---------|---------|
| MSCI          | 0.063% | 0.011     | −5.241% | −2.456% | 1.913%  | −10.789%| 7.547%  | −12.070%|
| Africa        |        |           |         |         |         |         |         |         |
| South Africa  | 0.040% | 0.018     | −11.944%| 4.736%  | 2.113%  | −7.508% | −7.020% | 4.966%  |
| America       |        |           |         |         |         |         |         |         |
| Brazil        | 0.024% | 0.017     | −2.862% | −1.729% | 1.533%  | −15.993%| 13.022% | −14.991%|
| Canada        | 0.040% | 0.010     | −1.709% | −1.465% | 1.111%  | −13.176%| 9.218%  | −10.409%|
| Chile         | −0.010%| 0.013     | −1.429% | −0.738% | −6.543% | 0.960%  | −15.216%|
| United States | 0.070% | 0.011     | −3.658% | −1.826% | 1.761%  | −9.995% | 8.881%  | −12.765%|
| Asia/Oceania  |        |           |         |         |         |         |         |         |
| Australia     | 0.026% | 0.011     | −3.232% | 0.468%  | −0.662% | −7.643% | 4.329%  | −10.203%|
| China         | 0.001% | 0.013     | −1.311% | 1.441%  | 0.580%  | −1.529% | −1.241% | −3.459% |
| India         | 0.031% | 0.011     | −2.264% | 0.020%  | 0.460%  | −8.532% | 3.964%  | −8.291% |
| Japan         | 0.039% | 0.014     | −8.253% | 2.361%  | 0.091%  | −4.511% | −6.274% | −2.492% |
| Europe        |        |           |         |         |         |         |         |         |
| Austria       | 0.047% | 0.013     | −7.302% | −4.706% | 1.970%  | −14.675%| 0.478%  | −11.052%|
| Belgium       | 0.041% | 0.012     | −6.613% | −4.149% | 2.153%  | −15.328%| 1.029%  | −7.349% |
| Finland       | 0.037% | 0.011     | −8.160% | −8.160% | 2.651%  | −10.788%| −1.488% | −5.540% |
| France        | 0.051% | 0.012     | −8.384% | −1.879% | 1.442%  | −13.098%| 1.816%  | −5.924% |
| Germany       | 0.045% | 0.012     | −7.067% | −3.065% | 1.909%  | −13.055%| 0.771%  | −5.452% |
| Greece        | 0.040% | 0.020     | −14.413%| −2.932% | 3.653%  | −11.217%| 2.461%  | −13.058%|
| Holland       | 0.052% | 0.011     | −5.873% | −3.010% | 1.421%  | −11.376%| 0.173%  | −3.786% |
| Ireland       | 0.043% | 0.012     | −8.051% | −10.416%| 2.787%  | −10.465%| 0.438%  | −8.257% |
| Italy         | 0.052% | 0.015     | −13.331%| −4.024% | 3.244%  | −18.541%| 6.874%  | −6.299% |
| Norway        | 0.071% | 0.011     | −2.956% | −3.044% | 2.342%  | −9.504% | 3.619%  | −5.619% |
| Portugal      | 0.001% | 0.012     | −7.247% | −2.366% | 2.282%  | −10.267%| 0.823%  | −4.459% |
| Russia        | 0.055% | 0.012     | −1.833% | −2.291% | 0.838%  | −8.646% | 1.303%  | −2.159% |
| Spain         | 0.011% | 0.014     | −13.185%| −1.843% | 2.448%  | −15.151%| 3.667%  | −8.208% |
| Sweden        | 0.047% | 0.011     | −8.800% | 2.569%  | −11.173%| 1.783%  | −3.497% |
| United Kingdom| 0.019% | 0.011     | −6.441% | −0.841% | 3.667%  | −10.083%| 0.668%  | −4.703% |

shown in Graph 1 for global equity markets). However Ireland (and Greece) had an equal (or even smaller) impact during the Covid-19 event than during the Brexit Referendum. Ireland was very linked to the outcome from the Brexit Referendum due to the links with the United Kingdom (UK). On the other hand, the result of the Brexit Referendum had a very large and negative impact in Greece due to the negative impact on tourism and an increase in the doubts about the future of the Greek rescue program in case the UK was exiting the EU. Graph 2 also shows that Italy and Spain had the largest negative impacts due to the Covid-19 out of the PIIGS countries.

Graph 3 shows that all BRICS countries followed a similar rule to global equity markets (see Graph 1) where the impact of the Brexit Referendum was smaller than the one of Covid-19. South Africa was the exception, since it is the primary trading partner of the UK in Africa. The Chinese stock market had also a higher negative impact during 2015 than during the Covid-19. During 2015, there was a slowing growth of the Chinese Gross Domestic Product (GDP), a fall of petroleum prices, the Greek debt default in June 2015 and the end of quantitative easing in the US. And all these events impacted very negatively specially in the Chinese stock market (see Graph
Graph 3 also shows that Brazil had the largest negative impact of declaring the Covid-19 to be a pandemic out of the BRICS countries. Graph 4 shows that all the rest of the analyzed countries follow the general pattern in global equity markets that the impact of the Brexit Referendum was smaller than the impact of declaring the Covid-19 as a pandemic, with the only exception of Japan. Japan considered the UK its gateway to Europe, particularly in economic matters. And depending on the outcome of the Brexit Referendum, Japan may lose some of that access, what explains the very large negative impact of the Brexit Referendum on the Japanese stock market. Graph 4 also shows that specially Austria, Belgium, Canada and Chile were the stock markets with the largest negative impact of Covid-19 being a pandemic. In Chile, the largest negative impact was at the third day after declaring the Covid-19 to be a pandemic.

3. Models and empirical results

3.1. The baseline model

Following Burdekin et al. (2018), we start by assessing the impact of the Brexit vote and the Covid-19 as a global pandemic on global equity markets using an event study approach (see MacKinlay, 1997). This methodology is well suited to both extreme events as they clearly came as a surprise. Then, we specify the following Capital Asset Pricing Model (CAPM) based regressions for time period $t$ and each of the 24 countries $p$

$$R_{pt} = \alpha_p + \beta_p \text{RMSCI}_t + \beta_{p24} D_{24} + \beta_{p27} D_{27} + \beta_{p28} D_{28}$$
$$+ \beta_{p12} D_{12} + \beta_{p13} D_{13} + \beta_{p16} D_{16} + \epsilon_{pt}$$

where $D_j$ are dummy variables that are equal to 1 on $j = 24, 27, 28$ of June 2016 and $j = 12, 13, 16$ of March 2020. Note that Eq. (1) is a very simple theoretical model in its conception, but also it is appropriate to simulate in stochastic terms the impact of extreme events. Moreover, and as we will show later, the results that we obtain with Eq. (1) are robust to using more complex multivariate extensions. In Eq. (1), since we are analyzing global equity markets and data from 2012 – where interest rates have been generally very low until nowadays –, we decided not to include a measure of the risk-free rate (following then a Black, 1972 version of the CAPM). Moreover, we only included one factor (i.e. RMSCI) due to the complexity of introducing additional factors such as market, size, book to market, profitability and investment (see e.g. Fama & French, 1992, 2015) when we are dealing with stock market indexes from several countries.

Table 2 shows the results of estimating Eq. (1) by ordinary least squares and applying Heteroskedasticity- and autocorrelation-consistent (HAC)-adjusted standard errors following Newey and West (1987) (the results are also robust when using bootstrapped standard errors). In Table 2 we show that the abnormal returns (the same as the unadjusted returns in Table 1) are also in general larger in the PIIGS countries than in the BRICS countries on the day immediately after the Referendum. Also, American stock markets were holding positive and statistically significant abnormal returns (versus markets from Africa, Asia/Oceania and Europe), confirming the result of positive abnormal returns for the US as given in Fisman and Zitzewitz (2019). South Africa, as the main trading partner of the UK in Africa, suffered very negative losses. In Asia, China and India did not experience abnormal returns on the day following the Referendum. In Europe, Norway and Russia were the countries that did not experience abnormal returns on the day following the Referendum.
The consequences of the declaration of Covid-19 as a global pandemic by the WHO were very different than the ones of the Brexit Referendum in the financial markets. From Table 1 we check that the unadjusted returns on 3/12/2020 that were clearly higher than the 10.7% losses that happened in the global market (see the unadjusted return of the MSCI index in Table 1 on 3/12/20) happened in Brazil (−15.99%), Canada (−13.18%), Austria (−14.68%), Belgium (−15.33%), France (−13.1%), Germany (−13.1%), Greece (−11.22%), Holland (−11.38%), Italy (−18.54%), Spain (−15.15%) and Sweden (−11.17%). Table 2 confirms with the abnormal returns similar results: the largest losses happened in Austria (−7.07%), Belgium (−8.66%), Brazil (−7.6%), Canada (−5.90%), Italy (−10.52%) and Spain (−7.53%). Therefore in special, the biggest losses, both with unadjusted and abnormal returns, were in Austria, Belgium, Brazil, Canada, Italy and Spain. All those cases can be explained as being those countries where on March 12, 2020 were announcing quarantine lockdowns that day. In order to justify our argument, we enumerate now the timeline of the Covid-19 pandemic in these six countries:
- In Austria, the first patient was tested positively for the Covid-19 disease on February 25, 2020. On March 10, 2020 universities were closed nationwide with the schools following on 16 March 2020 (see Risak, 2020).
- In relation to Belgium, the first death resulting from SARS-CoV-2 in Belgium was announced on March 11, by the Belgian Minister of Health. The government announced also its decision to close schools on March 12, 2020 (see Kurten & Beullens, 2021).
- Brazil declared Covid-19 a public health emergency on February 3, 2020, and on March 12, a Brazil Ministerial Decree provided for the regulation and implementation of the Public Health Emergency of National Importance Act measures. The main measures included regulation of social distancing, quarantine, violation of isolation and quarantine measures, and the requisitioning of assets and services (with compensation) from an individual or company during the public health emergency. On March 16, Rio de Janeiro state’s governor declared public health emergency and determined that schools and universities should remain closed (see Massard da Fonseca et al., 2020; Dantas et al., 2020). These new impacts very negatively on the Brazilian stock market following the news of the Covid-19 as a global pandemic.
- Canada experienced its first Covid-19 related death on March 9, 2020. On March 12, Prime Minister Trudeau went into self-isolation after his spouse tested positive for the virus. That same day, federal officials announced that between 30–70% of Canadians could become infected depending on how the country responded. By March 13, schools were closed, large public gatherings had been suspended, and the first province, Quebec, had declared a state of emergency (see Doorey, 2020).
- In Italy, the first lockdown order was issued in a cluster of cities in Lombardy and Veneto regions in the north on February 22, 2020. On March 8, it was expanded to all of Lombardy and 14 other northern provinces. On March 9, the central government declared a nationwide lockdown, closing parks and banning outdoor activities that included taking long walks far from home (see Ren, 2020).
- Finally in Spain, on March 12, 2020, several localities were in lockdown in Cataluña, and by March 13, cases had been confirmed in all 50 provinces of the country. The national lockdown was imposed on 14 March 2020 (see Paül & Trillo-Santamaría, 2021).

Table 2 also shows that the day after Covid-19 was declared as a global pandemic, China and Japan did not experience signs of abnormal returns in their financial markets. This is justified by being countries where lockdowns had already taken place in previous months. On February 27, there was an announcement of school closures by the Japanese government, and on 10 March, the Japanese government categorized the 2020 coronavirus pandemic in Japan as a historical emergency situation (see Kashima & Zhang, 2021). On the other hand, Chinese shares fell on March 13, 2020, tracking global markets downwards after intensifying fears over the spread of coronavirus around the world (as seen in our Table 1). But equities losses in China were much smaller compared with other markets, showing hopes that the virus outbreak was under control in China itself, and on expectations of further fiscal policy easing by Beijing (this justifies that the abnormal returns in Table 2 for China are not statistically significant). Indeed, on March 13, 2020, Huangshi and Qianjiang became the first Hubei cities to remove strict travel restrictions. And China claimed a symbolic victory on 18 March 2020 when it announced that it had reached a point of “zero infection” – no new local cases across the country (Ren, 2020).

Finally, from Table 2 we find that during the three days after declaring the global pandemic, the US was the only country showing evidence of positive abnormal returns, with a unique statistically significant positive return of 1.8% on 3/13/2020. This shows that during the first three days after
declaring the pandemic, the US was the only country that was trusted by the financial markets to provide a positive answer against the Covid-19 after declaring the national emergency. Indeed, as shown in Ananyev et al. (2021), the importance of Trump declaring the national emergency, was a very positive move that was perceived by the stock market reacting with the largest single-day gain since October 2008.

3.2. Robustness of the results: VAR model

In order to check the robustness of the results, following Iglesias (2015), we estimated a Vector Autoregressive Regression (VAR) model with heteroscedasticity-robust standard errors where all the returns of the different countries were the endogenous variables with also 1 lag (many of the 1-lagged parameter estimates were statistically significant), and as exogenous variables we considered the returns of the MSCI and the six dummy variables Dj that are equal to 1 on j = 24, 27, 28 of June 2016 and j = 12, 13, 16 of March 2020. We excluded from this VAR analysis Chile, Sweden and Finland because they did not have some of the returns available during the considered six dummy variables. Table 3 (we do not show the results for the parameters corresponding to the estimated lags due to space limitations) confirms the results we obtained both with unadjusted (Table 1) and abnormal returns (Table 2) where also the abnormal returns are on average larger in

| Table 3 | VAR results for abnormal returns relative to the market performance (estimates of abnormal returns are in percentage).1 |
|---------|-------------------------------------------------------------|
| Returns | Beta  | 6/24/16 | 6/27/16 | 6/28/16 | 3/12/20 | 3/13/20 | 3/16/20 | R²     |
| Africa  |       |         |         |         |         |         |         |        |
| South Africa | 0.171 | −12.062 | 5.156  | 3.143  | −2.446 | −5.069 | 2.471  | 0.160  |
| America |       |         |         |         |         |         |         |        |
| Brazil  | 0.768 | 1.236   | 0.492  | −0.269 | −8.627 | 6.230  | −3.501 | 0.390  |
| Canada  | 0.663 | 1.708   | 0.149  | −0.432 | −6.486 | 2.818  | −1.269 | 0.720  |
| United States | 0.955 | 1.430   | 0.327  | 0.049  | −0.125 | 0.166  | −0.322 | 0.923  |
| Asia/Oceania |       |         |         |         |         |         |         |        |
| Australia | 0.345 | −1.942 | 1.622  | −0.825 | −3.827 | 3.262  | −6.896 | 0.318  |
| China   | 0.199 | −0.696 | 2.268  | 1.037  | 1.500  | −0.978 | −2.426 | 0.070  |
| India   | 0.381 | −0.533 | 1.191  | 0.533  | −3.175 | 4.069  | −6.800 | 0.254  |
| Japan   | 0.292 | −7.408 | 4.618  | 1.310  | −0.529 | −4.796 | −2.122 | 0.224  |
| Europe  |       |         |         |         |         |         |         |        |
| Austria | 0.728 | −3.549 | −3.848 | 0.907  | −6.187 | −4.214 | −4.884 | 0.463  |
| Belgium | 0.635 | −3.402 | −2.487 | 0.789  | −7.325 | −3.699 | −2.419 | 0.505  |
| France  | 0.773 | −4.379 | −0.620 | −0.604 | −3.989 | −4.909 | 1.983  | 0.525  |
| Germany | 0.738 | −3.237 | −1.916 | 0.770  | −4.372 | −5.963 | 2.009  | 0.487  |
| Greece  | 0.634 | −11.519| −0.045 | 2.723  | −3.765 | −0.672 | −7.722 | 0.237  |
| Holland | 0.665 | −2.477 | −1.987 | 0.048  | −3.653 | −5.756 | 3.154  | 0.498  |
| Ireland | 0.654 | −4.810 | −9.063 | 1.809  | −2.569 | −4.237 | −1.932 | 0.457  |
| Italy   | 0.766 | −9.086 | −3.527 | 1.653  | −9.573 | −1.010 | 2.533  | 0.457  |
| Norway  | 0.492 | −0.626 | −2.537 | 1.333  | −3.774 | 0.353  | −1.745 | 0.390  |
| Portugal| 0.640 | −4.008 | −0.808 | 1.064  | −2.760 | −4.122 | 1.563  | 0.371  |
| Russia  | 0.413 | 0.242  | −1.989 | 0.042  | −3.541 | −1.764 | 1.088  | 0.185  |
| Spain   | 0.717 | −9.469 | −0.642 | 1.176  | −6.741 | −2.833 | −0.623 | 0.461  |
| United Kingdom | 0.698 | −2.697 | 0.298  | 1.809  | −2.113 | −5.143 | 2.797  | 0.546  |

1 In bold we denote statistical significance at the 5% level. We also omit the value of the estimated constant in the model since it is never statistically significant.
Table 4
CCC MARCH model results for abnormal returns relative to the market performance (estimates of abnormal returns are in percentage).1

| Returns         | Beta | 6/24/16 | 6/27/16 | 6/28/16 | 3/12/20 | 3/13/20 | 3/16/20 | ARCH (1) |
|-----------------|------|---------|---------|---------|---------|---------|---------|---------|
| Africa          |      |         |         |         |         |         |         |         |
| South Africa    | 0.092| −11.522 | 4.903   | 1.989   | −6.576  | −7.773  | 2.500   | 0.355   |
| America         |      |         |         |         |         |         |         |         |
| Brazil          | 0.790| 1.296   | 0.228   | 0.101   | −7.450  | 7.073   | −5.078  | 0.201   |
| Canada          | 0.666| 1.774   | 0.163   | −0.044  | −5.999  | 4.185   | −1.971  | 0.428   |
| United States   | 0.991| 1.535   | 0.607   | −0.159  | 0.695   | 1.402   | −0.217  | 0.802   |
| Asia/Oceania    |      |         |         |         |         |         |         |         |
| Australia       | 0.372| −1.313  | 1.342   | −1.123  | −3.667  | 1.479   | −8.560  | 0.411   |
| China           | 0.173| −0.379  | 1.891   | 0.363   | 0.363   | −2.520  | −2.141  | 0.613   |
| India           | 0.357| −0.419  | 0.870   | −0.007  | −4.704  | 1.239   | −6.624  | 0.414   |
| Japan           | 0.317| −6.631  | 3.101   | −0.172  | −1.132  | −8.702  | −1.288  | 0.287   |
| Europe          |      |         |         |         |         |         |         |         |
| Austria         | 0.725| −3.528  | −2.950  | 1.458   | −6.881  | −5.012  | −5.982  | 0.239   |
| Belgium         | 0.682| −3.046  | −2.480  | 1.908   | −7.980  | −4.119  | −2.363  | 0.248   |
| France          | 0.802| −4.193  | 0.078   | 1.140   | −4.456  | −4.254  | 0.750   | 0.115   |
| Germany         | 0.773| −3.029  | −1.180  | 1.642   | −4.729  | −5.874  | 0.941   | 0.063   |
| Greece          | 0.674| −10.880 | −1.275  | 3.037   | −3.946  | −2.622  | −8.092  | 0.380   |
| Holland         | 0.695| −2.253  | −1.326  | 1.261   | −3.901  | −5.092  | 2.264   | 0.149   |
| Ireland         | 0.688| −4.464  | −8.747  | 2.389   | −3.061  | −4.777  | −3.258  | 0.158   |
| Italy           | 0.806| −9.124  | −2.061  | 2.952   | −9.865  | 0.780   | 0.034   | 0.133   |
| Norway          | 0.535| −0.199  | −1.776  | 1.993   | −3.781  | −0.461  | −0.959  | 0.344   |
| Portugal        | 0.662| −3.756  | −0.719  | 1.949   | −3.103  | −4.153  | 0.740   | 0.137   |
| Russia          | 0.379| 0.111   | −1.403  | 0.521   | −4.599  | −1.601  | 3.525   | 0.284   |
| Spain           | 0.753| −9.215  | 0.030   | 2.435   | −7.003  | −1.993  | −3.091  | 0.217   |
| United Kingdom  | 0.707| −2.713  | 0.917   | 3.274   | −2.433  | −4.646  | 2.467   | 0.265   |

1 In bold we denote statistical significance at the 5% level. We also omit the value of the estimated constant in the mean equation of the model since it is never statistically significant.

the PIIGS countries than in the BRICS countries on the day immediately after the Referendum. Table 3 also confirms the results we obtained both with unadjusted (Table 1) and abnormal returns (Table 2), where again we find that the biggest losses on March 12, 2020 occurred in Austria, Belgium, Brazil, Canada, Italy and Spain. Also China, Japan and the United States did not present evidence of abnormal returns on that day. And during the three days after declaring the global pandemic, the United States was the only country showing no evidence of abnormal returns, opposite to the negative abnormal returns of all the rest of the analyzed countries. Using the baseline model, we obtained a statistically significant and positive abnormal return during the three days after the declaration of the pandemic while with the multivariate model we cannot find evidence of abnormal returns. Our conclusion with both the univariate and the multivariate VAR models is that the US did not show evidence of negative abnormal returns during the three days following the declaration of the pandemic.

3.3. Robustness of the results: a CCC MARCH model

Since returns are very likely to exhibit conditional heteroskedasticity, we fitted a Constant Conditional Correlation (CCC) Multivariate Conditional Autoregressive (MARCH) model of
order 1 derived by Bollerslev (1990), and the results are given in Table 4. As exogenous variables in the conditional mean equation, we considered the returns of the MSCI and the six dummy variables Dj that are equal to 1 on \( j = 24, 27, 28 \) of June 2016 and \( j = 12, 13, 16 \) of March 2020. We excluded from this VAR analysis Chile, Sweden and Finland because they did not have some of the returns available during the considered six dummy variables. The conclusions obtained with Eq. (1) and the VAR model are robust to employing now the CCC MARCH model. The PIIGS group had the largest negative abnormal returns the day following the Brexit Referendum. Also, Austria, Belgium, Brazil, Canada, Italy and Spain had the largest negative losses the day following the declaration of Covid-19 as a pandemic while China and Japan did not experience abnormal returns on that day. And during the three days following the declaration of the pandemic, the US was the only analyzed country that did not show evidence of negative abnormal returns.

4. Conclusions

In this paper first, we confirm the results in Burdekin et al. (2018) that the PIIGS group were having the largest negative unadjusted and abnormal returns on the day following the Brexit Referendum by showing that this result is robust to increasing the sample size and taking into account jointly other extreme events such as the Covid-19. Second, we show that the impact of the declaration of Covid-19 to be a global pandemic had a total different reaction in the financial markets to the one following the Brexit Referendum, impacting more negatively in those countries where on March 12, 2020 quarantine lockdowns were announced (e.g. Austria, Belgium, Brazil, Canada, Italy and Spain), independently on their debt-to GDP ratio. We also show that the day after Covid-19 was declared as a global pandemic, China and Japan did not experience evidence of abnormal returns in their financial markets, being countries that had already experienced lockdowns in the previous months. Finally, we provide evidence that during the three days after declaring the global pandemic, the US was the only country showing no evidence of negative abnormal returns; being the only country that financial markets were trusting to provide a positive reply to the pandemic due to declaring the national emergency.

Singh et al. (2021) showed that the response of stock market returns to policy interventions was less effective in countries when markets are integrated. Even with that caveat in mind, our results suggest that government policies must take into account and monitor specially health-related news at global level, since they can have enormous impacts on portfolio allocations on stock markets, in order to take more informed decisions.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jpolmod.2021.10.005.

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