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Policy responses to COVID-19 and stock market reactions - An international evidence

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ABSTRACT

The COVID-19 pandemic has caused escalating levels of business, economic and societal uncertainty and created extensive disruptions around the world. Policymakers have responded with a variety of measures to combat this unprecedented crisis. This paper investigates the stock market reactions to the national policy responses. We focus on the two influential policy actions: the nationwide lockdown order aiming to slow down the spread of the Coronavirus, and the interest rate cut policy aiming to minimize the negative economic impact of the pandemic. The Difference-In-Difference method is employed to conduct a cross-country analysis. We find that both policy actions have a significant and positive impact on the stock market performance. We also document a larger stock market reaction to the announcement of an interest rate cut policy than that of a lockdown order.

1. Introduction

The World Health Organization (WHO) officially declared the COVID-19 outbreak to be a global pandemic on March 11, 2020. Over 213 countries and territories and lives of millions of people have been affected by the novel Coronavirus spread. The global financial markets have experienced deep dive in the value and abnormal volatility (i.e. Alfaro, Chari, Greenland, & Schott, 2020; Baker et al., 2020). Policymakers worldwide have implemented a variety of measures aiming to mitigate the health, political, and economic effects of this enormously destructive crisis (Iyke, 2020, Hale, Petherick, Phillips, & Webster, 2020; Narayan, Phan, & Liu, 2021; Phan & Narayan, 2020). The two predominant policies are the lockdown order and the interest rate cut policy. The lockdown order is a non-pharmaceutical intervention (NPI) enforced by governments to control the spread of COVID-19. As of May 26, 2020, 48 countries have issued a full or partial lockdown policy. The interest rate cut policy is implemented to alleviate the financial and economic damages caused by the crisis. Many central banks have lowered the policy interest rate as the initial monetary policy response. In the US, the Fed first responded with a fed funds rate cut by 50 basis points to a target range of 1–1.25 % on March 3, 2020.

There is huge uncertainty surrounding the policy responses to COVID, centering around whether and how they can effectively revitalize the economy (Altig et al., 2020; Sharma & Sha, 2020). Stock market is one of the most important financial markets and plays an important role in the policy transmission. Therefore, it is critical to study the stock market reactions to policy responses. Furthermore, various interventions have different impacts on the stock markets (Yang & Deng, 2021). Considering that the NPIs are

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designed to stop or slow down the spread, while the monetary policies are designed to stimulate the economic activities, the stock market might react in different ways with different magnitude. It is valuable to evaluate the different policy impacts so that the governments can make informed decisions in choosing and prioritizing their intervention measures.

An involving literature has explored the stock market reactions to policy responses during the pandemic. Phan and Narayan (2020) hypothesized the positive effect of lockdown on stock markets and found the supporting evidence. A few studies have since reported mixed findings regarding the impact of the lockdown order on the stock market performance (Aggarwal, Nawn, & Dugar, 2021; Alam, Alam, & Chavali, 2020; Baig, Butt, Haroon, & Rizvi, 2021; Capelle-Blancard & Desroziers, 2020; Haroon & Rizvi, 2020; Scherf, Matschke, & Rieger, 2021). A handful of studies examined the stock market reaction to monetary policies (Capelle-Blancard & Desroziers, 2020; Haddad, Moreira, & Muir, 2020; Ozili & Arun, 2020; Phan & Narayan, 2020). However, some preeminent research questions remain open. What are the economic impacts of national policy responses on the stock market around the world? Whether and how does the stock market react differently to different types of policies, i.e. the NPI policies vs. the monetary policy?

In an attempt to address these questions, this paper investigates the behavior of stock market in response to these two policies in a global setting. Following Narayan et al. (2021), we develop our hypotheses for these two questions based on the literature in investor sentiment driven stock return theory. Prior studies show that investor sentiment predicts stock returns both in the cross-section and in the aggregate (i.e. Baker & Wurgler, 2006; Corredor, Ferrer, & Santamaria, 2013; Narayan, 2019; Yu & Yuan, 2011). Such effect has been observed during the pandemic (Chen, Liu, & Zhao, 2020; Narayan et al., 2021). We postulate that both policies influence stock market positively through increasing investors' confidence and sentiment, which in turn influence the stock markets positively. We believe that the lockdown policy has a positive effect on stock market because it is perceived by investors as a solution to the spread of the virus (Capelle-Blancard & Desroziers, 2020) and thus serving as a "confidence booster" to the investors and the market (Phan & Narayan, 2020; Yang & Deng, 2021). Similarly, we postulate that the interest rate cut policy has a positive effect because it stimulates financial activity and is considered by investors as catalysts for growth and a robust economy. In addition, we hypothesize that between these two intervention policies, the interest rate cut would have a more positive effect than the lockdown policy on the stock market. The lockdown policy aims at preventing the economic activities and there is controversy about whether it can slow down the spread, which may raise the investor concern and lead to weaker responses (Correia, Luck, & Verner, 2020; Lilley, Lilley, & Rinaldi, 2020; Ozili & Arun, 2020).

To test these hypotheses, we construct a panel dataset of eleven countries and one special administrative region (SAR) from January to July 2020. Our sample covers a group of nations across different continents, at various economic development stages and with diverse exposure to the COVID-19 crisis. We collected the country-level data on the daily confirmed cases, death numbers, stock market indices, government policies taken during the pandemic, and stringency of responses. To account for a potential issue of endogeneity stemming from the unobserved fixed effects of socio-economic aspects of a country, we employ a Difference-In-Differences (DID) method (Wooldridge & Imbens, 2007) to conduct the cross-country analysis. Our results reveal the following insights. First, on average, stock markets across countries have experienced negative returns at a mean value of -0.04 %. However, there existed discrepancies in the stock market reactions. Second, contrary to the belief that lockdown orders will trigger negative reactions from the market (Bauer & Weber, 2021), the results show that the global stock markets rebounded on the announcement of both policies. Third, we confirm that the magnitude of the reaction is dependent on the nature of the policy action. Stock markets have reacted more vigorously to the announcement of the interest rate cut policy, in comparison to the lockdown order.

Our findings contribute to literature on several fronts. First, our study extends the financial crisis literature (i.e. Jagannathan, Kapoor, & Schaumburg, 2013; Mian & Sufi, 2010) and complements the growing literature that examines the impact of COVID-19 on the financial markets (i.e. Capelle-Blancard & Desroziers, 2020; Ru, Yang, & Zou, 2020). The COVID-19 crisis is widely spread and occurring in almost every country, as compared to other crises. The historical risk-sharing among countries through global trade is not likely to help this time (Fernandes, 2020). We conduct a cross-country study to take advantage of its unique features and provide new perspectives on how the stock market performs in a time of global shock. Second, this paper contributes to a growing literature that connects the stock market behavior with countries' policy reactions. We found positive impact of both the lockdown policy and the interest rate cut policy. Our finding of the positive market reaction to the lockdown policy is consistent with the results reported by studies on the role of lockdown policies on stock market (Alam et al., 2020; Capelle-Blancard & Desroziers, 2020; Haroon & Rizvi, 2020; Narayan et al., 2021; Phan & Narayan, 2020). We also documented a positive impact of the interest cut policy on stock market, which confirmed the results reported by Capelle-Blancard and Desroziers (2020). The stock market forms an important transmission path for monetary policy (i.e. Bernanke & Kuttner, 2005). Mishkin (2009) argued that monetary policy is more potent during a crisis than during normal times. Our results reinforce the validity of the stock market channel and shed light on policy development. Third, we attempt to fill in the gap in the literature by not only investigating the impact of both policies, but also comparing their relative influence on the stock market. COVID-19 has caused both a health and economic shock of unprecedented scale and scope. There is a heated debate on how policymakers should respond. The lockdown policy aims to slow down the spread of COVID-19 and strengthen public health. At the same time, it can slow down economic activities. The monetary easing policy aims to mitigate the negative economic impacts. However, it might not be effective in creating overall demand and can trigger the unwelcoming "side effects" down the road. Our study expands to the role of non-economic factors and provides new evidence on how the stock market reacts to different types of policy changes. Our study is complementary to Capelle-Blancard and Desroziers (2020) by comparing the effects of the two policies - we found that stock markets reacted more favourably to the announcement of a monetary easing policy than that of a containment intervention policy. The monetary easing policy may have been perceived by investors as more active and consequential. An implication is that policymakers should pay attention to the pertinent messages in the financial markets and take them into account in the decision-making process. These conclusions hold the same as we performed robustness tests by including different measures of returns, different pandemic-related metrics, and employing the different model specifications.

The remainder of the paper is structured as follows. Section 2 reviews current literature and develops hypotheses on how stock market may react to both policies. In Section 3, we present the data used in the empirical analysis. Section 4 describes the methodology and Section 5 presents the empirical results. Section 6 describes the robustness check and Section 7 draws the paper's main conclusions and makes suggestions for future research.

2. Literature review and hypotheses

The COVID-19 pandemic has posed significant threat to the global economic growth. One major concern of investors and financial economists is the impact of the pandemic on stock markets (Takyi & Bentum-Ennin, 2021). Studies have shown the negative impact of the pandemic on different aspects of economies (e.g., Sha & Sharma, 2020; Sharma & Sha, 2020). This set of study can be categorized by the level of effects they examine, including global level (Cao, Li, Liu, & Woo, 2020; Liu, Choo, & Lee, 2020; Vidya & Prabheesh, 2020), individual countries (Gil-Alana et al., 2021; Haroon & Rizvi, 2020; Mishra, Rath, & Dash, 2020), market networks (Song, Zhang, Zhao, & Xu, 2020), and firms and sectors (Gu, Ying, Zhang, & Tao, 2020; He, Sun, Zhang, & Li, 2020; Shen, Fu, Pan, Yu, & Chen, 2020; Xiong, Wu, Hou, & Zhang, 2020). Industries and markets examined include insurance (Wang, Zhang, Wang, & Fu, 2020), healthcare (He et al., 2020), hotels (Ozili & Arun, 2020), and the oil industry (Liu, Wang, & Lee, 2020). Some studies found the shock to the market to be permanent (Gil-Alana et al., 2021) and heterogenous in nature (Liu, Choo et al., 2020; Song et al., 2020).

As a result, policymakers are facing unprecedented challenges. A prominent dilemma is a choice between "a healthy nation" and "a healthy economy". No one policy can achieve both and policies might be contradictory or conflicting among each other. The policy responses implemented to combat the COVID-19 catastrophe can be divided into four categories: (i) monetary policy, (ii) fiscal policy, (iii) public health measures, and (iv) non-pharmaceutical intervention (NPIs) (Ozili & Arun, 2020). Among these policies, the two that were among the first to be adopted worldwide are the NPI in the form of a nationwide lockdown or stay-at-home order and the monetary policy to lower the policy interest rate.

Studies have shown that the lockdown order can effectively slow down the transmission of COVID-19 (Haldar & Sethi, 2020; Lau et al., 2020). However, lockdown policies can potentially slow down the economy and lead to a deep recession. On the other hand, the interest rate cut policy is intended to stimulate economic activities and improve market function. However, it might not be effective in creating the overall demand when the health concern of the general public has elevated. To assist governments better strategize and prioritize efficient policies, it is important to examine and compare the impact of both policies. In the following, we review the related literature on the effects of these two types of policies. We also review a limited collection of studies that assesses the effects of both policies. Building on these literatures, as well as the investor sentiment literature, we develop our hypotheses on how these policies may influence stock returns.

2.1. Stock market reaction to the lockdown policy

There is a fast-growing literature that looks at the economic effect of NPIs such as lockdown policies. On the one hand, studies have observed positive effects of the lockdown policy on the stock market (Aggarwal et al., 2021; Alam et al., 2020; Capelle-Blancard & Desroziers, 2020; Chen, Igan et al., 2020; Haroon & Rizvi, 2020). The lockdown order is shown to effectively slow down the transmission of COVID-19 (Lau et al., 2020), and decrease the death numbers (Conyon, He, & Thomsen, 2020). Chen, Dasgupta, Huynh, and Xia (2020) found that in the US, the returns on firms located in lockdown states had a higher return. This effect was observed in other countries as well. For example, Alam et al. (2020) conducted a market model event study on the lockdown announcement in India and found that the market reacted with positive average abnormal returns. Capelle-Blancard and Desroziers (2020) analysed data of 74 countries and found that the lockdown policy has mitigated the decline in stock price. This positive effect of the lockdown policy was also observed in different groups of countries, including emerging equity markets (Haroon & Rizvi, 2020), G7 countries (Narayan et al., 2021), and countries that were most affected by the COVID-19 in terms of infected cases (Phan & Narayan, 2020). Most of these studies attribute the positive effect of this policy to its nature of slowing down the spread of the virus.

On the other hand, several studies reported the negative influence of this policy on stock market (Baig et al., 2021; Ozili & Arun, 2020; Scherf et al., 2021) or no effects (Chen, Igan et al., 2020). Bauer and Weber (2021) showed that the lockdown policies can potentially slow down the economy and increase the unemployment, leading to a deep recession. Ozili and Arun (2020) found that the number of lockdown days are negatively related to the closing, opening, lowest and highest stock prices and the level of general economic activities. Studies also discuss how such effects can be heterogenous across different markets (Haroon & Rizvi, 2020).

We argue that, when facing the uncertainty brought by the pandemic, the lockdown policy, which aims to mitigate the effects of the pandemic will have a positive effect on stock market returns. The rational is based on the investor sentiment driven stock return literature (Baker & Wurgler, 2006; Corredor et al., 2013; Narayan et al., 2021; Yu & Yuan, 2011). This body of literature has documented the relationship between investor sentiment and stock market performance. In our context, investors have been experiencing fear sentiment and uncertainty introduced by the pandemic, which led to market volatility (Chen, Liu et al., 2020). The lockdown policy can reduce such negative sentiment by mitigating the spread and uncertainty, and is thus seen by investors as a solution to the spread of the crisis (Capelle-Blancard & Desroziers, 2020), as well as a "confidence booster" to the market (Phan & Narayan, 2020). As such, the investors feel safe to invest (Scherf et al., 2021), which helps the market to rebound. Therefore, we propose the following hypothesis:

Hypothesis 1. The lockdown policy has a positive impact on the stock market return.

2.2. Stock market reaction to monetary policies

While the lockdown and other social-distancing policies aim to prevent economic activities from taking place, the accommodative monetary policies are intended to "stimulate economic activities and improve market function" (Ozili & Arun, 2020). Many countries around the global have lowered the policy interest rate as the initial monetary policy response to the pandemic (see Ozili & Arun, 2020 for a list of countries that have adopted this policy). There is extended literature studying the relationship between monetary policy and asset prices. One of the influential studies is Bernanke and Kuttner (2005). They examined the cross-sectional effects of monetary policy actions on stock returns in the United States and found that an unexpected 25 basis point cut in the Federal Funds target rate is associated with a 1 % increase in broad stock indexes. Many other studies have explored the responses of stock prices to monetary policy in different dimensions and provided supporting evidence (i.e. Ehrmann & Fratzscher, 2004; Gorodnichenko & Weber, 2016; Thorbecke, 1997).

A small but growing literature started to investigate the impact of monetary policies on stock market during this pandemic. Haddad et al. (2020) found that in the US, the rebound date of the stock market corresponded to the moment when monetary authorities announced the implementation of the stimulus plan. Phan and Narayan (2020) found a similar pattern, but only for countries that already imposed travel bans and the lockdown. Capelle-Blancard and Desroziers (2020) found that investors are very sensitive to news made by public authorities, especially central banks, and reported a positive market reaction to lower interest rates among 74 countries. On the other hand, Ozili and Arun observed a negative relationship between monetary policies during the pandemic and the level of economic activities in four continents. They also documented a similar negative impact of these policies on the closing, opening, lowest, and highest stock prices. Similarly, Zhang, Hu, and Ji (2020) argued that the monetary policies would further introduce uncertainty to the market.

The interest rate cut policy demonstrates the governments' determination and efforts to tackle the economic crisis. It stimulates the growth and greater profits by lowering the cost of capital and improving the financial condition. Investors perceive the interest rate cut as catalysts for a robust economy. In addition, this policy action reassures the investors that the government will be a strong participant of preserving the economy (Capelle-Blancard & Desroziers, 2020) and flatten the recession curve (Gourinchas, 2020), which lifts investors' confidence. Based on the abovementioned investor sentiment driven stock market hypothesis, the stock market will react positively with this increased investor confidence. Therefore, we hypothesize that:

Hypothesis 2. The interest rate cut policy has a positive impact on the stock market return.

Furthermore, we postulate that between the two policies, the interest rate cut will have a greater impact on the stock market. The lockdown policy aims at preventing economic activities from taking place and can potentially slow down the economy (Bauer & Weber, 2021; Ozili & Arun, 2020). In addition, many NPIs are considered controversial due to their unclear effects on slowing down the spread (Correia et al., 2020; Lilley et al., 2020). Investors might be concerned that the lockdown policy might not be able to alleviate the financial and economic damages caused by COVID. Therefore, our last hypothesis is as follows:

Hypothesis 3. Between the two policies, the impact of the interest rate cut policy is greater than the impact of the lockdown policy on the stock market.

Very few studies have performed the cross-country analysis investigating the effect of both of response policies. Three exceptions are (Capelle-Blancard & Desroziers, 2020; Ozili & Arun, 2020; Yang & Deng, 2021). Yang and Deng (2021) assessed the aggregated effects of intervention measures and thus did not focus on the individual effects of any specific policy. Capelle-Blancard and Desroziers (2020) found that both the lockdown and interest rate cut policies mitigated the negative impacts of the COVID-19 on the global stock markets while Ozili and Arun (2020) reported that the number of lockdown days and the monetary policy decisions are negatively related to the closing, opening, lowest and highest stock prices and the level of general economic activities. None of these studies compare the relative effects of the two policies. Our study found results that are similar to Capelle-Blancard and Desroziers (2020) but is different from it in several ways. First, we collect the policy announcement date and focus on how the stock market incorporates the new information into pricing. Second, we add the time dimension to the analysis and compare the stock market reactions not only across countries but across time. The empirical method also controls for the unobserved common time trends. Finally, we compare the magnitude of impact of the two policies.

3. Data

We construct a panel dataset containing the daily COVID-19 case data, national policy responses data, and the stock market indices data. The country-level COVID-19 data are collected from the website https://coronaboard.com from January 2020 to July 2020. This public site provides the data of daily new cases, cumulative cases, daily deaths, as well as cumulative deaths for more than 200 countries on a daily frequency.[1] The policy responses data are obtained from the IMF policy tracker[2] and using news search. We collect the data on two policy actions: nationwide lockdown/stay-at-home order and interest rate cut policy. The announcement dates were when the policymakers announced the policy action for the first time. The daily stock index data of each country are from Datastream.

[1] The website provides a disclaimer regarding the data: "All the information relies upon publicly available from multiple data sources that do not always agree".

[2] The website for IMF policy tracker is https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

Table 1
COVID Events and Policy Events.

	First COVID Case Date	Lockdown Order Effective Date	First Interest Rate Cut Date	Interest Rate Cut in Basis Points
Argentina	3/4/2020	3/19/2020	3/5/2020	38−40bp
Australia	1/25/2020	NA	3/3/2020	25−50bp
Canada	1/28/2020	NA	3/4/2020	50−125bp
China	1/21/2020	NA	2/19/2020	10bp
Hong Kong	1/23/2020	NA	3/16/2020	64bp
India	1/30/2020	3/25/2020	3/27/2020	75bp
Italy	1/31/2020	3/9/2020	NA	NA
Singapore	1/24/2020	NA	3/30/2020	NA
Spain	2/1/2020	3/14/2020	NA	NA
Sweden	2/1/2020	NA	NA	NA
UK	1/31/2020	3/23/2020	NA	NA
US	1/23/2020	NA	3/3/2020	100bp

Notes: The data are pulled from multiple public data sources which might not always agree. NA indicates that the corresponding country has not implemented a nationwide lockdown/stay-at-home policy, or an interest rate cut policy. If a country has experienced multiple interest rate cuts, the date is based on the first interest rate cut. The Monetary Authority of Singapore (MAS) manages monetary policy through exchange rate settings, rather than interest rates. The monetary policy easing was implemented as setting a zero percent per annum rate of appreciation of the policy band starting at the prevailing level of the S$NEER and keeping the width of the policy band unchanged.

The index returns are calculated based on the Datastream price index[3] and measured in the local currency. The starting date of each country's daily index return corresponds to the date when the first COVID-19 case was confirmed in each country. We collect the stringency index, human development index, and GDP per capita from the website https://ourworldindata.org/covid-cases, which sources the stringency index data from Oxford COVID-19 Government Response Tracker (OxCGRT[4]). This index is a composite measure of the following government actions in response to COVID-19: school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls.[5]

Our sample includes 11 countries (Argentina, Australia, Canada, China, India, Italy, United Kingdom, United States, Singapore, Spain, Sweden) and one special administrative region (SAR), Hong Kong.[6] The selection incorporates the heterogeneity in the global responses to the pandemic, covering countries across different continents, at various economic development stages, and with diverse exposure to the COVID-19 crisis.

Table 1 summarizes the major policy events as well as the first COVID case dates of all the countries in our sample. China reported the first confirmed case at the earliest date on January 21, 2020. Argentina was the last to report the first confirmed case on March 4, 2020. Five countries have implemented the nationwide lockdown or stay-at-home orders, including Argentina, India, Italy, Spain, and the United Kingdom, all in March 2020. Central banks or policy authorities of seven countries have lowered the policy interest rate and the magnitude of rate cut ranges from 10 to 125 basis points.

Table 2 presents the summary statistics of our data. The mean value of daily case increase rate is 8.07 % across all countries/SAR with a standard deviation of 25.78 %. The top three countries that have experienced the highest one-day increase in the confirmed cases were India, Italy, and Sweden, with the one-day increase being more than quadrupled. The United Kingdom is the only country that has experienced a one-day decrease in the confirmed cases. The mean value of daily stock index return is −0.04 %, indicating that on average the stock markets across countries have experienced negative returns during the pandemic. The minimum and maximum return values of −0.15 % (Singapore) and 0.14 % (Argentina), respectively, showing the variation in how the stock market in each country reacts to the COVID-19 crisis.

4. Methodology

We employ a difference-in-differences (DID) method to analyze the effects of the sudden change in economic environment and policy on the stock market reactions. The differencing nature of the method can account for a potential issue of endogeneity stemming from the unobserved fixed effects of socio-economic aspects of a country (Wooldridge & Imbens, 2007). For instance, countries may differ by their economic health, resilience to the pandemic, and public health policies. We assume that such aspects do not change on daily basis, which enables the DID to cancel out confounding effects of the time-invariant and unobserved socio-economic variables in our analysis. Nevertheless, our model needs to control for time-varying effects such as daily new cases and the stringency of policies.

We focus on the two sudden changes due to the pandemic: nationwide lockdown/stay-at-home order and interest rate cut. A treatment group is defined as the countries/SAR that have undertaken a policy action to combat the COVID-19 crisis and a control

[3] The Datastream mnemonic for price index is "PI". The price index does not factor in the dividend reinvestments.
[4] OxCGRT obtains publicly available information on 18 indicators of government response. More information can be found at https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker
[5] See https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/index_methodology.md for how this index is calculated.
[6] Hong Kong is a special administrative region (SAR) of the People's Republic of China.

Table 2
Summary Statistics.

	Case Increase Rate (%)					Stock Index Return (%)					Stringency Index (1−100)					Human Development Index	GDP per Capita
	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max	Obs		
Argentina	10.56	27.55	0.00	300.00	136	0.14	4.55	−14.75	12.60	98	85.04	23.06	11.11	100.00	137	0.845	18933.91
Australia	5.18	9.12	0.00	40.00	175	−0.11	2.54	−9.89	7.41	125	51.06	22.84	5.56	75.46	175	0.944	44648.71
Canada	7.58	12.49	0.00	100.00	172	0.10	1.79	−5.99	4.99	124	52.23	29.89	2.78	74.54	173	0.929	44017.59
China	3.76	11.83	0.00	84.79	179	−0.03	2.88	−12.48	12.53	129	73.55	10.05	26.39	81.94	179	0.761	15308.71
Hong Kong	4.99	14.91	0.00	150.00	177	−0.09	1.85	−6.88	4.61	127	54.36	10.03	13.89	66.67	178	0.949	56054.92
India	10.15	29.80	0.00	366.67	170	−0.04	2.57	−12.84	8.83	122	68.71	34.13	10.19	100.00	171	0.645	6426.674
Italy	10.16	41.56	0.00	466.67	169	−0.09	2.85	−17.13	8.63	121	66.06	22.79	19.44	93.52	170	0.892	35220.08
Singapore	7.16	17.83	0.00	200.00	176	−0.15	2.00	−7.14	6.72	126	52.26	19.46	25.00	82.41	177	0.938	85535.38
Spain	10.08	30.81	0.00	300.00	168	−0.14	2.77	−14.33	7.81	120	56.51	27.55	11.11	85.19	169	0.904	34272.36
Sweden	10.01	48.15	0.00	600.00	168	0.02	2.38	−10.71	7.07	120	48.04	23.14	5.56	64.81	169	0.945	46949.28
UK	8.19	15.63	−9.23	100.00	169	−0.11	2.37	−10.87	8.87	121	55.70	28.40	8.33	79.63	170	0.932	39753.24
US	9.96	16.96	0.00	118.75	177	0.03	2.89	−12.12	9.40	127	52.65	29.08	0.00	72.69	178	0.926	54225.45
ALL	8.07	25.78	−9.23	600.00	2036	−0.04	2.66	−17.13	12.60	1460	59.24	26.40	0.00	100.00	2046	0.884	40112.19

Notes: This table reports the summary statistics of our sample. The *Case Increase Rate* is measured as the daily percentage growth in the COVID-19 total confirmed cases. The stock index return is calculated based on a country's stock market price index obtained from Datastream. Because Human Development Index and GDP per capita are both time-invariant, the mean, min, max, and standard deviation values are not applicable.

Table 3
Daily Stock Market Performance Pre- and Post- Policy Responses.

	Lockdown/Stay-at-home		Interest Rate Cut	
	Average Daily Stock Index Return		Average Daily Stock Index Return	
	Before	After	Before	After
Control Group	−0.685	−0.690	−1.314	−3.200
(without policy event)	(obs: 208)	(obs: 665)	(obs: 52)	(obs: 428)
Treated Group	−1.643	−0.524	−2.594	−3.069
(with policy event)	(obs: 138)	(obs: 440)	(obs: 219)	(obs: 752)
Differences	−0.958***	0.166	−1.280***	0.132
(Treated - Control)	(0.303)	(0.187)	(0.417)	(0.174)
Difference in Differences Test	(After) - (Before) = 1.124***		(After) - (Before) = 1.412***	
	(0.340)		(0.340)	

Notes: This analysis compares the average daily stock index returns of the treated group vs. the control group before and after the treatment. The treated group includes the countries that have implemented a policy action (interest rate cut or lockdown/stay-at-home order) to combat the COVID-19 pandemic. The control group includes the countries that have no policy response during our sample period. The pre- (post-) period refers to the period that was before (after) the policy announcement date. We controlled for the following variables: daily case increase rate, the stock return of the prior day, countries' daily stringency index, countries' gdp per capita, and countries' human development index. Standard errors in parentheses for differences. *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

group as those that have not. The analysis seeks to capture the impact of policy changes on the stock markets by comparing the treatment and control group before and after the treatment, nationwide lockdown/stay-at-home order and interest rate cut. The DID method uses the trends in the control group as a baseline to control for the unobserved variables which may affect both groups and mitigate the estimation bias of causal effects. The model setup is as follows:

$$R_{i,t} = \alpha_i + \beta_1 * Policy\ Change_{i,t} + \beta_2 * Post\ Event\ Period_{i,t} + \beta_3 * DID_{i,t} + \beta_4 * R_{i,t-1} + \beta_5 * Case\ Increase\ Rate_{i,t} + \beta_6 * Stringency_{i,t} + \beta_{1:n} * CC_i + \varepsilon_{i,t} \quad (1)$$

$R_{i,t}$ measures the daily stock index return of the country i on day t. α_i is unobserved fixed effects of the country i. Following Narayan et al. (2021), we include $R_{i,t-1}$ to capture the inertia factor in stock returns. *Policy Event* is a dummy variable that takes the value of 1 if an observation was in the treatment group (countries/SAR that have taken policy changes in response to the COVID-19), or 0 otherwise. *Post Event Period* takes the value of 1 if an observation was in the post-event period, or 0 otherwise. For the treatment group, the post-event period was on and after the date when a country/SAR announced a containment or monetary policy change for the first time. For example, as Argentina announced their first interest rate cut on March 5, 2020, we coded the *Post Event Period* as 1 for all the Argentina observations that were on and after March 5. For the control group, we set the post-event period as on and after the date of the policy event was first announced. The interest rate cut policy was first announced by China on February 19. Thus, *Post Event Period* was coded as 1 for all the observations in the control group that were on and after February 19 for the interest rate cut analysis. Similarly, as Italy was among the first to announce the nationwide lockdown order on March 9, *Post Event Period* was coded as 1 for all the observations in the control group that were on and after March 9 for the lockdown policy analysis.

The main variable of interest is *DID*, measured as the product of two dummy variables, *Policy Event* x *Post Event Period*. *DID* takes the value of 1 for those observations that correspond to the treatment group in the post-treatment period. And the coefficient of β3 is the main effect of interest and captures the effects of sudden changes in policy. We also control for other factors that may affect the stock market behavior. Following (Aggarwal et al., 2021; Scherf et al., 2021), we include *Case Increase Rate,* which is calculated as the daily percentage change of country i's total confirmed case. Daily stock index return on the trading day prior to the announcement date ($R_{i,t-1}$) captures the inertia factor in stock returns. *Stringency* captures the stringency level of a country's intervention policies and changes daily. Finally, we include CC_i, which is a vector that captures country-level, time-invariant characteristics, such as the country's human development index, and gdp per capita. $\varepsilon_{i,t}$ is a random, unobserved error term that is allowed to be heteroskedastic and contemporaneously correlated between countries.

5. Empirical results

We first present the descriptive statistics of comparing stock market performance across countries and across time. Second, we present the DID estimation of stock market reactions to the policy responses.

Table 3 reports the comparative statistics of the treated group (countries that have taken a policy response) and control group (countries that have not taken a policy response) before and after the treatment (policy announcement). The results show that prior to the policy announcement, the stock markets in the treated group performed worse than those in the control group, suggesting that those countries may have greater exposure to the COVID-19 or maybe more vulnerable. The DID statistics (1.124 and 1.412) are positive and statistically significant at the 1 % level, suggesting that for those countries in the treated group, the stock market rebounded after the policy announcement.

Table 4 Panel A presents the results of the DID analysis as described in Eq. (1), for each policy response. The *Policy Event* dummy captures the difference in stock index return between countries that have implemented the policy vs. those that have not. The

Table 4
Stock market reactions to policy responses.

Panel A. Individual Policy Event		
DV:	Lockdown/Stay-at-home Stock Index Return	Interest Rate Cut
Policy Event	−0.9580***	−1.2804***
	(0.3032)	(0.4170)
Post Event Period	−0.0048	−1.8866***
	(0.4244)	(0.4255)
DID	1.1239***	1.4120***
	(0.3403)	(0.4330)
R_{t-1}	−0.1991***	−0.2018***
	(0.0258)	(0.0258)
Case Increase Rate	−0.0077***	−0.0069**
	(0.0029)	(0.0029)
Stringency	0.0081*	0.0241***
	(0.0044)	(0.0037)
GDP	−0.0000	0.0000
	(0.0000)	(0.0000)
HDI	0.3498	1.7308
	(1.2421)	(1.4228)
Constant	−0.6847	−1.3136
	(1.0062)	(1.1905)
Obs	1451	1451
Adj. R-sq	0.061	0.066
Panel B. Both Policy Events		
DV:		Stock Index Return
Lockdown		−1.2319***
		(0.3519)
Post Lockdown Period		0.5040
		(0.3368)
DID_Lockdown		1.3423***
		(0.3753)
Interest Rate Cut		−1.9262***
		(0.4615)
Post Interest Rate Cut Period		−2.6088***
		(0.4528)
DID_Interest Rate Cut		1.9652***
		(0.4618)
R_{t-1}		−0.2132***
		(0.0257)
Case Increase Rate		−0.0043
		(0.0029)
Stringency		0.0128***
		(0.0046)
GDP		−0.000
		(0.000)
HDI		0.4743
		(1.4791)
Constant		0.9997
		(1.3634)
Obs		1451
Adj. R-sq		0.081

Notes: This table reports the Difference-in-Differences estimation for Eq. (1): $R_{i,t} = \alpha_i + \beta_1 * Policy\ Change_{i,t} + \beta_2 * Post\ Event\ Period_{i,t} + \beta_3 * DID_{i,t} + \beta_4 * R_{i,t-1} + \beta_5 * Case\ Increase\ Rate_{i,t} + \beta_6 * Stringency_{i,t} + \beta_{1:n} * CC_i + \varepsilon_{i,t}$.
Panel A reports the estimation for each individual policy, and Panel B reports the estimation for both policies so that we can compare the market reactions to the two policy responses. The dependent variable is the daily Stock Index Return in percentage. *Policy Event* is a dummy variable that takes the value of 1 if an observation was in the treatment group (countries/SAR that have taken policy action changes in response to the COVID-19), or 0 otherwise. *Post Event Period* takes the value of 1 if an observation was in the post-event period, or 0 otherwise. For the treatment group, the post-event period was on and after the date when a country/SAR announced a containment or monetary policy change for the first time. *DID* is the product of two dummy variables, *Policy Event* x *Post Event Period*. R_{t-1} is the stock index return (in percentage) of the prior day. *Case Increase Rate* is the daily increase in the total COVID cases in percentage. *Stringency* is the stringency index, which is a composite measure of government response actions. *GDP* is the GDP per capita of each country. *HDI* is the human development index of each country. Standard errors in parentheses for differences. *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

Table 5
Stock Market Reactions to Policy Responses – Random and Fixed Effect Models.

DV:	Model (1) – Random Effects Stock Index Return based on Price Index	Model (2) - Fixed Effects Stock Index Return based on Price Index
Lockdown	−1.232***	
	(0.352)	
Post Lockdown Period	0.504	0.412
	(0.337)	(0.344)
DID_Lockdown	1.342***	1.368***
	(0.375)	(0.378)
Interest Rate Cut	−1.926***	
	(0.461)	
Post Interest Cut Period	−2.609***	−2.650***
	(0.453)	(0.455)
DID_Interest Rate Cut	1.965***	2.023***
	(0.462)	(0.466)
R_{t-1}	−0.213***	−0.215***
	(0.026)	(0.026)
Case Increase Rate	−0.004	−0.005
	(0.003)	(0.003)
Stringency	0.013***	0.015***
	(0.005)	(0.005)
GDP	−0.000	
	(0.000)	
HDI	0.474	
	(1.479)	
Constant	1.000	−0.522***
	(1.363)	(0.201)
Obs	1451	1451
Adj. R-sq	0.081	0.077
Random Effects	Yes	
Fixed Effects		Yes

Notes: This table reports the Difference-in-Differences estimation for Eq. (1): $R_{i,t} = \alpha_i + \beta_1 * Policy\ Change_{i,t} + \beta_2 * Post\ Event\ Period_{i,t} + \beta_3 * DID_{i,t} + \beta_4 * R_{i,t-1} + \beta_5 * Case\ Increase\ Rate_{i,t} + \beta_6 * Stringency_{i,t} + \beta_{1:n} * CC_i + \varepsilon_{i,t}$ by using random effect model (Column 1) and fixed effect model (Column 2) specifications. Standard errors in parentheses for differences. *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

coefficient is negative and statistically significant at the 1 % level for the lockdown policy, which is consistent with the results in Table 3. The *Post Event Period* dummy captures the change in the stock market return before and after the policy announcement. The coefficient is not statistically significant for the lockdown policy and significant at 1 % level for the interest rate cut policy. More importantly, the *DID* coefficients are positive and statistically significant for both policy responses, 1.1239 ($p < 1$ %) for the lockdown and 1.4120 ($p < 1$ %) for the interest rate cut policy respectively, showing that for those countries that have implemented a policy action, the stock market performed better after the policy announcement. Both H1 and H2 are supported. This result suggests that the market participants hold a positive belief about the policy change. We also find that the coefficient of *Case Increase Rate* is negative and statistically significant at the 1 % level, indicating that the stock market reacted negatively to the increase in the confirmed case. This result is consistent with the literature on stock market behavior (Alfaro et al., 2020; Ru et al., 2020) and confirms the disruptive effect of the COVID-19.

In Panel B, we include both policy events in the DID analysis to compare the market reactions to two different types of policy responses. The *DID* coefficient is 1.3423 ($p < 1$ %) for lockdown dummy and 1.9652 ($p < 1$ %) for the interest rate dummy, which is consistent with the results in Panel A. On average, stock markets worldwide reacted positively to the policy announcements. More importantly, the results show that the magnitude of the reaction is dependent on the nature of the policy action. Stock markets have reacted more vigorously to the announcement of an interest rate cut policy than that of a lockdown and stay-at-home order. H3 is thus supported. The variation suggests that market participants have different perceptions about the two policies and integrate them into the pricing. The stronger responses to the interest rate cut are consistent with the policy transmission literature and confirm the important role of the stock market in channelling the monetary policy. Interestingly, after including both events in the analysis, the coefficient of *Case Increase Rate* lost the significance.

6. Robustness checks

6.1. Random and fixed effect models

We consider the potential unobservable heterogeneity and dependencies in panel data and include the random and fixed effects in the analysis. Table 5 reports the results of both models. The coefficients of DID remain significantly positive at the 1 % level, leading to the same conclusion. Besides, a Hausman test indicates that the fixed-effects model and random-effects model are not significantly different.

Table 6
Stock Market Reactions to Policy Responses – Using Case and Death Numbers.

DV:	Model (1) Stock Index Return based on Price Index	Model (2) Stock Index Return based on Price Index
Lockdown	−1.238***	−1.233***
	(0.349)	(0.350)
Post Lockdown Period	0.563*	0.570*
	(0.332)	(0.332)
DID_Lockdown	1.372***	1.354***
	(0.374)	(0.375)
Interest Rate Cut	−1.867***	−1.860***
	(0.454)	(0.455)
Post Interest Cut Period	−2.579***	−2.611***
	(0.444)	(0.439)
DID_Interest Rate Cut	1.927***	1.944***
	(0.455)	(0.455)
R_{t-1}	−0.211***	−0.211***
	(0.0256)	(0.0256)
Ln_Case	−0.010	
	(0.031)	
Ln_Death		0.008
		(0.035)
Stringency	0.013***	0.012**
	(0.005)	(0.005)
GDP	−0.000	−0.0000
	(0.000)	(0.0000)
HDI	0.509	0.575
	(1.489)	(1.476)
Constant	0.865	0.012**
	(1.366)	(0.005)
Obs	1458	1459
Adj. R-sq	0.077	0.077

Notes: This table reports the results of the regression of the stock market index return on policy events and total number of death or total number of cases. Ln_Case represents the natural log of daily coronavirus cases. Ln_Death represents the natural log of daily coronavirus related deaths. Following Baig et al. (2021), we add one to the number of cases, and number of deaths and then take the natural log to avoid excluding zero values. Standard errors in parentheses for differences. *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

6.2. *Using other pandemic related indices*

Following the work by Baig et al. (2021) and Phan and Narayan (2020), we replace the case growth rate by two other pandemic related measures: the natural log of daily coronavirus cases (denoted as Ln_Case), and the natural log of daily coronavirus death (denoted as Ln_Death). To avoid excluding zero values, we follow Baig et al. (2021) and add one to the number of cases and number of deaths, before taking the natural log. Table 6 provides the estimate of the regression. In both models, the coefficients of DID remain significantly positive at the 1 % level, leading to the same conclusion. Furthermore, the interest rate cut policy has a higher impact than the lockdown rate in both models.

6.3. *Using other stock market indices*

Finally, we use an alternative measure, the total return index, to calculate the stock index return for each country. The total return index is obtained from Datastream and includes the reinvestment of dividends. The results are presented Table 7 and remain the same – both coefficients are significantly positive at the 1 % level, with the interest rate cut event has a higher impact.

7. Discussion and conclusion

Recent studies have found support of the impact of COVID-19 policies on the financial market, through investor sentiment (Narayan et al., 2021; Phan & Narayan, 2020). We build on this literature and develop hypotheses on how the stock market would react positively to the two policies implemented during the pandemic – the lockdown policy, and interest rate cut policy by reducing investors' fear and uncertainty.

Using a sample of 12 countries/SAR throughout January to July 2020, we make a few interesting findings. First, we document a strong and positive response of the stock market to both policy actions. Our results are consistent with both the policy transmission literature (i.e. Bernanke & Kuttner, 2005) and the literature on the stock market behavior in a time of the pandemic (Mishkin, 2009). We empirically confirm the role of the lockdown policy as the "confidence booster" to the market (Phan & Narayan, 2020), which supports several prior studies (Alam et al., 2020; Capelle-Blancard & Desroziers, 2020; Chen, Dasgupta et al., 2020; Haroon & Rizvi, 2020; Narayan et al., 2021; Phan & Narayan, 2020). We also find a positive market reaction to the interest rate cut policy, confirming the results reported by Capelle-Blancard and Desroziers (2020). Our study provides the evidence to support the disruptive effects of the

Table 7
Stock Market Reactions to Policy Responses – Using Total Return Index.

DV:	Stock Index Return based on Total Return Index
Lockdown	−1.229***
	(0.352)
Post Lockdown Period	0.499
	(0.337)
DID_Lockdown	1.336***
	(0.375)
Interest Rate Cut	−1.920***
	(0.462)
Post Interest Cut Period	−2.591***
	(0.453)
DID_Interest Rate Cut	1.958***
	(0.462)
R_{t-1}	−0.213***
	(0.026)
Case Increase Rate	−0.004
	(0.003)
Stringency	0.013***
	(0.005)
GDP	0.435
	(1.479)
HDI	−0.000
	(0.000)
Constant	1.029
	(1.364)
Obs	1451
Adj. R-sq	0.080

Notes: This table reports the Difference-in-Differences estimation for Eq. (1): $R_{i,t} = \alpha_i + \beta_1 * Policy\ Change_{i,t} + \beta_2 * Post\ Event\ Period_{i,t} + \beta_3 * DID_{i,t} + \beta_4 * R_{i,t-1} + \beta_5 * Case\ Increase\ Rate_{i,t} + \beta_6 * Stringency_{i,t} + \beta_{1:n} * CC_i + \varepsilon_{i,t}$ by using stock index return based on total return index as the dependent variable. Standard errors in parentheses for differences. *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

COVID-19 on the stock market and the role of the stock market in channeling the policy actions. Second, we extend current understanding on the role of COVID policy actions by comparing the relative impacts of both policies. We find the evidence of a larger stock market response to an interest rate cut policy aiming to mitigate the negative economic impacts of the pandemic, in comparison to a lockdown or stay-at-home order aiming to slow down the spread of COVID-19 and mitigate the health risks. Our study is complementary to Capelle-Blancard and Desroziers (2020) by comparing the effects of the two policies, showing that the stock market reactions provide valuable insights into the market perceptions of the policy actions.

One limitation is that our study does not assess the effectiveness of the policy responses, but how the market participants integrate the public information of policy responses into pricing. Also, this paper does not provide a potential explanation for the stock market variations. There are several directions for future research. First, it would be important to investigate why the stock markets responded to the policy responses as they did in the pandemic and what might cause the cross-country differences. Second, future studies could explore the spillover effects of policy responses on the financial markets of neighbouring countries or countries with strong trade or economic connection. Third, the inter-linkages between the policy change, financial markets, and the real sectors of the economy need to be better modelled and understood. One implication is that policymakers should pay close attention to the role of non-economic factors in the financial system and take them into account in the decision-making process.

Data availability

Data will be made available on request.

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