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Stock market performance, COVID-19 related government measures, and immunization: Evidence from the G7

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Abstract

Research Question: What impact has the COVID-19 transmission rate, death rate, state involvement, and vaccine growth rate had on the stock market returns of the group of seven countries?

Motivation: On the one hand, the majority of the literature has only looked at the impact of government interventions, the number of confirmed Covid 19 cases, and the number of deaths on stock markets individually, not their combined impact. Additionally, there hasn't been any research done in the literature up to now on the effect of vaccination on stock market returns. By examining the impact of all four factors—vaccination growth rate, mortality rate, and speed of transmission of covid 19—on the stock market returns of the group of seven G7 countries, our study aims to close this difference. This study is the first comprehensive attempt to investigate the relationships among governmental engagement, COVID-19 vaccination, and stock market returns.

Idea: This study explains how stock markets in the G7 countries reacted to the spread rate of Covid 19, mortality rates, containment measures, and immunization

Data: The data was collected from a number of sources. The www.investing.com website provides information on daily stock market performance for the G7 economies. S&P 500 (US), FTSE 100 (UK), TSX (Canada), DAX 30 (Germany), CAC 40 (France), MIB (Italy), and Nikkei 225 (Japan) are the only major stock indices we choose. The www.ourworldindata.org website is used to collect the data required to calculate our covid 19 variables (Transmission speed, Mortality rate, Growth in immunization, Containment, and Health Index).

The Investment Freedom Index is collected from the Heritage Foundation's website, heritage.org. On www.policyuncertainty.com, you may obtain the Economic Policy

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Uncertainty Index. The World Bank's World Development Indicators are where the GDP data is derived. All data are for the period of January 1, 2020, to August 31, 2021.

Tools: We choose the panel data analysis method to investigate the impact of the COVID-19 pandemic, government action, and vaccines on G7 stock returns. Three COVID-19 variables are first calculated (speed of transmission, mortality rate, and vaccination growth). In the following step, we do panel pooling ordinary least squares regressions. Lastly, a number of robustness tests are applied.

Findings: Results show that Covid 19 transmission negatively affects the performance of the G7 stock market. Additionally, research suggests that the virus has infected the atmosphere in the trading halls of seven of the biggest economies in the world, since neither government initiatives nor immunization, have been able to reassure investors or deliver positive results.
Contribution: Although there is a substantial amount of literature on stock market performance, this study provides fresh information by examining the impact of three COVID-19 indicators on the performance of the G7 stock markets during the epidemic. In contrast to earlier research, this study assessed the G7 stock market's reaction to vaccination for the first time.

Keywords: stock market performance, COVID-19, containment measures, vaccination, G7 stock market returns, panel pooled OLS.

JEL codes: G01, G10

1. Introduction

More than 750 million infections have been confirmed globally as a result of the COVID 19 pandemic, and more than 6.5 million people have died as a result. The COVID-19 outbreak is more than a devastating pandemic; it also contributed to financial and economic unrest, sending the global economy into its worst crisis since the Great Depression. As a result, the coronavirus has generated considerable interest and has emerged as a vital research issue across the board (Leoni *et al.*, 2022). Stock markets, for example, are among the most immediate and direct reacting sectors of economic and financial systems (Bai *et al.*, 2021). In terms of the influence of Covid 19 on financial markets, Bai *et al.* (2021); Goodell (2020) and Garfatta *et al.* (2023) noted that the pandemic had a significant impact on all financial markets as well as the global economy. On the other hand, (al-Awadhi *et al.*, 2020; Alblescu, 2021; Achraf, 2020; Baker *et al.*, 2020; Bannigidadmath *et al.*, 2021; Li *et al.*, 2021; Rouatbi *et al.*, 2021; Rehman *et al.*, 2021; Zhang *et al.*, 2020) stated that the effect of COVID 19 on stock markets is unique in history. According to Morales and Andreosso-O'callaghan (2020), he is a "black swan" event in the stock market.

As a result of the devastating impact of this epidemic on the global economy, many actions have been taken by all nations of the world to combat the COVID-19 crisis

and its negative consequences, as well as to save the global economic fabric, such as government restrictions imposed prior to the arrival of vaccination in early 2021, which has appeared to be the light at the end of the tunnel for the entire world.

As a result, a growing number of studies have been done to investigate the influence of COVID-19 indicators on stock market returns in various countries (number of confirmed cases, COVID-19 transmission speed, number of fatalities, mortality rate). Other studies look at how the Covid-19 epidemic and government actions affect stock market performance. However, there has been a minimal economic study on the influence of vaccination on stock market returns, particularly on G7 stock market returns.

Among the research that looked at how daily COVID-19 instances and deaths affect stock markets are (Sharif *et al.*, 2020; Al-Awadhi *et al.*, 2020; Zhang *et al.*, 2020; Albulescu, 2021). In the United States, Sharif *et al.* (2020) observed an important relationship between stock returns, confirmed cases of COVID-19, economic policy uncertainty, and geopolitical risk. Albulescu (2021) also revealed that new cases and deaths reported in the United States and throughout the world were increasing volatility in financial markets in the United States. Additionally, Al-Awadhi *et al.* (2020) found that a daily increase in the total number of COVID-19 cases and fatalities had a negative impact on stock market returns.

In another part of the literature, we find further research focusing on the impact of the Covid-19 pandemic and government interventions (lockdown, social distancing...) on stock market performance. So, Stordal *et al.* (2021) examined the effects of different government measures, such as school closures, travel restrictions, and financial assistance, in Norway and Sweden from January 1 to November 5, 2020. They observed that government intervention had minimal influence on Norwegian stock market yields while having a favorable effect on the stock market. Alexakis *et al.* (2021) evaluated the impact of social distancing measures imposed by the government. Zaremba *et al.* (2020) shown in this context that non-pharmaceutical treatments considerably enhance equities market volatility.

Since late 2020, governments have gradually eased restrictions and implemented extensive vaccination campaigns in order to have an economic recovery. According to (Fu *et al.*, 2022) The covid 19 vaccine is a key weapon to fight the pandemic and resurrect the depressed economy. So, a study of the available literature on the influence of COVID-19 immunization on stock market returns shows some theoretical analyses, such as those by FU *et al.* (2022) and Hartono (2021), as well as a limited empirical review. Hartono (2021), for example, investigated the relevance of the global stock market and the effects of the covid19 vaccination on investor confidence in his conceptual work. His research found that investors' favorable impressions of the vaccination program affected the stock market's success. As a result, this emphasizes the significance of acquiring further empirical evidence. There is a knowledge gap regarding the influence of the COVID19 vaccine

on stock market performance. The important question at this point is whether the Covid 19 vaccine had an impact on the stock market returns of seven major worldwide nations?, and if so, what was the nature of that impact?.

So far as we know, no financial research on the impact of vaccination on the performance of the G7 stock index has been done. Khalfaoui *et al.* (2021), who evaluated temporal relationships between Covid-19 immunization, infection rates, death rates, and stock market returns in the United States, are among those who have empirically researched the reaction of stock markets to the advent of the COVID-19 vaccine. He used daily data on the number of infections, deaths, and vaccinations, as well as returns on the S & P 500 index. They found that daily infections, daily deaths, and new coronavirus vaccination rates had a positive and significant impact on the performance of the S & P 500 index.

Rouatbi *et al.* (2021) studied the impact of COVID-19 vaccination on global stock market volatility. They pointed out that immunization programs helped stabilize global stock markets and that immunization had a greater impact on developed markets than on emerging markets. These studies largely focus on the volatility and stability of the stock market, as well as vaccination announcements. Thus, our research adds to both the existing body of information regarding the impact of epidemics (like Ebola and SARS) on financial markets as well as the most recent body of knowledge about the implications of the current coronavirus-19 danger for the economy and the financial system. From 1 January 2020 to 31 August 2021, we examine the consequences of Covid 19 spread rate, mortality rates, containment measures, and immunization on stock markets in the G7 countries. To do this, we choose panel data analysis as our method. Performing panel pooling ordinary least squares regressions is the next step. Several robustness tests are then applied.

In particular, our study provides the following contributions: First and foremost, we chose the G7 countries as a study sample because, despite being the world's largest industrialized countries, they were severely impacted by covid-19. Second, our study is the first to assess the response of the G7 stock market to vaccination. Thirdly, unlike most studies that looked at the impact of COVID-19 on stock markets, we calculated three daily indices: COVID-19 transmission rates, mortality rates, and immunization rates relative to new confirmed cases, new deaths, and new numbers of immunized patients, in that order. Fourth, our sampling period is the longest and most complete time ever used in previous studies. Our findings indicate that Covid 19 transmission has a detrimental impact on the performance of the G7 stock market. Furthermore, research indicates that the virus has infiltrated the environment in the trading halls of seven of the world's largest economies, since neither government measures nor vaccines have been able to comfort investors or produce beneficial effects.

The remainder of this paper is organized as follows: Section 2 provides a summary of the related documentation. Section 3 describes the research methodology used in

this study. Section 4 presents the empirical results methodology. Section 5 examines the Robustness analysis estimation results. Finally, Section 6 concludes the document.

2. Literature review

Since December 2019, a new pandemic type, covid-19, has been discovered in Wuhan, China. The pandemic quickly spread throughout China and the rest of the world. The outbreak has a direct impact on global financial and stock markets. A large number of studies have been conducted to investigate the financial market impact of the covid-19 pandemic (al- Awadhi *et al.*, 2020; Ashraf, 2020; Goodell, 2020; Zhang *et al.*, 2020). This part reinforces the view that covid-19 caused a historical economic and financial crisis.

For example, according to Al-Awadhi *et al.* (2020), all China stock returns correlated negatively with confirmed infected cases and deaths per day. Ashraf (2020) finds that stock market returns declined as the number of confirmed cases increased, using daily confirmed case and death data and confirmed stock market returns from 64 countries during the period January to April 2020. Also, The COVID-19 had a negative and significant impact on the returns of US stocks, according to Alfaro *et al.* (2020). Furthermore, through text analysis, Baker *et al.* (2020) found that the main drivers of daily fluctuations in the US stock market from the end of February to April 2020 are positive and negative news. According to the author, no other epidemic has had such a large impact on the stock market as covid-19. Additionally, Hsu & Liao (2022) show that five COVID-19 indicators all have a negative correlation with stock returns using U.S. data, which is considerably affected by COVID-19.

According to Goodell (2020), the COVID-19 pandemic is causing massive economic damage around the world. He stressed that due to the impact of investor sentiment on decision-making, the epidemic has a far-reaching impact on the financial sector, including the stock market. Similarly, Zhang *et al.* (2020) discovered that COVID-19 increased risk in the global financial market for countries in the top ten confirmed cases in March 2020. Also, the number of COVID-19 cases had a negative and significant effect on the G7 equity markets, according to Izzeldin *et al.* (2021). Based on daily data from December 31, 2019, to November 13, 2020, Ur Rehman *et al.* (2021) investigated the combined change in G7 stock return and the number of newly confirmed coronavirus-19 cases. They used wavelet coherence to measure the incidence of confirmed cases and deaths in the G7 stock market and discovered that confirmed cases and deaths caused by new coronavirus-19 strongly correlate with the G7 stock market.

In her research, Kotishwar (2020) used the VECM to determine the link and found that the Covid-19 had a substantial long-term negative relationship with all the stock indexes of the six nations (USA, Spain, France, Italy, China and India).

To limit the negative impact of the epidemic and stabilize financial markets, countries worldwide must first implement containment measures. Stordal *et al.* (2021) investigated the impact of selected government interventions in Norway and Sweden on their respective stock markets. The results show that these interventions positively impact the Swedish stock market but have little impact on Norway's yield. Zaremba *et al.* (2020) investigated the effectiveness of stringent measures implemented by 67 countries worldwide to combat the coronavirus pandemic. They demonstrate that non-drug intervention significantly raises the volatility of international stock market returns. Wang *et al.* (2021) used a panel quantitative regression model to assess how government interventions associated with COVID-19 affect the tourism and leisure stock market. They show that containment and health measures have improved stock returns. Based on daily stock market performance data, CVID-19 confirmed case growth and government policy announcements in 77 countries between 22 January and 17 April 2020; Ashraf (2020) finds that announcements about the implementation of social distancing measures have a dual effect on stock market performance, both directly negative and indirectly positive. Alexakis *et al.* (2021) are investigating the COVID-19 social distancing measures' direct and indirect effects. He employs spatial econometrics. He discovers a negative relationship between stock market returns and the intensity of the blockage. Aharon and Siev (2021) are studying the impact of government interventions to prevent the spread of COVID-19 on emerging stock markets. The findings suggest that government interventions harm these financial markets. Khalfaoui *et al.* (2021) investigate the time-varying relationship between COVID-19 vaccination, infection rate, and case fatality ratio in the United States and stock market returns using COVID-19 daily confirmed number of infections, deaths, and vaccinations and the daily US stock market index return. They demonstrate that the COVID-19 vaccination rate, infection rate, and case fatality ratio all positively and significantly influence S&P 500 returns at most business cycle frequencies with an in-phase relationship.

3. Research methodology

The methodology used in this study can refer to many different aspects, such as the sample choice, the data sources, and the econometrics techniques used to analyze them. Following is an analysis of all of this.

3.1 Sample selection and data source

This study's major goal is to illustrate how the financial markets in the G7 nations responded to Covid 19 spread rates, mortality rates, containment strategies, and vaccines. For that, a variety of sources were used to collect our data. First, from each sample country, we choose only one major stock index (S&P 500 (US), FTSE 100 (United Kingdom), TSX (Canada), DAX 30 (Germany), CAC 40 (France), MIB (Italy), and Nikkei 225 (Japan)). These main stock market indices' daily prices were

obtained from the www.investing.com website. The dates chosen for the sampling are January 2, 2020, through August 31, 2021.

The data relatives for calculating our COVID-19 variables (Transmission speed, Mortality rate, and Growth in vaccination) and the containment and health index are all from the website www.ourworldindata.org. The Investment Freedom Index can be found on the Heritage Foundation's website at www.heritage.org. The Economic Policy Uncertainty Index is available at www.policyuncertainty.com. We include Log (GDP), which equals the natural logarithm of each country's total gross domestic product (GDP), with GDP data sourced from the World Bank's World Development Indicators.

3.2 Variables measurement

3.2.1 Dependent variable

Like any other quantitative empirical study, ours examines the potential impact that various independent factors may have on the dependent variable. In this study, taking into consideration our goal, the return of the daily stock market indices for the Group of Seven countries serves as our dependent variable. The daily stock market return was computed as $Ret_t = [\frac{Index\ value_t}{Index\ value_{t-1}}] - 1$. All stock index returns are converted into dollars.

3.2.2 Independent variables

We were able to find a number of independent elements that could affect stock market results by studying the literature and keeping our goal in mind. We computed our three COVID-19 variables—Transmission speed, Mortality rate, and Growth in vaccination—after gathering information about covid19 from the website www.ourworldindata.org. We created the following measures:

$$transmission\ speed_t = New\ confirmed\ cases_t / Cumulative\ confirmed\ cases\ _t \times 100$$

$$Mortality\ rate_t = New\ deaths_t / (Cumulative\ deaths_t\ ) \times 100$$

$$Growth\ in\ vaccination_t = New\ vaccination_t / Total\ vaccinationt_t\ \times 100$$

We also included the containment and health index as an independent variable in our model. This index is a composite measure based on thirteen policy response indicators, including school closures, workplace closures, travel restrictions, testing policy, contact tracing, face coverings, and vaccination policy, which have been rescaled to a value of 0 to 100 (100 being the tightest). The fifth control variable is the Investment Freedom Index which can be found on the Heritage Foundation's

website at www.heritage.org. The sixth control variables are the Economic Policy Uncertainty Index. And the seventh controls variables, which we include is Log (GDP), which equals the natural logarithm of each country's total gross domestic product (GDP). Finally, we collected all the data of our variables and integrated them to make our research model while eliminating the daily observations of which one was missing.

3.3 Regression model

The primary goal of this research is to examine the influence of the COVID-9 epidemic, government intervention, and vaccine on G7 stock returns. We picked the panel data analysis approach to investigate this. As Ashraf (2020) pointed out, the virus spreads within a few days, and the panel data can more effectively capture the time relationship between dependent and independent variables. In addition, Al-Awadhi *et al.* (2020) pointed out that panel data regression reduced estimation bias, multicollinearity, and individual heterogeneity. As a result, we used the following general least squares regression model for empirical investigation based on Ashraf (2020):

$$Ret_{c,t} = \alpha_c + \beta_1 COVID - 19_{c,t-1} + \sum_{k=1}^{k} \beta_k Z_c^k + \sum_{t=1}^{T-1} \epsilon_t D_t + \varepsilon_{c,t}$$

Eq. (1)

The *c* and *t* subscripts represent country and day, respectively. α_c is a constant term. The dependent variable is *Ret*, and it represents stock market returns in county *c* on day *t*. We calculated the daily stock market return as $Ret_t = [\frac{Index\ value_t}{Index\ value_{t-1}}] - 1$.

$COVID - 19_{c,t-1}$ represents (1) Transmission speed of COVID-19, (2) Mortality rate with covid 19, (3) represents Containment and health index, and (4) represents Daily Growth in vaccination in each country. Z_c^k is a collection of country-level control variables that includes investment freedom (IF), economic policy uncertainty (EPU), and log (GDP). D_t is a set of daily fixed-effects dummy variables, to control the reaction of stock markets to daily international events. These dummy variables have a value of 1 for one day and 0 for all other days. These dummy variables effectively control systematic risk dummy variables. $\varepsilon_{c,t}$is an error term. To estimate *p-values* in regressions, we use heteroskedastic-robust standard errors.

4. Empirical results

4.1 Descriptive statistical analysis

Table 1 summarizes the statistics of the main variables used in our study. It provides information on the daily fluctuations of stock market returns in the G-7 countries. As can be seen from the table, the stock return is between -0.187 and 0.136, with an average of zero.

Similarly, for COVID-19 variables, the minimum transmission rate is -0.074 as long as the maximum rate is 1.214 with an average of 0.026. The average death rate is 0.033, with a low of -0.008 and a high of 2.417. The daily vaccination rate for Covid-19 ranges from 0 to 0.993. His average is 0.038. The economic policy uncertainty index ranges from 41.307 to 678.817. Similarly, the lowest level of investment freedom is 60, the highest level is 85, and the average level is 78.065.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Stock market returns	2935	0.000	0.018	-0.187	0.136
Transmission Speed	2768	0.026	0.075	-0.074	1.214
Mortality Rate	2633	0.033	0.148	-0.008	2.417
Containment index	2893	57.918	18.192	0.000	85.42
Growth in vaccination	1167	0.045	0.09	0.000	0.993
Economic Policy Uncertainty	2935	236.777	119.379	41.307	678.817
Investment Freedom	2935	78.065	5.811	60	85
Log (GDP)	2935	28.928	0.808	28.1	30.7

Notes: This table presents descriptive statistics for the variables considered in our investigation. Stock market returns are calculated as the daily change in the primary stock index of each G7 country. The daily transmission pace of COVID-19 is assessed by the ratio of new cases to accumulated cases. The daily mortality rate of COVID-19 is assessed by the ratio of new fatalities to cumulative deaths. The Containment Index is collected from www.ourworldindata.org. website. This index gauges the severity of government policy. Growth in vaccination is evaluated by the ratio of new vaccination to total vaccination. Investment freedom is obtained from the Freedom House website. Index of EPU is downloaded from the economic policy uncertainty website. The log (GDP) is obtained from the World Bank's World Development Indicators (WDI).

4.2 Correlations analysis

The test's primary objectives are to determine whether the variables are multicollinear and to identify any relationships between them. Table 2 displays the pairwise correlation coefficients between all variables used in our analysis, indicating that transmission rate, mortality rate, and vaccination growth are all significantly and negatively correlated with stock market returns, providing preliminary evidence that COVID-19 vaccination share does not play an important

role in stock market returns. But the containment index is significantly and positively correlated with stock returns.

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Ret	1.000							
(2) TransmissionSp~d	-0.13*	1.000						
	(0.00)							
(3) MortalityRate	-0.12*	0.490*	1.000					
	(0.00)	(0.00)						
(4) Cont	0.055*	-0.43*	-0.20*	1.000				
	(0.00)	(0.00)	(0.00)					
(5) Growthinvacc	-0.08*	0.187*	-0.013	-0.08*	1.000			
	(0.00)	(0.00)	(0.66)	(0.00)				
(6) EPU	-0.005	0.155*	0.147*	0.039*	0.121*	1.000		
	(0.77)	(0.00)	(0.00)	(0.03)	(0.00)			
(7) IF	-0.007	-0.002	0.021	0.232*	-0.13*	0.274*	1.000	
	(0.70)	(0.90)	(0.27)	(0.00)	(0.00)	(0.00)		
(8) Log (GDP)	-0.017	-0.08*	-0.04*	-0.11*	0.044	-0.24*	0.186*	1.000
	(0.35)	(0.00)	(0.01)	(0.00)	(0.13)	(0.00)	(0.00)	

Notes: The Pearson correlations between the primary variables are displayed in this table. Stock market returns are calculated as the daily change in the primary stock index of each G7 country. The daily transmission pace of COVID-19 is assessed by the ratio of new cases to accumulated cases. The daily mortality rate of COVID-19 is assessed by the ratio of new fatalities to cumulative deaths. The Containment Index is collected from www.ourworldindata.org. website. This index gauges the severity of government policy. Growth in vaccination is evaluated by the ratio of new vaccination to total vaccination. Investment freedom is obtained from the Freedom House website. Index of EPU is downloaded from the economic policy uncertainty website. The log (GDP) is obtained from the World Bank's World Development Indicators (WDI).
*, ** ,*** Denotes the level of significance at the 1%, 5% and 10%, respectively.

4.3 Regression-analyses and findings

To examine the impact of the covid 19 pandemic, government interventions, and vaccination on the returns of the stock market indices of the group of seven countries, we estimate Eq. (1) using the panel pooled ordinary least squares regression technique. The use of this technique is motivated by other studies that have been examined on the effects of COVID-19 on financial markets (e.g., Ashraf, 2020; Rouatbi *et al.*, 2021). The outcomes are shown in Table 4. The results show that the transmission speed variable is negative and significant in Model (1), and it retains the same effect after including the control variables in Model (2) as it does after including daily fixed-effects dummy variables in Model (3). These results confirm the idea that COVID-19 transmission was negatively and significantly associated with changes in index returns. Our results are, among others, comparable to those of (Al-Awadhi *et al.*, 2020; Alfaro *et al.*, 2020; Ashraf, 2020; Zhang *et al.*, 2020; Xu 2021). The study applied the VECM to know the relationship and observed that the Covid-19 having the significant negative long run relationship with all the selected countries stock indices. The variable growth in deaths also enters negative (Models 4 and 5), but it loses significance when adding daily fixed-effects dummy variables (Model 6). These findings indicate that the stock market's reaction to the number of deaths is weak.

The containment index variable is positive and significant in Models (7 and 8). Still, when the daily fixed-effects dummy variables are included in Model (9), the results completely change, and the containment index variable becomes negative and significant. This demonstrates that the stock market has a negative reaction to government policies. Our results are similar to those of Alexakis *et al.* (2021). Daily vaccination growth is negative and significant in the Model (10, 11, and 12), implying that G7 stock markets are reacting negatively to the increase in COVID-19 vaccination even when we introduced daily fixed-effects dummy variables into the Model (12).

Overall, these findings suggest that the rate of covid-19 transmission, containment index, and immunization growth all have a significant and negative impact on G7 market returns. We believe that although government interventions and immunization programs are designed to limit the impact of new coronavirus-19, they do more harm than good. This may be because investors are still afraid of the future and investment.

Table 3: Impact of COVID-19, containment and vaccination on G7 stock market returns

Variables	Stock market returns											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TransmissionSp~d	-0.032*** (0.000)	- 0.03*** (0.000)	-0.01* (0.085)									
MortalityRate				-0.015**	-0.015**	0.001						
				(0.02)	(0.015)	(0.761)						
Containment							0.000*** (0.006)	0.000*** (0.006)	-0.000* (0.075)			
Growth in vacc										-0.009** (0.025)	-0.009** (0.028)	-0.007* (0.094)
Economic Policy Uncertainty		0.000 (0.692)	0.000 (0.79)		0.000 (0.678)	0.000 (0.951)		-0.000 (0.861)	-0.000 (0.614)		0.000 (0.519)	0.000 (0.119)
Investment Freedom		0.000 (0.519)	0.000 (0.469)		0.000 (0.763)	-0.000 (0.464)		-0.000 (0.301)	0.000 (0.164)		0.000 (0.806)	0.000 (0.704)
Log (GDP)		-0.001** (0.016)	-0.001*** (0.002)		-0.000** (0.038)	-0.001*** (0.005)		-0.000 (0.685)	-0.001* (0.062)		-0.001* (0.086)	-0.001* (0.070)

Variables	Stock market returns											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TransmissionSp~d	-0.032*** (0.000)	- 0.03*** (0.000)	-0.01* (0.085)									
MortalityRate				-0.015**	-0.015**	0.001						
				(0.02)	(0.015)	(0.761)						
Containment							0.000*** (0.006)	0.000*** (0.006)	-0.000* (0.075)			
Growth in vacc										-0.009** (0.025)	-0.009** (0.028)	-0.007* (0.094)
Economic Policy Uncertainty		0.000 (0.692)	0.000 (0.79)		0.000 (0.678)	0.000 (0.951)		-0.000 (0.861)	-0.000 (0.614)		0.000 (0.519)	0.000 (0.119)
Investment Freedom		0.000 (0.519)	0.000 (0.469)		0.000 (0.763)	-0.000 (0.464)		-0.000 (0.301)	0.000 (0.164)		0.000 (0.806)	0.000 (0.704)
Log (GDP)		-0.001** (0.016)	-0.001*** (0.002)		-0.000** (0.038)	-0.001*** (0.005)		-0.000 (0.685)	-0.001* (0.062)		-0.001* (0.086)	-0.001* (0.070)

Notes: The following table summarizes the panel pooled ordinary least squares results of the impact of COVID-19 on G7 stock returns. The estimation is based on the heteroskedasticity robust standard error. The dependent variable on all models is stock market returns, and they are measured by the daily changes in a country's main stock index. The daily transmission speed of COVID-19 is measured with the ratio of new cases to cumulative cases. The daily mortality rate of COVID-19 is measured with the ratio of new deaths to cumulative deaths. The Containment Index is obtained from the www.ourworldindata.org website. This index measures the rigor of government policies. Growth in vaccination is measured by the ratio of new vaccination to total vaccination. Investment freedom is taken from the Freedom House website. Index of EPU is downloaded from the economic policy uncertainty website. The log (GDP) is obtained from the World Bank's World Development Indicators (WDI).
P-values are given in parenthesis, and *, **, *** indicate the significance level at 10%, 5%, and 1%, respectively.

5. Robustness analyses

To corroborate the above-mentioned major conclusions, we undertake numerous robustness tests. We initially use the panel random-effects regression approach to re-estimate all of the requirements in Table 4. All of the re-estimation findings are fairly comparable to those in Table 3. Second, to guarantee that missing data do not impact our conclusions in a cross-country situation, we re-estimate Eq. (1) using country fixed-effects dummy variables rather than country-level control variables. The new results are qualitatively comparable to those previously presented in Table 4. To summarize, Table 5 indicates that our findings are robust when these alternative tests are utilized.

Table 4: Impact of COVID-19, containment and vaccination in G7 stocks markets robustness tests

Variables	Stock market returns			
	(1)	(2)	(3)	(4)
TransmissionSp~d	-0.001* (0.093)			
MortalityRate		0.001 (0.751)		
Containment			-0.000* (0.1)	
Growthinvacc				-0.007* (0.089)
Daily fixed-effects dummy variables	Yes	Yes	Yes	Yes

Variables	Stock market returns			
	(1)	(2)	(3)	(4)
Country fixed-effects dummy variables	Yes	Yes	Yes	Yes
Constant	0.007***	-0.002	0.007**	-0.01***
	(0.000)	(0.902)	(0.019)	(0.000)
Observations	2768	2633	2893	1167
R-Squared	0.673	0.6727	0.608	0.569

Notes: This table shows the robustness test results for the impact of COVID-19, containment, and vaccination on G7 stock markets after incorporating country fixed-effects dummy variables into the main model. The dependent variable on all models is stock market returns, and they are measured by the daily changes in a country's main stock index. The daily transmission speed of COVID-19 is measured with the ratio of new cases to cumulative cases. The daily mortality rate of COVID-19 is measured with the ratio of new deaths to cumulative deaths. The Containment Index is obtained from the www.ourworldindata.org website. This index measures the rigor of government policies. Growth in vaccination is measured by the ratio of new vaccination to total vaccination. The following results are estimated using a pooled OLS estimator with heteroskedasticity robust standard errors.
P-values are given in parenthesis, and *, **, *** indicate the significance level at 10%, 5%, and 1%, respectively.

6. Conclusion

A panel pooling OLS regression technique is used in this study to examine the impact of COVID-19, containment measures, and vaccination on G7 stock market returns. Thus, from January 2, 2020, through August 31, 2021, we constructed three indices for daily confirmed instances of covid19, daily fatalities, and daily vaccination. The findings indicate that the spread of Covid-19, as well as government involvement and immunization, has had a detrimental influence on stock market performance. To be more specific, we find that the COVID-19 spread hurts G7 stock market returns, which is consistent with (Al-Awadhi *et al.*, 2020; Ashraf, 2020a; He *et al.*, 2020, Zhang *et al.*, 2020; Xu, 2021). Second, we find that the multiple G7 government programs have a negative effect on the returns for the G7 stock markets. Our results are consistent with research done in other nations (Ashraf, 2020b; Alexakis *et al.* 2021; Haldar & Sethi, 2020; Narayan, 2020b).

Our findings have far-reaching implications for investors, policymakers, and regulators, in the developed world. Investors and policymakers should seek strategies rather than waiting for the pandemic to have a negative and significant impact on the stock market returns in the event of further disruptions (e.g., future covid 19 waves). Furthermore, our findings support the critical role that

policymakers and governments can play in sending positive signals to investors, thereby reducing the spread of pessimism. Additionally, global policymakers must formulate appropriate policies, enact bans (such as a short-selling prohibition) to reduce the possibility of market loss, reduce uncertainty and protect market stability. As part of future research, it would be interesting to expand our study to address certain limitations by (raising the number of nations, splitting the period (after and before vaccination), or comparing to other developed countries). Furthermore, the incorporation of macroeconomic factors is important; we leave it for future research.

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