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Stock market reactions to COVID-19 lockdown: A global analysis

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ABSTRACT

The COVID-19 pandemic has caused dramatic changes in the way people around the globe live, and has had a profound negative impact on the global economy. Much of this negative impact did not result from the disease itself, but from the lockdown restrictions imposed to contain the spread of the virus. We investigate how national stock market indices reacted to the news of national lockdown restrictions in the period from January to May 2020. We find that lockdown restrictions led to different reactions in our sample of OECD and BRICS countries: there was a general negative effect resulting from the increase in lockdown restrictions, but we find strong evidence for underreaction during the lockdown announcement, followed by some overreaction that is corrected subsequently. This under-/overreaction pattern, however, is observed mostly during the first half of our time series, pointing to learning effects. Relaxation of the lockdown restrictions, on the other hand, had a positive effect on markets only during the second half of our sample, while for the first half of the sample, the effect is negative.

1. Introduction

When the first COVID-19 cases were reported to the World Health Organisation (WHO) on December 31, 2019, the New York Stock Exchange did not really react. Only around February 20, when the disease started to spread in the North of Italy, did the Dow Jones change trend. On March 3, the index dropped by more than 2000 points within a day, followed by another precipitous drop on March 12 and finally, the highest point drop ever on record on March 16, 2020. On March 9, Italy imposed a national lockdown, followed by other EU countries. While most countries imposed restrictions on business and social activities in the course of 2020, the restrictions varied by country, date and duration, as evidenced by the Oxford COVID-19 Government Response Tracker (OxCGRT) index.[1]

In this paper, we investigate the effects of COVID-19 government responses on the financial markets, contributing threefold to the literature. First, we test the market impact of government interventions in an international setting. Secondly, we test how well markets are connected and identify regional learning effects. Thirdly, we show that the financial markets did not behave efficiently in the first half of our sample period, but these inefficiencies decreased in the second half of our sample period. This is in line with Dima et al. (2021) who show that the VIX index in 2020 was no more or less efficient than during other time periods.

In our study, we combine a multi-country market panel analysis with an event study design in the vein of Kaplanski and Levy (2010a) to investigate the effects of lockdown stringency on abnormal market returns, using a comprehensive OECD and BRICS country panel dataset for the period from January 22 to May 20, 2020. This design allows us to control for the timing of government interventions on a daily basis and to group certain days. Our sample start date is January 22, 2020 (first major Corona restriction: lockdown in Wuhan), the end date is May 20, 2020 (last day for which the OxCGRT index was available throughout the summer).

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[1] See Hale et al. (2020a) (database) and Hale et al. (2020b) (description).

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We explain abnormal national stock market returns (residuals of an auxiliary regression of national returns on their lags and leads and the world market returns) by the timing of changes in restrictions to contain the pandemic. We investigate how well the financial markets in different countries, ranging from emerging to highly industrialized economies, were able to absorb information in the course of the crisis. Similarly to Edmans et al. (2007), we also find a link between events of more or less national importance (sports event outcomes vs. national Corona policies) and national stock markets. As Becchetti and Ciciretti (2011), we conclude that knowledge of past events may lead to a reconsideration of available information.

We find that national Corona-related measures lead to a typical under/-overreaction pattern in the national stock market returns. A tightening of national lockdown restrictions coincides with negative stock market returns, but these effects are delayed (initial underreaction). The subsequent negative reaction is an overreaction which is in turn partly reversed, at least during the first half of our time series. This confirms the result of Rahman et al. (2021) that the Australian stock market underreacted to the announcement of a national emergency and the introduction of stimulus packages. Moreover, since we include leads and lags of the OxCGRT index change instead of cumulative abnormal returns into our model, we are able to also identify a subsequent overreaction. Even after having purged the world market return effect from the data, we find a separate influence of the first major restrictive measures within a country and greater region. Moreover, the easing of lockdown restrictions has a comparable positive mirror impact on stock market returns as does tightening, considering the entire sample period. Interesting differences emerge, however, when we split the sample into an earlier and a later period. In the early period, the markets did not appreciate the easing of restrictions.

Considering the effects of Corona lockdown, our study is related to Askitas et al. (2020), a multi-country panel event study on the effect of different types of lockdown restrictions on the COVID-19 infection numbers and mobility patterns.

As regards COVID-19 financial market repercussions, Ru et al. (2020a) and Ru et al. (2020b) show that countries affected by the SARS epidemic of 2003 were quicker and more decisive in their policy responses, resulting in quicker stock market reactions. Alfaro et al. (2020) show that especially unexpected changes in the numbers of COVID-19 cases influence the U.S. stock market. Ramelli and Wagner (2020) consider the performance of individual stocks at the beginning of 2020. At first, the stock prices of firms with China ties suffered the most, but later the stocks of firms with high debt and low liquidity were most affected. Beirne et al. (2020) find that financial markets in emerging economies in Asia and Europe were more severely hit by the pandemic than those of advanced economies, as abrupt and sizable capital outflows were triggered. Baker et al. (2020) compare the current pandemic to other pandemics and conclude that the much stronger government response to COVID-19 drives the observed strong market volatility in the U.S.

In Section 2, we describe the data used in our study and present the empirical model. In Section 3, we document the main results. Section 4 concludes. Details about methodology and results, as well as additional results, are in the online appendix.

2. Data and methodology

To investigate how stock markets are affected by government interventions to control the spread of COVID-19, we use data from three different sources.

Infection data are obtained from the Humanitarian Data Exchange, which is compiled and updated daily by the Johns Hopkins University (JHU) in Baltimore.

The Reuters database contains the individual stock market data for each country as well as the MSCI World Index. We use the value weighted country all share index, a standard measure of stock market performance (Nyberg, 2010), if available; otherwise, we employ the index including the highest number of companies. Moreover, if available, we use the total return index because it includes dividends and other rights offerings and is therefore considered a more accurate performance measure (Nyberg, 2010). Since local currencies are affected by an individual country's expected inflation, which is reflected in the individual asset discount rate (Damodaran, 2012), we employ individual stock market indices in Euros.

To measure the effect of government interventions, we use the OxCGRT stringency index.

We limit our sample to countries of the Organisation for Economic Cooperation and Development (OECD) and the BRICS states (Brazil, Russia, India, China, and South Africa) because these industrialized or big emerging economies have a large impact on the global economy (Garcia-Herrero, 2012). In total, this study analyzes daily data from 42 different countries from January 22 to May 20, 2020.

We follow an event-study approach and test whether the national COVID-19 case numbers and COVID-19 related government interventions affect a country's stock market. All regressions use heteroskedasticity and serial correlation robust estimators (Arellano et al., 1987).

We estimate our model in two stages. In the first stage, we control for confounding effects (correlations of stock indices, Monday effect, non-weekend holidays etc. (Edmans et al., 2007; Cho et al., 2007; Kaplanski and Levy, 2010b)). The estimation equation is:

$$R_{i,t} = \gamma_0 + \sum_{j=-1}^{1} \gamma_{1j} R^m_{t+j} + \gamma_2 M_t + \gamma_3 H_{i,t} + \sum_{j=1}^{4} \gamma_{4j} R_{i,t-j} + \epsilon_{i,t}; \quad (1)$$

where $R_{i,t}$ is the daily rate of return of country i at time t. Following Edmans et al. (2007), we control for the correlation of local stock indices across countries by including a world market portfolio R^m_t in the regression, the daily MSCI World index rate of return. Furthermore, we include its lead R^m_{t+1} and lag R^m_{t-1} to control for time-varying correlations. To control for the Monday effect in stock markets (Cho et al., 2007), we include a dummy variable M_t. We also include a dummy variable $H_{i,t}$ for the day after a non-weekend holiday (Edmans et al., 2007; Kaplanski and Levy, 2010b). Finally, we control for serial correlation in national stock market returns by including country i's jth previous-day rate of return.

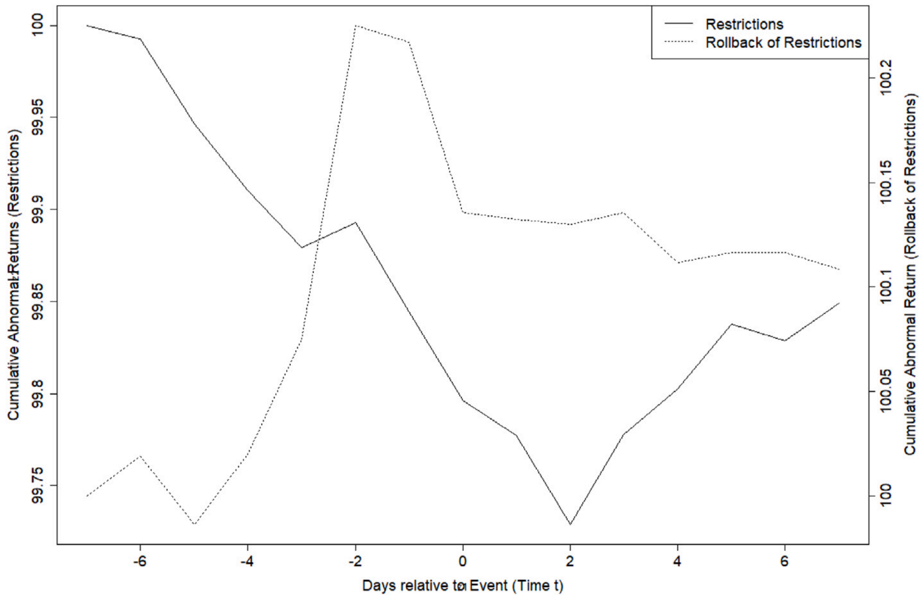

Fig. 1. OECD and BRICS cumulative abnormal return index base 100. This figure shows the cumulative abnormal returns around the event day (t=0) with either restrictions or the rollback of restrictions for the period from January 22 to May 20, 2020. For better illustration, the returns have been rebased to create an index around the event day which starts at t-7 with a value of 100. The next index points are calculated as follows: Index value$_t$ = Index value$_{t-1} \cdot (1 + \beta(\Delta S_{it}))$ for $t = \{-6...7\}$.

In the second stage, we estimate

$$\begin{aligned}\hat{\epsilon}_{i,t} \;=\; & \beta_0 + \beta_1 C_{i,t} + \beta_2 C_t^w + \beta_3 F_{i,t} + \beta_4 G_{r,t} \\ & + \left(\beta_5 \Delta S_{i,t-2} + \beta_6 \Delta S_{i,t-1} + \beta_7 \Delta S_{i,t} + \beta_8 \Delta c_{1,2} S_{i,t} + \beta_9 \Delta c_{3-7} S_{i,t}\right) \chi_+(\Delta S_{i,t}) \\ & + \left(\beta_{10} \Delta S_{i,t-2} + \beta_{11} \Delta S_{i,t-1} + \beta_{12} \Delta S_{i,t} + \beta_{13} \Delta c_{1,2} S_{i,t} + \beta_{14} \Delta c_{3-7} S_{i,t}\right) \chi_-(\Delta S_{i,t});\end{aligned} \tag{2}$$

where

$$\chi_+(x) := \begin{cases} 1, & \text{if } x \geq 0, \\ 0, & \text{otherwise;} \end{cases} \qquad \chi_-(x) := \begin{cases} 1, & \text{if } x < 0, \\ 0, & \text{otherwise.} \end{cases}$$

As dependent variable, we use the abnormal returns (estimated regression residuals $\hat{\epsilon}_{it}$, from the first-stage model). The explanatory variables (for more details, see online appendix) include:

- daily percentage change in country i's total COVID-19 cases $C_{i,t}$,
- percentage change in the worldwide number of cases C_t^w,
- dummy variable $F_{i,t}$ for i's first strict measures to curb the virus spread,
- dummy variable $G_{r,t}$ that controls for the first strict measures in the greater region r where i is located,
- daily changes in government interventions $\Delta S_{i,t}$, with $(\Delta S_{i,t})\chi_+$ representing restrictions and $(\Delta S_{i,t})\chi_-$ relaxations of government interventions.
- Since the information about policy changes is released prior to the event day, we lag $\Delta S_{i,t}$ by one and two days and include the variables $\Delta S_{i,t-1}$ and $\Delta S_{i,t-2}$ in our regression.
- For day $t+1$ as well as the other six days following the event day (dates $t+j$ with $j = \{1, \ldots, 7\}$), we merged $\Delta S_{i,t+1}$ till $\Delta S_{i,t+7}$ into two separate variables. The first variable $\Delta c_{1,2} S_{i,t}$ cumulates ΔS_{it+1} and $\Delta S_{i,t+2}$ into one variable. The second variable $\Delta c_{3-7} S_{i,t}$ cumulates $\Delta S_{i,t+3}$ till $\Delta S_{i,t+7}$.

We also split the whole sample into two sub-samples. The first sub-sample period starts on January 22 and ends on March 27, 2020 (day by which all countries in our sample had implemented their first restrictive measures). The second half starts on March 28 and ends on May 20, 2020.

3. Main results

The results for the first-stage regression as well as descriptive statistics and robustness results are provided in the online appendix. The main results are summarized in Fig. 1. We see an initial price drift, corresponding to an underreaction on the stringency measures that leads to an overreaction, which can be seen from the partial recovery starting a few days after the stringency event. The patterns for restrictions and their rollbacks are mostly symmetric.

Table 1
OECD and BRICS countries (January 22–May 20, 2020).

Variable	Coefficient	p-value
intercept	2.62E−04	0.61
new cases (country i) $C_{i,t}$	−1.92E−03	0.12
new cases (global) C_t^w	4.45E−03	0.26
first strict measures (country i) $F_{i,t}$	−1.58E−02	0.01**
first strict measures (region) $G_{r,t}$	−1.95E−02	0.00**
positive stringency index t-2 $\Delta S_{i,t-2}\chi_+(\Delta S_{i,t})$	−3.36E−06	0.99
positive stringency index t-1 $\Delta S_{i,t-1}\chi_+(\Delta S_{i,t})$	−6.06E−04	0.00**
positive stringency index t0 $\Delta S_{i,t}\chi_+(\Delta S_{i,t})$	−5.13E−04	0.02**
pos. cum. string. index t1 & t2 $\Delta c_{1,2}S_{i,t}\chi_+(\Delta S_{i,t})$	−3.40E−04	0.03**
pos. cum. string. index t3 - t7 $\Delta c_{3-7}S_{i,t}\chi_+(\Delta S_{i,t})$	2.28E−04	0.01**
negative stringency index t-2 $\Delta S_{i,t-2}\chi_-(\Delta S_{i,t})$	−1.70E−03	0.04**
negative stringency index t-1 $\Delta S_{i,t-1}\chi_-(\Delta S_{i,t})$	−5.12E−04	0.34
negative stringency index t0 $\Delta S_{i,t}\chi_-(\Delta S_{i,t})$	4.60E−04	0.33
neg. cum. string. index t1 & t2 $\Delta c_{1,2}S_{i,t}\chi_-(\Delta S_{i,t})$	6.42E−06	0.92
neg. cum. string. index t3 - t7 $\Delta c_{3-7}S_{i,t}\chi_-(\Delta S_{i,t})$	−5.60E−05	0.37
adjusted R^2		0.06
N		2666

$*\ p \leq 0.1$, $**\ p \leq 0.05$.
The corresponding estimation equation is (2).

Table 1 shows the second-stage regression results for the full sample of OECD and BRICS countries. In the overall sample, neither local nor global new COVID-19 cases have a significant effect on local stock markets. However, if the first country implements the first strict preventive measures against COVID-19 within a given region, the national stock markets in that region react negatively. The results are highly significant. Similarly, the first measures implemented by an individual country negatively affect the respective stock market. This confirms that the stock market expects negative economic consequences as a result of government restrictions. Comparing the two returns, we see that the first regional restriction has a similar, but slightly bigger impact compared to the first national restriction. Once the first strict restrictions have been implemented in a region, it can possibly be expected that other countries will follow suit.

Concerning the sequential impact of further government interventions, the restrictions have a highly significant negative impact one day before, on the day the measures are implemented, and up to two days after the implementation. This is in line with an announcement effect: announced measures are priced in before implementation. In comparison to the effect of the first national preventive measures, these negative returns are smaller. When looking at days 3 to 7 after implementation, we find a significant positive return: the market slightly overreacted, which was then corrected. On the other hand, a restriction relaxation has a significant positive (double negative) impact on the stock market two days before the relaxation.

Table 2 shows the results for periods January 22–March 27 & March 28–May 20. The estimation equation is the same as in Table 1. In the first sub-sample, we find – contrary to the overall sample – a highly significant positive return for an increase in the number of global COVID-19 cases, while an increase in local COVID-19 cases does not have a significant impact on local stock markets. The results for regional and national first strict measures are analogous to the results for the whole sample. The first sub-sample also confirms the pattern of the stock market decline after further government restrictions and the subsequent correction. Contrary to the results for the whole sample, we find a significant negative effect on the day of restriction relaxation (negative stringency index). Possibly the market considers early relaxations as premature and, therefore, reacts negatively.

In the second sub-sample, as for the overall sample, we do not find a significant effect of an increase in COVID-19 cases. Considering the restriction implementation, we only find weakly (at the 10% level) significant returns on day $t-1$. Possibly, restrictions have been expected by the market and, thus, have already mostly been priced in. Considering the restriction relaxation, we find a significant positive (double negative) return two days before the implementation.

Alternative regression specifications with additional, more disaggregated leads and lags of the stringency indices are provided in the online appendix. The robustness analysis shows that the main results are indeed robust.

4. Conclusion

The COVID-19 pandemic is an ideal test situation for market efficiency, as the unfolding events were completely novel for financial market participants and largely exogenous. The initial stock market reaction shows a delayed response: only after the number of COVID-19 cases started to increase in Italy, did the international stock markets drop. When governments tried to contain the virus spread by introducing stricter preventive measures, stock markets reacted with further decreases. The reaction, however, showed clear signs of underreaction with a significant post-announcement drift, i.e., the market takes a couple of days to incorporate the new information. At least in the first half of our time series, we also see clear signs of overreaction: three days after the introduction of the restrictions, the stock markets started to show abnormal positive returns for a few days.[2] In summary, we find

[2] This cannot be explained by positive effects of the preventive measures on the infection rates, as such effects can only be observed after a longer period, certainly not within two days, given that the incubation time of COVID-19 and the time needed to detect new cases add up to about a week on average.

Table 2
OECD and BRICS countries (January 22–March 27 & March 28–May 20, 2020).

Variable	(1) Coefficient	p-value	(2) coefficient	p-value
intercept	−2.16E−03	0.00**	1.47E−03	0.20
new cases (country i) $C_{i,t}$	−1.21E−03	0.31	−3.30E−03	0.87
new cases (global) C_t^w	1.25E−02	0.01**	1.41E−02	0.67
first strict measures (country i) $F_{i,t}$	−1.60E−02	0.01**		
first strict measures (region) $G_{r,t}$	−1.76E−02	0.00**		
positive stringency index t-2 $\Delta S_{i,t-2}\chi_+(\Delta S_{i,t})$	8.26E−05	0.76	3.43E−04	0.44
positive stringency index t-1 $\Delta S_{i,t-1}\chi_+(\Delta S_{i,t})$	−5.73E−04	0.00**	−4.58E−04	0.07*
positive stringency index t0 $\Delta S_{i,t}\chi_+(\Delta S_{i,t})$	−5.49E−04	0.02**	1.65E−04	0.68
pos. cum. string. index t1 & t2 $\Delta c_{1,2}S_{i,t}\chi_+(\Delta S_{i,t})$	−3.12E−04	0.07*	−1.98E−05	0.92
pos. cum. string. index t3–t7 $\Delta c_{3-7}S_{i,t}\chi_+(\Delta S_{i,t})$	2.88E−04	0.00**	1.29E−04	0.31
negative stringency index t-2 $\Delta S_{i,t-2}\chi_-(\Delta S_{i,t})$	−4.00E−04	0.93	−1.68E−03	0.00**
negative stringency index t-1 $\Delta S_{i,t-1}\chi_-(\Delta S_{i,t})$	2.23E−04	0.82	−3.70E−04	0.53
negative stringency index t0 $\Delta S_{i,t}\chi_-(\Delta S_{i,t})$	6.21E−03	0.00**	2.14E−04	0.45
neg. cum. string. index t1 & t2 $\Delta c_{1,2}S_{i,t}\chi_-(\Delta S_{i,t})$	−5.49E−05	0.44	1.84E−04	0.10
neg. cum. string. index t3–t7 $\Delta c_{3-7}S_{i,t}\chi_-(\Delta S_{i,t})$	4.63E−05	0.38	−7.68E−06	0.95
adjusted R^2		0.08		0.01
N		1591		1075

$* \ p \leq 0.1$, $** \ p \leq 0.05$.
This table reports the regression results for OECD and BRICS countries in the subsample periods January 22–March 27 (1) and March 28–May 20 (2). The estimation equation is (2).

the typical pattern of a delayed and then too strong response to a surprising exogenous event. This pattern is inconsistent with the efficient market hypothesis that prices immediately and fully reflect all available information, but is in line with other empirical rejections of the efficient market hypothesis (Sewell, 2012; Boubaker et al., 2015; Rahman et al., 2021).

Moreover, markets reacted to the first strict national preventive measure, but also to the first strict preventive measure within the same greater region. In fact, a region's first strict measure prompted a stronger response than that of an individual country, probably due to anticipation effects.

When restrictions were relaxed again, stock markets reacted, but in different ways: they reacted negatively to earlier restriction relaxations (mainly between January and the end of March) and positively to later relaxations. This suggests that market participants deemed early relaxations premature and counter-productive, but considered later relaxations as reasonable and beneficial for economic development.

Finally, the number of new COVID-19 cases nationally and worldwide did not significantly affect stock market returns, which is somewhat surprising since these numbers triggered the imposition or relaxation of stringency measures. This feedback effect does not seem incorporated in market prices.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Tables and figures

See Tables 1 and 2 and Fig. 1.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.frl.2021.102245.

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