

The Influence of COVID-19 on Emerging and Mature Stock Market Based on Time-Fixed Effects Model

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Abstract: The outbreak of COVID-19 pandemic has caused irreversible impact on the entire social aspects, especially in stock markets. Under this background, understanding the relationship between the COVID-19 pandemic and stock performance has become increasingly important. This paper examines the effects of the COVID-19 pandemic on the stock markets, including both emerging and mature stock markets. By systematically reviewing daily data of the number of COVID confirmed cases and stock market returns from March 10, 2020, to April 30, 2020, in ten different countries (five emerging countries and five mature countries), this paper conducts the quantitative assessment using time-fixed effects model and unit root test, and finds that there is a negative relationship between the growing number of COVID confirmed cases. When looking at emerging and mature stock markets respectively, our findings suggest that emerging markets responded more strongly compared with mature markets. Understanding the link between the severity of the pandemic and the performance of the stock market will help governments around the world improve market adjustment mechanisms and maintain the stability of stock markets.

1 INTRODUCTION

The outbreak of pandemics has long been regarded as an uncontrollable factor in affecting the performance of stock markets. It refers to a widespread occurrence of a novel, contagious disease over a large area or across the world (Wikipedia 2021). At the end of 2019, the outbreak of COVID-19 in Wuhan, China has rapidly swept across the globe. According to the World Health Organization, as of August 2021, there have been more than 202,000,000 confirmed cases of COVID-19 globally, with over 230 countries suffering from it (*who.int* 2021). Due to its extreme infectiousness and high pathogenicity, pandemics may have extensive and disruptive consequences in healthcare services, social activities, and the global economy. Among these aspects, one of the hardest-hit components is undoubtedly the global stock market. Apart from controlling the spread of the disease, governments also implemented national stimulus plans or programs to recover the economic loss. Although the impact of COVID-19 on financial stock markets came as no surprise, a systematic understanding of their quantitative relation is still not sufficient. Therefore, the purpose of this investigation is to evaluate the influence of COVID-

19 on stock markets, compare the diverse impact on emerging and mature economies, and further address the research gaps in this field.

The remaining part of the paper proceeds as follows: Section 2 presents the literature review and current academic progress. Section 3 displays data, methodology, and findings. Section 4 summarizes the concluding remarks.

2 LITERATURE REVIEW

2.1 Literature Analysis

A growing body of research has paid particular attention to many public health emergencies in history, including the Spanish Influenza, the severe acute respiratory syndrome (SARS), the Swine flu (H1N1 flu), etc. To date, many have begun to consider their implications on the stock market, such as disruptions on the supply chain of products, losses in international business and trade, as well as poor cash inflow toward the stock markets. This section sets out to conduct a comprehensive literature analysis on the current academic progress regarding the relationship between pandemics and the stock.

Table 1: Search Queries and Results.

Keyword Strings	Results
(pandemic AND stock) OR (pandemic AND market) OR (epidemic AND stock) OR (epidemic AND market)	921 document results
(pandemic AND stock) OR (pandemic AND market) OR (epidemic AND stock) OR (epidemic AND market) AND (COVID*)	779 cument results

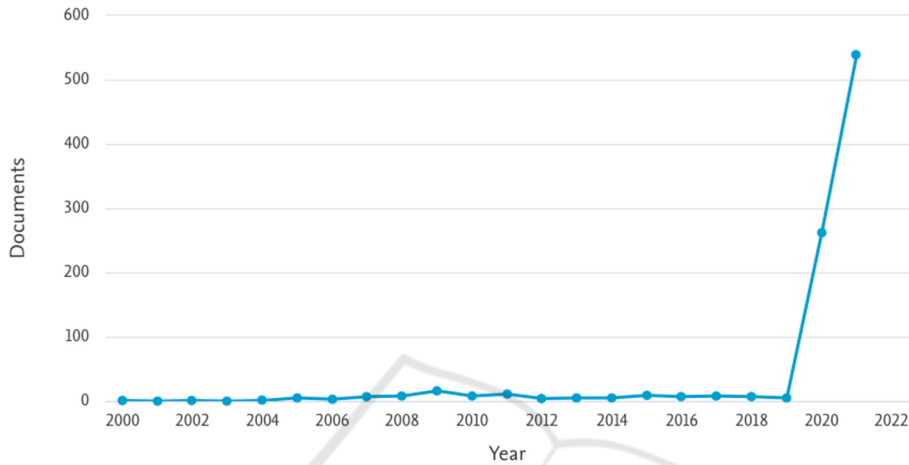


Figure 1: Documents by Year.

market. The methodology is to utilize keyword search and text analysis to retrieve and review related academic literature through Web of Science and Elsevier’s Scopus, the two largest online journal archives and databases. The search queries and results are shown in the Table 1.

As presented in Figure 1, by looking at the changes in the number of published articles, journals, and papers by year, it is obvious that the statistics remained steady from 2000 to 2019, with an average of 1 or 3 documents each year. However, the number of documents has soared in the past three years and is now at a record high, with 539 publications over the first-half year of 2021. This may be explained by the outbreak of COVID-19 in 2019, which sets off a great wave of academic discussions and refocus their efforts on analyzing its series of social, economic, and environmental influences.

Figure 2 describes the geographical spread of the retrieved list of key references and presents the top fifteen countries with the highest number of them. The results have covered most continents of the world, including Asia, Europe, North America, and Oceania. 159 documents are published in the United States, while China is running a close second with 115 published literature. However, when taking a closer look at the finished documents from 2020 to

2021, which is also referred to as the post-COVID times, we noticed that the number of publications in China is almost the same as in the United States. Furthermore, Figure 3 provides the breakdown of funding sponsors behind the literature progress. Nearly 80% of these researches are supported by national foundations or national institutes focusing on natural science, healthcare, and human services. What stands out in the figure is that many studies are funded or cooperated with government departments and institutions, such as the European Commission, the Ministry of Education of the People’s Republic of China, U.S Department of Health and Human Services. This reflects that descriptive research analysis and scientific guidance on the effects of pandemics have become significant issues that academic and political circles face commonly.

2.2 How Pandemics Affected Stock Markets

Apart from literature analysis, this paper also delved into text analysis and attempted to conclude the impact of various pandemics on stock markets that we have investigated so far. It is commonly agreed in the academic circle that pandemics can bring about tremendous uncertainty in the world situation and

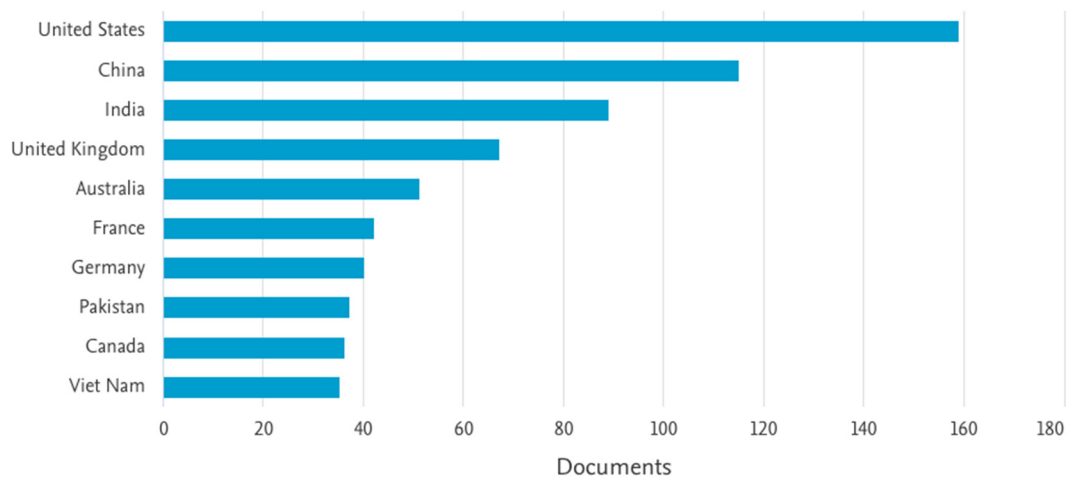


Figure 2: Documents by Country or Region.

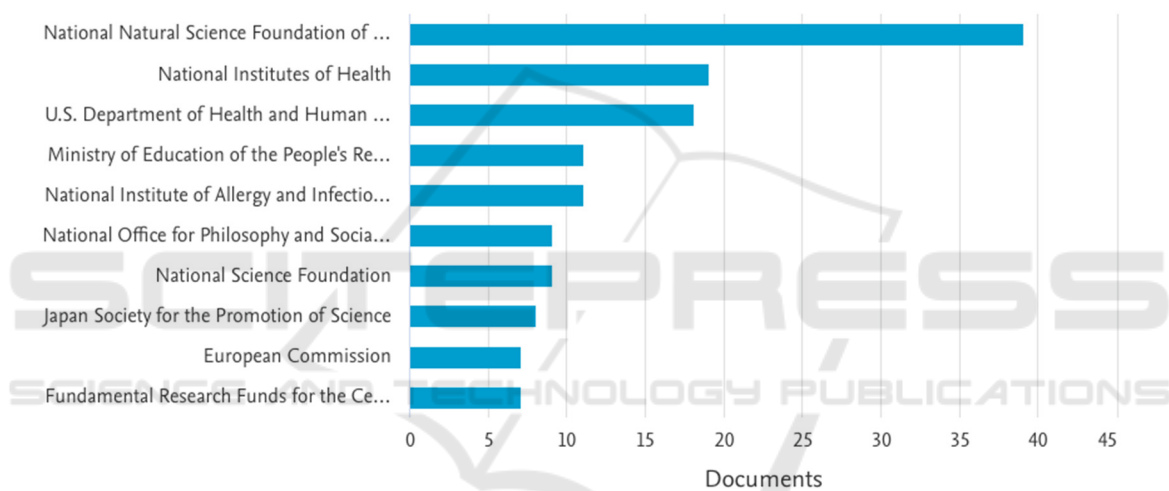


Figure 3: Documents by Funding Sponsor.

may provoke a prudential and even pessimistic atmosphere in a wide range of industries with intensified fear among a majority of investors, causing further economic losses and sharp movements in stock markets. For instance, Chen et al. investigated how the SARS pandemic in 2003 affected the Taiwan stock market by comparing the stock prices and market returns of listed companies in multiple industries on and after the day of the SARS outbreak (Chen, Chen, Tang and Huang 2009). Their findings indicated that the disease had a significantly negative impact on the market performance of tourism, retail sector, and hotel businesses, which all showed unfavorable returns. However, it has played a positive role in accelerating the development of biotechnology and health science with higher stock returns. Jiang et al. analyzed the relationship between the pandemic H7N9 outbreak

and the stock performance in China using distributed non-linear model, and found out that, as the daily number of cases rises, stock prices and market indexes have been negatively affected, ranging from the biomedicine sector to tradition medicine sector (Sun 2017). Verikios et al. applied the Monash health model to explore the financial impact of two H1N1 epidemics on the Australian economy, and believed that the increased scope of pandemics could result in a drastic reduction in domestic investment, GDP, and employment (Wong and Deng 2011).

2.3 How COVID-19 Affected Stock Markets

Meanwhile, as the COVID-19 pandemic phases progress, numerous studies have been undertaken to examine its negative impact on stock markets around

the world. Takyi et al. examined the quantitative relationship between the COVID-19 and stock performance in thirteen African countries (Takyi and Bentum-Ennin 2021). Based on their time-series findings, the pandemic posed restrictive effects on multiple stock markets in Africa and the stock returns have experienced a notable deduction during and after the outbreak. Ashraf et al. further explored how the stock markets reacted to the COVID-19 pandemic using statistics from 64 countries and verified a negative relationship between confirmed cases and stock returns. They also found out even though stock markets generally responded quickly to any of the dynamic aspects of the pandemic (Ashraf 2020).

On the other hand, the outbreak of COVID-19 is also accompanied by legislative and policy changes, including lockdowns, travel restrictions, and short-sales bans, to reduce infection risk and maintain the stability of the market. Several studies also analyzed how these policies may influence stock markets. For example, Bannigidadmth et al. analyzed the impact of policy incentives, lockdowns, and travel bans in 25 countries and suggested negative returns in most countries (Bannigidadmth, Narayan, Phan and Gong 2021). Anh et al. investigated a positive impact of the nationwide lockdown in Vietnam on its stock markets, and concluded that the favorable returns came from investors' confidence in government decisions (Anh and Gan 2020). However, considering the scope and severity of the COVID-19 pandemic, it definitely needs more studies to offer both theoretical and practical guidance compared with the other pandemics. Therefore, this paper aims to further assess the influence of the COVID-19 pandemic on stock markets, both emerging and mature markets

included, and enhance the process of epidemic response, scientific policy-making, and financial control.

3 DATA AND METHODOLOGY

In order to accurately measure the impact of the COVID-19 pandemic on the stock performance, this paper seeks to conduct quantitative analysis on correlated variables and gain insights into market responses to the ongoing spread of the pandemic and the dynamic mechanism of the global stock market. Previous studies have based their measurement on time-series methods and panel data analysis, and these techniques are particularly useful in tracking changes over time and studying diverse subjects in selected countries. Thus, this paper will follow the same analytical path to capture the complexity of this issue and to obtain additional research evidence in the academic arena.

3.1 Data Collection

This paper started by identifying several variables and public websites and databases. To ensure that the obtained results have universality and our dataset is complete and reliable, this paper selected ten stock markets spanning all five continents as our research samples, and they include five emerging stock markets and five mature stock markets. The detailed information is as follows:

Table 2: Sample Description.

	Country	Stock Index	The Date of 1st Confirmed Case
Mature Stock Markets	USA	S&P 500	Jan 22, 2020
	UK	FTSE 100	Jan 31, 2020
	Japan	Nikkei 225	Jan 22, 2020
	Australia	S&P_ASX 200	Jan 26, 2020
	South Africa	TOP 40	Mar 5, 2020
Emerging Stock Markets	Brazil	Bovespa	Feb 26, 2020
	Russia	MOEX	Jan 31, 2020
	India	BSE Sensex 30	Jan 30, 2020
	China	Shanghai Stock	Jan 22, 2020
	Chile	S&P CLX IPSA	Mar 3, 2020

Table 3: Summary Statistics.

	Variables		
	Stock Market Returns	Oil Prices	Confirmed COVID cases
Observations	350	350	350
Mean	0.00090463	60.6608	64661.5314
Median	0.00408785	64.86	6578.5
Standard Deviation	0.00215329	0.77139797	9213.33806
Minimum	-0.1477968	-37.63	7
Maximum	0.13908215	69.63	1081105

Table 4: Unit Root Test Results.

Variables	P-value (Original Data)	P-value (After First-Order Difference)
Stock Market Returns	0.9925	0.0000
COVID	0.7835	0.0095
Oil Price	0.9983	0.0000

Firstly, this paper used the number of confirmed cases as a share of total population to evaluate the severity of COVID-19. The statistics are downloaded from Johns Hopkins Coronavirus Resource Center by country from March 10, 2020 to April 30, 2020. Secondly, to record stock market indices and returns, we acquired daily stock market data from Investing Database and Yahoo Finance database. Considering the data availability, consistency, and integrity, we only adopted one major stock market index as shown in Table 2. Thirdly, this model also takes the oil price into account for it is another important factor that influences the macro economy and the stock market. A popular benchmark for oil price shocks is the Brent crude oil prices in U.S. dollars per barrel, and its daily data over the same time span are retrieved directly from www.investing.com. Lastly, even though the number of confirmed COVID cases can be easily observed after the first case is detected in a country, data of stock markets can be unavailable when stocks close during the weekends or national holidays. After removing these missing or incomplete values, the dataset has also been reviewed multiple times before being put into our model. The summary statistics are presented in the Table 3.

3.2 Model Building

Since our dataset includes observations of numerous subjects at different points in time, this paper chose to conduct panel data analysis and establish a fixed-effects estimated model to control time-invariant variables. An advantage of panel data analysis is that it performs better in reflecting time-varying

relationship as well as reducing the possibility of multicollinearity and estimation bias. Hence, we propose the following model:

$$d.SMR_{it} = \alpha_0 + \beta_1 d.COVID_{it} + \beta_2 d.OP_{it} + u_i + \varepsilon_{it} \quad (1)$$

Here, the subscript i ($i=1, \dots, N$) denotes each country, and the subscript t ($t=1, \dots, T$) denotes the time period. α_0 refers to the constant term that contains no variables or does not change accordingly, ε_{it} means an idiosyncratic error, and u_i stands for the time fixed effects. The dependent variable SMR_{it} represents the stock market returns in country i on the day t . Similarly, independent variables $COVID_{it}$ represents the number of confirmed COVID-19 cases as a share of total population in country i on the day t , while OP_{it} represents the oil price confirmed COVID-19 cases in country i on the day t .

3.3 Empirical Analysis

This section will present our data analysis process and final empirical results. To test time-series stationarity, we initially conducted the unit root test using the most common method ADF test. In view of the test results documented in Table 4, it is clear that we cannot reject the null hypothesis of the unit root of 5% significance because all the p values far exceed this confidence level. Therefore, this paper processed the original data using the first-order numeric difference method and then inputted them into the model (1). The processed data show their first-order difference stationary and were ready for further investigation.

The final empirical results are shown in the Table 5. Our findings indicate that the relationship between the stocking performance and the COVID-

Table 5: Empirical Results.

d. SMR	d. COVID	d. OP
Coef.	-.0076627	.000145
Robust Std. Err.	.003882	.0005369
t	-1.97	0.27
P > t	0.084	0.794
[95% Conf. Interval]	[-.0166146, .0012893]	[-.0010932, .0013832]

Table 6: Results in Emerging and Mature Market.

d. SMR	d. COVID (Emerging Market)	d. OP (Mature Market)
Coef.	-.030182	-.006134
Robust Std. Err.	.0060845	.0020844
t	-1.36	-1.11
P > t	0.045	0.082

COVID-19 pandemic is still significant. Furthermore, it is clear that the growth in the number of COVID confirmed cases as a share of total population can negatively impact the stock market returns. Specifically, for each unit increase of *d. COVID*, the stock market returns are expected to decrease 0.0076627. This negative relationship remains the case when we add daily fixed effects variables in the model (1). On the other hand, for each unit increase of *d. OP*, the stock market returns will rise 0.000145, suggesting that a positive correlation is in existence between the stock market and oil prices.

Meanwhile, this paper also recognizes the fact that the impact of COVID may vary across emerging and mature markets due to market maturity, opening degree, trading system, and regional conditions, and putting data from all countries could possibly result in aggregation bias (Anh and Gan 2020). In this case, we regrouped the samples by emerging and mature stock markets to evaluate their effects respectively. As reported in Table 6, we noticed that emerging markets are hit the hardest by the pandemic, and the reason might be contributed to its heavy dependence on global economic activities. On the other hand, the impact on stock markets in developed countries is relatively less severe, especially for those countries that released stimulus package and implemented countermeasures promptly to promote the economic resurgence.

4 CONCLUSION

The present study was undertaken to determine the effects of the COVID-19 pandemic on the stock market. We investigated the number of COVID

confirmed cases, total population, oil price, and stock market data in 10 different countries after the outbreak from March 10, 2020 to April 30, 2020. Our findings have shown that the stock markets react negatively when the number of confirmed cases grows, and the stock market returns also go through a significant decline. Overall, this study strengthens the idea that the spread of the COVID pandemic adversely impacts stock performance. Besides, to gain a better understanding on its impact on diverse economies, this paper grouped samples by emerging and mature stock markets and analyzed them separately. The results demonstrate that the growth in the number of cases has a greater impact on emerging stock markets than mature stock markets. In general, therefore, the insights generated in this paper support the idea that the COVID-19 pandemic could negatively affect the stock market, contributing to existing knowledge by providing additional quantitative evidence.

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