Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Finance Research Letters 36 (2020) 101671

Contents lists available at ScienceDirect

Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

Freedom and stock market performance during Covid-19 outbreak

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1. Introduction and the story of Covid-19

The outbreak of the novel coronavirus Covid-19 pandemic, which is accepted as the third serious coronavirus outbreak in less than 20 years (Yang et al., 2020), has caused a global pandemic, with approximately 3.1 million confirmed cases and 227,000 deaths as of April 30, 2020 (Roser et al., 2020). The harsh measures imposed, such as closing borders, sealing off cities, stay-at-home orders, and lockdowns severely hit many countries' economies and financial markets. The U.S. economy already contracted 4.8% in the first quarter of 2020. The International Monetary Fund, in its April 2020 report, projects a global growth rate of −3% in 2020 (The lowest global growth rate during the 2007–09 global financial crisis was recorded as −1.7% in 2009). (Gormsen and Koijen 2020) predicts a 6.3% decrease in the EU`s GDP growth. (Reinhart 2020) states that the economic consequences will "likely surpass those of the 2007–09 global financial crisis." America`s S&P500 Index dropped by 22% from January 21, the day the first case was reported in the USA, until March 31, 2020.

Countries have been announcing their number of cases and deaths since the onset of the pandemic. However, certain country groups, those especially associated with more freedom, reported a higher number of cases and deaths than others with less freedom. For example, Romania (which ranks 66 in freedom index among 197 countries) reported 622 Covid-19 infection cases per million as of the end of April, whereas its very neighbor Hungary (which ranks 85) announced 287, and its other neighbor Ukraine (which ranks 108) announced 225. There are similar cases in the world, which raises doubts about the pandemic data.[1] To be more specific, countries that have an above-median freedom score (I will call these "freer countries" hereafter), report an average of 550 cases per million, whereas below-median countries (less-free countries, hereafter) report an average of 127.[2] Deaths per million in these country groups are 25.6 and 1.5, respectively. Thus, per-million cases are 3 times higher, per-million deaths are 16 times higher in freer countries.

Is the difference attributable to the control-incapability of some countries or does it have something to do with their regime? It is impossible to answer this question precisely, especially because of the lack of transparency. However, as (Pastor and Veronesi 2009) emphasize, certain facts turn out to be less puzzling, after checking certain financial market parameters, such as volatility, and understanding that they are subject to learning. Thus, we can use stock markets to track how investors react to each country`s announcement of Covid-19 data, and link the Covid-19 data and the stock markets, concerning especially the freedom of countries.

Several studies link Covid-19 data and stock markets. Analyzing 43 countries, (Barro et al., al.,2020) find evidence that the 1918–20 Great Influenza Pandemic (Spanish flu) caused worldwide decreases in stock prices, and increases in volatility.

Most of the Covid-19 research currently focuses on specific countries. (Ramelli and Wagner 2020) and (Schoenfeld 2020) explore the impacts of Covid-19 on American firms, (Takahashi and Kazuo 2020) perform another firm-based analysis with Japanese firms and (Al-Awadhi et al., 2020) analyze the effects of the coronavirus disease on Chinese stock market firms. One of few studies dealing with global consequences belongs to (Albulescu 2020), which connects VIX (volatility index) to Covid-19 data and concludes that reports from outside China have more impact on VIX. Using data from 12 most-affected countries, (Zhang et al., 2020), map how the correlation between countries` stock markets before and after the Covid-19 crisis.

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[1] See (Beech, et al. 2020)

[2] See Data and Methodology section for the definitions.

https://doi.org/10.1016/j.frl.2020.101671
Received 6 May 2020; Received in revised form 20 June 2020; Accepted 26 June 2020
Available online 28 June 2020
1544-6123/

Here, I intend to show how investors react to different coronavirus data announcement, considering especially the level of freedom in each. To do this, I employ a panel regression analysis with 75 countries (the list is given in the Appendix) using their stock market index returns and volatilities as dependent variables and their Covid-19 data (number of cases per million and number of deaths per million), their level of freedom as independent variables.

The contribution of this study is two-fold: First, unlike most of the current studies, this study is not country-specific; it covers 75 countries, and thus draws a global conclusion. Second, it builds a connection between how the returns of stock market indices differ with respect to Covid-19 news from different regimes, i.e. free and not-free countries. To the best of my knowledge, no study has yet analyzed how the level of freedom affects the size of the impact of the same shock, i.e. Covid-19, on different stock exchanges.

My results indicate two findings: First, the pandemic has significant negative effects on stock markets, i.e. decreasing returns, increasing volatility (The effect of growth in the number of cases per million on stock returns is almost three times that of growth in the number of deaths per million). Second and more importantly, investors process the coronavirus data depending on the level of the freedom of that country. Specifically, for every increase in the number of cases per million, the stock market returns in freer countries are associated with less decrease than those in less-free countries are. Similarly, for every increase in the number of cases per million, the volatilities in stock markets in freer countries are associated with less increase than those in less-free countries. Thus the adverse effects of the Covid-19 on the stock markets are less in freer countries.

2. Data and methodology

In this study, I use the daily broad stock market indices of 75 countries together with their corresponding Covid-19 data (total number of confirmed cases per million, the total number of deaths per million) for the period January-April 2020. Unlike similar studies — like (Al-Awadhi et al., 2020) and (Zhang et al., 2020) — I prefer to use "per million" adjustment, to prevent a possible bias toward more populated countries. The global stock market indices were gathered from Bloomberg, and the data on global coronavirus cases were obtained from https://ourworldindata.org (Roser et al., 2020). Countries whose stock market data are not available are excluded from the analysis. I also collect countries' 2019 freedom index from Freedom House. This index adds the scores of 10 political rights indicators and 15 civil liberties indicators for 195 countries to come up with a unique number for each country, ranging from 0, the lowest freedom, to 100, the highest freedom.[3] I also created a dummy variable from this index, which is defined below (Eq. (4)).

The stock market index returns and 5-day moving volatility are calculated as follows:

$$R_{i,t} = \ln(Index_{i,t}/Index_{i,t-1}) \tag{1a}$$

$$S_{i,t} = \sqrt{\sum_{t=1}^{5} (\boldsymbol{R_{i,t}} - \bar{\boldsymbol{R}}_{\boldsymbol{i}})^2/4} \tag{1b}$$

where $Index_{it}$ is the level of a dollar-denominated major stock market index in country i at time t. and $\bar{R}_i$ stands for 5-day average of the index returns for country i.

The growth in coronavirus-related data is calculated in a similar manner:

$$GC_{i,t} = \ln(Case_{i,t}/Case_{i,t-1}) \tag{2}$$

$$GD_{i,t} = \ln(Death_{i,t}/Death_{i,t-1}) \tag{3}$$

where $Case_{i,t}$ is the number of confirmed coronavirus cases per million in country i at time t, and $Death_{i,t}$ is the number of deaths per million in country i at time t.

I also form a dummy variable, $FD_{i,t}$, defined as:

$$\boldsymbol{FD_{i,t}} = \begin{cases} 1, & \textit{if } \boldsymbol{F_{i,t}} \geq 81 \\ 0, & \textit{otherwise} \end{cases} \tag{4}$$

where $F_{i,t}$ is the freedom score of a country in Freedom House's freedom data and 81 is the median of the $F_{i,t}$ data (see Table 1).

(Ramelli and Wagner 2020) divide the Covid-19 sample into three periods: Incubation (January 2 to 17), outbreak (January 20 to February 21), and fever (February 24 to March 31). In their analysis of the Japanese stock market, (Takahashi and Kazuo 2020) show that no factor stands as determinants of stock returns during Phase 1. That's why I focused on what (Ramelli and Wagner 2020) define as second and third phases.

Table 1 summarizes the descriptive statistics in three panels: total sample; subsample with freedom dummy 1; and the other subsample with freedom dummy 0.

The following figures show how the number of cases per million and the number of deaths per million evolve, under the freedom dummy.

As it can be seen in Fig. 1a, the average number of cases per million in freer countries ($FD_{i,t} = 1$) has mostly been higher than those of others. It is also worth noting from Table 1 that, during the mentioned period, freer countries reported more cases per million on average, 550 versus 127 (mean difference test p-value = 0.00). Similarly, Fig. 1b and Table 1 show that, on average, freer countries

[3] See https://freedomhouse.org/sites/default/files/2020-02/Methodology_FIW_2019_for_website.pdf for the methodology.

Table 1
Descriptive Statistics (January 20 to April 30, 2020) with respect to freedom scores of countries. R stands for stock market index return, S stands for the 5-day moving volatility of the stock market index returns. C is the number of confirmed cases per million, D is the number of deaths per million. Freedom is the freedom index.

	Descriptive Statistics				
PANEL A: Total					
N	Mean	Median	Std. Deviation	Minimum	Maximum
R (Return)	5475	−0.003	0.000	0.028	−0.194	0.139
S (St.Dev)	5175	0.021	0.015	0.018	0.000	0.155
C (Cases pm)	3570	351.112	34.300	772.790	0.001	6020.998
GC (Growth in C)	3428	0.161	0.073	0.262	−0.075	3.784
D (Death pm)	4388	14.585	0.045	57.018	0.000	647.217
GD (Growth in D)	2281	0.159	0.072	0.245	0.000	2.025
Freedom	5550	69.893	81.000	28.459	0.000	100.000
PANEL B: Freedom Dummy, $FD_{i,t} = 1$					
R (Return)	2774	−0.003	−0.001	0.029	−0.194	0.113
S (St.Dev)	2622	0.022	0.017	0.017	0.000	0.105
C (Cases pm)	1894	549.881	132.099	959.946	0.003	6020.998
GC (Growth in C)	1826	0.168	0.070	0.274	−0.075	3.784
D (Death pm)	2372	25.666	0.107	75.715	0.000	647.217
GD (Growth in D)	1242	0.173	0.084	0.250	0.000	1.924
Freedom	2812	92.105	93.500	5.549	81.000	100.000
PANEL C: Freedom Dummy, $FD_{i,t} = 0$					
R (Return)	2701	−0.004	0.000	0.028	−0.194	0.139
S (St.Dev)	2553	0.020	0.013	0.019	0.000	0.155
C (Cases pm)	1676	126.489	11.969	368.650	0.001	4360.895
GC (Growth in C)	1602	0.154	0.075	0.247	0.000	2.793
D (Death pm)	2016	1.547	0.018	4.226	0.000	36.531
GD (Growth in D)	1039	0.143	0.059	0.238	0.000	2.025
Freedom	2738	47.081	51.000	24.143	0.000	80.000

report more death per million, 25.6 versus 1.5 (mean difference test p-value = 0.00).

Table 2 presents the correlation between the variables and their significance. Most importantly the growth in cases per million, *GC*, is significantly negatively correlated (−0.253) with stock market index returns, R, and significantly positively correlated (0.248) with stock market return volatilities.

Using a panel regression, I estimate the index returns and volatilities as follows:

$$\boldsymbol{R_{i,t}} = \alpha_0 + \alpha_1 \boldsymbol{G_{i,t}} + \alpha_2 \boldsymbol{FD_{i,t}}^* \boldsymbol{G_{i,t}} + \alpha_3 \boldsymbol{X_{i,t}} \boldsymbol{\varepsilon_{i,t}} \tag{5}$$

$$\boldsymbol{S_{i,t}} = \alpha_0 + \alpha_1 \boldsymbol{G_{i,t}} + \alpha_2 \boldsymbol{FD_{i,t}}^* \boldsymbol{G_{i,t}} + \alpha_3 \boldsymbol{X_{i,t}} \boldsymbol{\varepsilon_{i,t}} \tag{6}$$

Where $G_{i,t}$ represents either $GC_{i,t}$ or $GD_{i,t}$, and $X_{i,t}$ is the fixed-effect variables (countries and time). These regressions are run to understand whether there is a relationship between the freedom score of countries and their stock market movements in response to Covid-19 announcements. As many free countries are developed countries with complex financial systems, state and time fixed effects are used to eliminate a possible effect that might be caused by countries' economic and financial strength.

3. Results

This section presents the results of the panel data regressions in Table 3. Country fixed effects (74 dummies) and time fixed effects (14 dummies) are employed in all regressions. Columns (1) and (2) of Table 3 present the results of Eq. (5), with country and week fixed effects. Similarly columns (3) and (4) present the results of Eq. (6) with country and month fixed effects.[4]

The results suggest that an increase in both the number of cases per million, GC, and the number of deaths per million, GD, have significant negative effects on stock market returns, and significant positive effects on volatilities. However, the effect of GC on returns is almost three times larger than that of GD. This might be because the number-of-cases data is an early warning signal and already give a rough idea of the coming death rates. So, the number of deaths might be irrelevant, it might not stand as a strong new information. This is consistent with the early studies performed on the financial markets, such as *(*Al-Awadhi et al., 2020*)* who find that the effect of daily growth in total death has a lower effect in the Chinese stock market than the daily growth in total confirmed cases.

Another point to notice in the regressions is that the coefficient of the cross term *FD*GC* is positive and significant in (1) and negative and significant in (3). This is not the case for *FD*GD* in (2) and (4). These results state that the index returns in freer countries exhibit less decrease (0.015) for every increase in the number of cases per million. Similarly, index volatilities in freer countries exhibit less increase (−0.005) for every increase in the number of cases per million. Moreover, the coefficients of *GC* and

[4] I use month fixed effects in the latter because the volatility calculation drops a large amount of data.

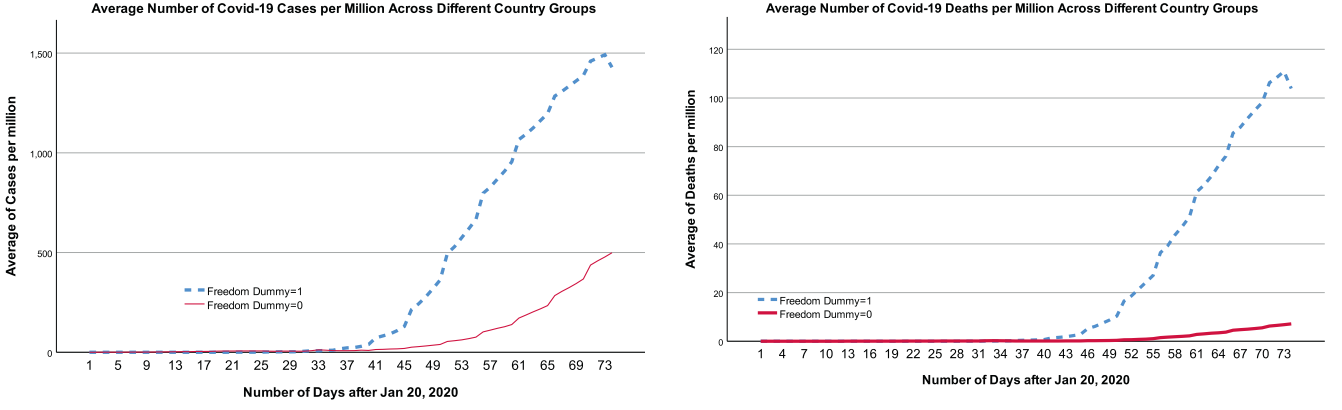

Fig. 1. (a) (left): Global Average Number of Covid-19 cases per million, $GC_{i,t}$, with respect to Freedom Dummy, $\boldsymbol{FD_{i,t}}$. (b) (right): Global Average Number of Covid-19 deaths per million, $GD_{i,t}$, with respect to Freedom Dummy, $\boldsymbol{FD_{i,t}}$.

Table 2
The Pearson correlation coefficients between the variables and their corresponding significance. R stands for stock market index return, S stands for the 5-day moving volatility of the stock market index returns. GC is the growth in the number of confirmed cases per million, GD is the growth in the number of deaths per million. F is the freedom index.

		R	S	GC	GD	F
R	Correlation	1				
	p-value					
S	Correlation	−0.106	1			
	p-value	0.000				
GC	Correlation	−0.253	0.248	1		
	p-value	0.000	0.000			
GD	Correlation	−0.100	0.288	0.596	1	
	p-value	0.000	0.000	0.000		
F	Correlation	−0.003	0.119	0.038	0.076	1
	p-value	0.804	0.000	0.026	0.000	

Table 3
This table presents panel regressions for 75 countries from January 20 to April 30, 2020. The dependent variable for regressions (1) and (2) is the major stock market index returns, and for (3) and (4) is 5-day moving volatility of index returns. All regressions use country-fixed effects and time-fixed effects. ***,**,* represents 1%, 5%, 10% significance levels. The numbers in brackets are the associated t-statistics.

	Dependent Variable: R, Daily stock market index returns		Dependent Variable: S, 5-day moving volatility of stock market indices	
	(1)	(2)	(3)	(4)
Intercept	0.001	−0.001	0.007***	0.008
	[0.062]	[−0.083]	[2.953]	[3.334]
GC	−0.036***		0.005***	
	[−8.92]		[3.564]	
GD		−0.013***		0.007***
		[−2.84]		[4.298]
FD*GC	0.015***		−0.005***	
	[2.74]		[−2.845]	
FD*GD		−0.001		−0.003
		[−0.137]		[−1.468]
Number of observations	5475	5475	5175	5175
Country-Fixed E.	Y	Y	Y	Y
Week-Fixed E.	Y	Y		
Month Fixed E			Y	Y
Country*Week Fixed E.	Y	Y		
Country*Month Fixed E.			Y	Y
Number of Countries	75	75	75	75
Adjusted R^2	0.088	0.034	0.638	0.68

*FD*GC* in the model (3) are equal with opposite signs. A coefficient test of the sum of these two coefficients being equal to zero is failed to be rejected (p-value = 0.83), and thus their sum is not statistically different from zero This suggests that the increase in stock market volatility due to an increase in growth of infection cases, *GC*, is completely offset in freer countries.

All in all, freer countries experience less return decreases, and less volatility increases (almost zero) in response to an increase in of Covid-19 cases growth. One might argue, however, that this might be because most free countries have more complex and efficient financial systems. Thus, these results might be attributable to their financial strength not to their freedom. This argument is eliminated by the country and time fixed effects, which are used to control the effects that might be caused by different economic and financial environments of the countries such as the size of the economy.

The results are striking because even though freer countries report a higher number of cases and deaths than less-free countries, the effect of the same size of an increase in pandemic cases has less effect on their stock markets. There might be several explanations for this. First, as less-free countries are associated with more suppression of freedom of expression (Freedom House 2019), they might easily hinder information about the severity of the disease. This can be due to a fear of a possible economic crisis or to protect their prestige. Thus, the investors trading in these countries might be suspecting that the number of cases is being underreported, and thus what they see might be the "tip of the iceberg." Because of this unmeasurable and ununderstandable uncertainty, they might overreact to the same size of announcement. Second, as (Lei and Wisniewski 2018) state, expropriation is more likely in autocratic states. (Durnev and Fauver 2011) say that this likelihood increases the mismanagement of the firms and lowers the firm value by as much as 5%. The possibility of expropriation, which may have increased because of economic challenges during Covid-19 times, might have been suppressing the stock market performance in less-free countries.

4. Conclusion and discussion

This study analyzes whether there is a relationship between the freedom of countries and their stock market movements in response to Covid-19 announcements. Considering that freer countries announce higher numbers of confirmed cases and death tolls than the others, the study is specifically concerned with how markets react to these countries` pandemics announcements.

Using broad stock market indices of 75 countries together with their coronavirus toll numbers, the results suggest first that markets are significantly negatively affected by the pandemic: the index returns decrease and volatilities increase. However, the effect of growth in the number of cases per million on stock returns is almost three times that of growth in the number of deaths per million.

Moreover and more interestingly, the adverse effects of the coronavirus on the stock markets are less in freer countries. In other words, the stock markets of less-free countries are affected more by the same size of an increase in the number of coronavirus cases. Similarly, the index volatilities in freer countries are associated with less increase than those in less-free countries. These results are obtained by controlling country-specific and time-specific factors such as the size of the economy. Therefore there does seem to be a strong negative relationship between freedom of a country and the effect of the pandemic on stock markets.

I propose two explanations for these results: First, investors in less-free countries might be thinking that the number of cases is being underreported, and thus they overreact to the same size of announcement. Second, the possibility of expropriation, which is more likely in autocratic states, might have been increasing during pandemics, and leading to mismanagement in firms. This situation lowers the firm value, suppressing the stock market performance in less-free countries.

Author statement

This is a single-author paper and thus all the work belongs to me.

APPENDIX: List of Countries in the study

Argentina, Australia, Austria, Bahrain, Belgium, Botswana, Brazil, Bulgaria, Canada, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Ghana, Greece, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Kenya, Laos, Latvia, Lebanon, Lithuania, Luxembourg, Malaysia, Malta, Mauritius, Mexico, Mongolia, Morocco, Namibia, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, United States, Vietnam, Zambia

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