COVID-19 IMPACT OF GLOBAL INDUSTRY CLASSIFICATION STANDARD (GICS) SECTORS: AN EMPERICAL ANALYSIS THROUGH EVENT STUDY APPROACH

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1. Introduction

Since the Coronavirus disease (COVID-19) outbreak, there has been extensive research on its impact on the global economy and the financial markets. Some studies investigate the unprecedented impact of the pandemic on the stock exchange of G-20 countries and WAEMU (West African Economic and Monetary Union) (Singh et al.; Zoungrana et al.). Some studies investigate whether the COVID-19 pandemic significantly affected the performance of 11 leading global stock indices and explore the extent and direction of the pandemic in the performance of the stock indices (Ji et al.).

Due to the severity and frequency of the virus, many countries all over the world started taking Public Health and Social Measures (PMSH) defined by WHO such as social distancing, wearing masks, and lockdowns to mitigate the spread ("Coronavirus"). Economic activity particularly suffered in sectors that rely heavily on human interaction in product or service products such as hotels, restaurants, retail, and entertainment (Ashraf et al., 2021). Looking back to 1985, no other infectious disease outbreak had more than a tiny effect on U.S. stock market volatility (Baker et al.). Looking back further to 1900, there is not a single instance in which contemporaneous newspaper accounts attribute a large daily market move to pandemic-related developments. That includes the Spanish Flu of 1918-20, which killed an estimated 2.0 percent of the world's population (Barro et al., 2020). In contrast, various studies have shown that news related to COVID-19 – both positive and negative – is the dominant driver of large daily U.S. stock market moves. Recent studies by Baek et al., 2020; Goodell and Huynh, 2020; Koren and Pető, 2020 show that changes in volatility are more sensitive to COVID-19 news than economic indicators. Additionally, the negative news regarding the number of deaths is twice as impactful as positive news regarding recoveries suggesting a negativity bias (Baker et al.).

The ongoing situation of the pandemic makes it important to take contemporaneous events and data into account. Despite the extensive literature available on the pandemic's impact on the stock market, few studies take into consideration the Omicron wave of COVID-19. The intense global surge of Omicron infections and waves of infection of subvariants of Omicron caused essential services to be rapidly overwhelmed in many countries, including through illness or quarantine of essential personnel. The reduced severity of Omicron, compared to Delta, changed the cost-benefit balance of implementing strict PHSM and further contributed to the decoupling between incidence and severe disease (WHO, 2023). Moreover, the previous studies don't take into account the ongoing banking crisis in 2023 and the rapid increase in interest rates and their effects on the stock market. The current events can be a long-term outcome of the pandemic and taking them into account may be imperative for drawing a comprehensive conclusion on the pandemic and the stock market.

Three of the aforementioned research are utilize the event study approach to provide insights into the impact of COVID-19 on the stock market. Event studies have become increasingly sophisticated over the years, with modifications made to accommodate specific hypotheses and confounding variables. This progress has enabled researchers to analyze the impact of significant events, such as the outbreak of COVID-19, on financial markets (MacKinlay, 1997).

I employ the event study methodology to analyze the impact of COVID-19 on specific sectors within the stock market. The study utilizes S&P sector indices that align with the General Industry Classification Standards (GICS) sectors, with all data sourced from investing.com. It investigates the shift in investor sentiment before and after the event. A key insight from the research is the potential attainment of information about the event in the market preceding the event, as highlighted by MacKinlay (1997).

Examining Tables 4 and 5, it becomes evident that the pandemic wielded predominantly adverse effects across various sectors. Nevertheless, it is important to note that certain sectors managed to exhibit a rather positive response. As a case in point, the energy sector bore a significantly unfavorable brunt, as evidenced by the CAR plummeting from a statistically significant -2.3464 in the pre-event period to a staggering -17.4570 in the post-event period.

In contrast, Consumer Staples sector experienced a positive effect post pandemic. It is evident from the CAR rising from a statistically significant -1.7328 in the pre-event period to 0.0692 in the post-event period. We will explore the causation of these reaction further in the paper.

This study contributes to literature investigating the effects of unexpected events and catastrophes on the financial markets. Second, it will add to the findings in the existing literature regarding COVID-19's impact on the stock market. Last, it documents how different waves of the pandemic affected the stock market.

The remainder of the paper is structured as follows: the second section contains relevant literature on the topic. The third section presents elucidates what an event study is and sets up the methodology that will be used to analyze the impact. The fourth section will summarize the data sources. The fifth section will present the results of the study. Finally, the sixth section concludes the findings. An Appendix section contains definitions, and results not shown in the main paper.

2. Literature Review

COVID-19 is fundamentally different from financial and economic crises as it is intrinsically uncertain, when the crisis will end and when major or small economies will bounce back from the current recession are unknown, compared to the structural problem or defects inherent to financial and economic crises (Ji et al., 2021).

Ji et al. (2021) uses the event study method to analyze the impact of the COVID-19 pandemic on global stock indices. The study takes January 23, 2020, when the news of the Wuhan lockdown was released to the public, as the event date. Their research indicates that COVID-19, as a significant negative shock, has an adverse effect on the stock market indices of the affected areas. China Stock indices Hang Sen Index (HIS) and Shanghai Composite Index (SSEI) experienced the most significant drop in earnings on the first day after the event. Their paper further suggests the Abnormal Returns (ARs) of the Asian stock market indices experienced a sharp drop on the day of the event because COVID-19 was confined to Asia. Moreover, their analysis of OLS regressions indicates that the daily ARs on the stock market indices are negatively associated with the number of confirmed cases at the onset of the COVID-19 pandemic, meaning that the international stock markets are sensitive to the evolution of the novel coronavirus.

Singh et al. (2020) also uses the event study method to analyze the Stock Market response to the COVID-19 outbreak in G-20 countries. G-20 countries consist of both highly developed and developing economies, hence, the sample is extensive and produces comprehensive empirical results. The event window is 57 days long and the event date in this study is chosen as 20 January 2020, when for the first-time news of the virus appeared in the media, unlike the date the Wuhan lockdown was announced used by Ji et al. (2021). The results reveal that post-outbreak, stock markets all over the world performed badly and experienced negative returns. However, in the pandemic's later stages, the economy is discovered to gradually recover from the setback, as indicated by the positive cumulative abnormal returns (CARs). This is due to the market absorbing the shock to some extent and countries resuming their economic activities. Overall the results suggest that future uncertainty due to the COVID-19 outbreak, initially, caused panic selling in the stock market across the globe. However, as the stock markets started experiencing the influx of capital, it helped facilitate the recovery which helped mitigate the volatility and negative cumulative abnormal returns. This study concluded that investors could adopt long-term investment strategies in weakened market conditions, and the suitable response would be to buy stocks.

He et al. (2020) uses an event study approach to empirically study the market performance and response trends of Chinese industries to the Covid-19 pandemic. They conclude that transportation, mining, electricity and heating, and environment industries have been adversely impacted by the pandemic. However, manufacturing, information technology, education, and healthcare industries have been resilient to the pandemic (Zoungrana et al, 2020). Liu et al. (2020) analyze the immediate effect of COVID-19 on the stock market of major affected countries. The result shows investor’s fear sentiment is proved to be a complete mediator and transmission channel for the COVID-19 outbreak’s effect on stock markets.

3. Event Study

Event studies have a long history since James Dolley (1933). Since this pioneering research, economists have used event studies to study the impact of specific events on particular entities such as the value of a firm, the housing market, and the stock market. There have been modifications that relate to complications arising from violations of the statistical assumption used in the early work and relate to adjustments in the design to accommodate more specific hypotheses (MacKinlay, 1997).

An event study measures the impact of an economic event on the price of a security. It is based on the assumption of an efficient market hypothesis that the effects of an event will immediately reflect in security prices. Thus a measure of the event's economic impact can be constructed using security prices observed over a relatively short time period.

The initial step for conducting an event study is defining the event and identifying the time period over which the security prices involved in the event will be examined — the event window. For this paper, we are attempting to examine the impact of COVID-19 on the stock market. Following the recent literature, I choose the event as the announcement of the outbreak of the pandemic. The event window will include the announcement day. It is common to include larger time periods as it helps capture the effect of the event post-announcement. The prior time period also may provide interesting insights.

Appraisal of the event's impact requires a measure of abnormal returns. It is the difference between the actual ex-post return of the security over the event window and the normal return of the firm over the event window. The normal return is the expected return without conditioning on the event taking place. For firm i and event date τ the abnormal return is

$$\mathrm{AR}_{\mathrm{i},\tau} = \mathrm{R}_{\mathrm{i},\tau} - \mathrm{E}\,(\mathrm{R}_{\mathrm{i},\tau} \mid \mathrm{X}_{\tau})$$

Where $\mathrm{AR}_{\mathrm{i},\tau}$, $\mathrm{R}_{\mathrm{i},\tau}$, and $\mathrm{E}\,(\mathrm{R}_{\mathrm{i},\tau} \mid \mathrm{X}_{\tau})$ are the abnormal, actual, and normal returns respectively for the time period τ. X_τ is the conditioning information for the normal return model. There are two common choices for modeling the normal return — the constant mean return model where X_τ is constant, and the market model where X_τ is the market return. We will be utilizing the market model which assumes a stable linear relation between the market return and the security return.

After the selection of a normal performance model and the event window, the estimation window needs to be defined. This is a time period prior to the event window which doesn't include the event date. Conventionally, the event window and the estimation window don't overlap to prevent the event from influencing the normal performance model parameter estimates. With the parameter estimates for the normal performance model, the abnormal returns can be calculated.

Next comes the design of a testing framework for abnormal returns.

Now, let's define the timeline for the event study. The event day is represented by $\tau = 0$. $T_1 + 1$ to T_2 represents the event window, and $T_0 + 1$ to T_1 constitutes the estimation window that we will utilize to predict expected returns. Even though the event is an announcement on a particular date, it is typical to set an event window of a length larger than one. This facilitates the use of abnormal returns around the event day in the analysis.

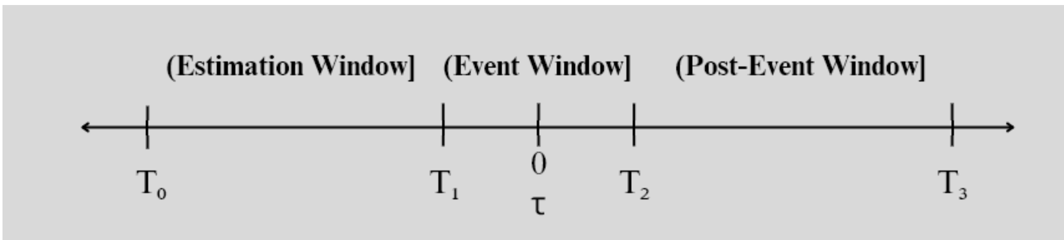

Figure 1: Timeline for Event Study

It is typical for the windows not to overlap with each other. This design provides estimators for the parameters of the normal return model which aren't influenced by returns around the event. Including the event window while estimating the normal model parameters would lead both the normal and abnormal returns to capture the effect of the event. This would be problematic as the model is built under the assumption that abnormal returns capture the impact of the event.

The normal returns during the estimation window period can be calculated using Ordinary Least Square (OLS).

$$R_{i,t} = \alpha_i + \beta_i R_{m,t}$$

Where $R_{i,t} = \ln[\frac{p_{i,t}}{p_{i,t-1}}]$ is the return on the index i on day t; α_i is the intercept term; β_i is the systematic risk measuring the sensitivity of the sector index return $R_{i,t}$ to the market index; $R_{m,t}$ is the market index, which is the realized market index on day t. It is derived from the S&P 500 index by $R_{m,t} = \ln[\frac{p_{m,t}}{p_{m,t-1}}]$; the error term $\varepsilon_{i,t}$ is the statistical disturbance.

The estimated coefficients $\hat{\alpha}_i$ and $\hat{\beta}_i$ are generated by the OLS using the estimation window. Therefore, the estimated ARs can be calculated by the following equations:

$$E(R_{i,t}) = \widehat{\alpha_i} + \widehat{\beta_i} R_{m,t}$$

$$AR_{i,t} = \varepsilon^*{}_{i,t} = R_{i,t} - E(R_{i,t}) = R_{i,t} - (\widehat{\alpha_i} + \widehat{\beta_i} R_{m,t})$$

For index j on day t, $E(R_{i,t})$ is the expected return. $R_{i,t}$ is the actual return, and $AR_{i,t}$ is the actual return within the event window. The market return on day t is $R_{m,t}$.

In my event study, I use the estimation window to predict the expected returns for event window using linear prediction. To calculate AR for each sector I subtracted actual returns $R_{i,t}$ by expected returns $E(R_{i,t})$. Visualization of abnormal returns is illustrated by the difference between the gaps of the actual return and linear prediction return in Figure B1 and B2 in the appendix..

The cumulative average returns (CAR) of index i from t_0 to t_1 in the event window can be derived from $CAR_i(t_0, t_1) = \frac{1}{N} * \sum_{t=t_0}^{t_1} AR_{i,t}$ (Ji et. al, 2022; MacKinlay, 1997).

4. Data Source and Sample

I have selected the 11 sectors from The Global Industry Classification Standard (GICS) to assess the impact of COVID-19 outbreak. MSCI and S&P Dow Jones Indices developed this classification standard to provide investors with consistent and exhaustive industry definitions ("The Global Industry Classification Standard"). I used the S&P 500 sector index funds to calculate the returns for the sectors (see Tabel 1). Stock prices and market indices data were sourced from investing.com, a prominent data provider frequently utilized in prior literature, including studies by Ji et al. (2022) and Singh et al. (2020). I selected the event date of January 23, 2020, which has been widely employed in most of the preceding literature. This date marks the announcement of the world's inaugural lockdown measures and is significant in the COVID-19 timeline as acknowledged by cdc.gov, marking the announcement of the world's inaugural lockdown measures.

Table 2 shows the brief composition of all the sectors classified by the GICS. To get a more comprehensive picture of what the GICS sectors encompass, visit the Wikipedia link in the reference.

Table 1 Selected Global Industry Classification Standard Industries (source: https:// www.investing. com/indices/us-spx-500)

Industries	Stock Index	Symbol
Energy	S&P 500 Energy	SPNY
Materials	S&P 500 Materials	SPLRCM
Industrials	S&P 500 Industrials	SPLRCI
Consumer Discretionary	S&P 500 Consumer Discretionary	SPLRCD
Consumer Staples	S&P 500 Consumer Staples	SPLRCS

Health Care	S&P 500 Health Care	SPXHC
Financials	S&P 500 Financials	SPSY
Information Technology	S&P 500 Information Technology	SPLRCT
Communication Services	S&P 500 Telecom Services	SPLRCL
Utilities	S&P 500 Utilities	SPLRCU
Real Estate	S&P 500 Real Estate	SPLRCREC
Market	S&P 500	SPX

The sector returns corresponding to the indices of the GICS sector are given in Table 1A. In Table 2, presents the descriptive statistics of indices pre-event date in the top panel, and the bottom panel presents the descriptive statistics of indices post-event date.

All sectors yielded positive average returns before the announcement of lockdown policy except Energy (SPNY) as shown in the former table. The standard deviation was also near one. After China, the world's largest exporter, declared its first lockdown policy, mean returns of all the sectors and the S&P 500 are negative as shown the latter table. Moreover, the standard deviation of all the indices increased substantially compared to pre-event period. This shows the increased volatility across all sectors and the market due to the announcement.

Despite the outbreak of COVID-19, some sectors like Consumer Staples (-0.13%), Utilities (-0.07%), and Real Estate (-0.14) show relatively low negative mean returns. This may be attributed to their inelastic nature. In contrast, sectors such as Energy, Industrials, and Financials experienced comparatively high negative returns, which can be attributed to consumers speculation of lockdowns in other economies in the future.

Table 2 Descriptive analysis of returns selected indices

Variable	Mean	SD	Min	Max
Pre-event period: April 23, 2019 to January 22, 2020				
Variable	Mean	SD	Min	Max
SPNY	-0.0790	1.2183	-4.2056	3.2386
SPLRCM	0.0269	0.9500	-3.3100	3.3620
SPLRCI	0.0329	0.9538	-3.0395	2.3383
SPLRCD	0.0330	0.8702	-3.1889	2.6001
SPLRCS	0.0629	0.6818	-2.7299	1.5390
SPXHC	0.1075	0.7673	-2.8749	2.1866
SPSY	0.0652	0.9514	-3.6242	2.6716
SPLRCT	0.1174	1.0994	-4.1541	3.2072
SPLRCL	0.0705	0.9474	-3.1118	3.1941
SPLRCU	0.0877	0.7175	-2.1749	2.1180
SPLRCREC	0.0655	0.8155	-1.9751	2.2998
SPX	0.0700	0.7683	-3.0230	2.1206
Post-event period: January 24, 2020 to March 6, 2020				
Variable	Mean	SD	Min	Max
SPNY	-1.0362	2.4292	-5.7770	3.7126
SPLRCM	-0.4013	2.0590	-4.7694	4.0625
SPLRCI	-0.5049	1.9572	-5.0874	4.1051
SPLRCD	-0.3343	1.8183	-4.1526	3.4357
SPLRCS	-0.1313	1.7991	-4.1521	5.3371
SPXHC	-0.2408	2.0076	-3.3882	5.6496
SPSY	-0.6320	2.2071	-5.0040	4.7547
SPLRCT	-0.3276	2.4463	-5.4748	5.5493
SPLRCL	-0.3706	1.8587	-4.1330	3.5226
SPLRCU	-0.0714	1.9977	-4.8052	5.6973
SPLRCREC	-0.1400	1.9402	-5.7513	4.9313
SPX	-0.3742	1.9746	-4.5168	4.5011

Source: author's calculation of data from investing.com; the event date is January 23, 2020

5. Event Study Results

5.1 Abnormal Returns of GICS Sectors

The event's impact on the sectors can be seen evidently in section C. of the appendix. It is seen clearly that after the event the standard deviation of abnormal returns substantially increased signifying uncertainty and speculation in the market. Moreover, there is a period of greater volatility after a certain number of days as seen in the figures in section C. This is because of another significant event that took place on 25th February 2020. CDC's Dr. Nancy Messonnier, the incident manager for the COVID-19 response, held a telebriefing and braced the nation to expect mitigation efforts to contain the SARS-CoV-2 virus in the U.S. that may include school closings, workplace shutdowns, and the canceling of large gatherings and public events, stating that the "disruption to everyday life may be severe." ("CDC Museum"). The greater level of volatility after the second event compared to the first is illustrated in Table 3. The greater volatility is reasonable, as it can be attributed to the second event occurring in the US, unlike the first event which happened in China.

The immediate and more intuitive reaction from the market is seen in the next day of the second event compared to the first. As seen in table 2, after the first event, the abnormal return increases from -0.3402 to -0.0896 for energy index (SPNY) and decreases from -0.6425 to -0.9993 for health care index (SPXHC). In contrast, after the second event, the abnormal return decreases from -1.0832 to -2.4762 for energy index (SPNY) and increases from -0.5279 to 0.1549 for health care index (SPXHC). With a possibility of a lockdown, it is rational to see the market expect the energy index to go down and health care index to go up.

The energy sector comprises of oil and gas products and services as seen in Table A1 in the appendix. Most of the energy resources are utilized for transportation and industrials (see appendix section D.). With an expectation of a countrywide lockdown, transportation and industrial activities are expected to go down, ultimately, driving the demand for oil and gas down. This will have implications for earnings for the Energy sector, which is reflected in the decrease in abnormal returns of SPNY on the day after the announcement on 26 Feb 2020. Moreover, with the increasing severity and profound measures taken by the country it is intuitive to expect the demand for health care to increase in the future. This is evident in the increase in abnormal returns of SPXHC on the day after the US announcement.

Table 3 Abnormal returns of selected indices

Indices (GICS)	23 Jan, 2020	24 Jan, 2020	25 Feb, 2020	26 Feb, 2020
SPNY	-0.3402	-0.0896	-1.0832	-2.4762
SPLRCM	-0.2278	0.2013	-1.4233	0.0416
SPLRCI	1.0262	0.5480	-0.7165	-0.3522
SPLRCD	0.0420	-0.3558	0.5963	-0.2619
SPLRCS	-0.3603	-0.1455	0.0176	-0.2941
SPXHC	-0.6425	-0.9993	-0.5279	0.1549
SPSY	-0.3711	-0.3931	-0.1240	-0.2757
SPLRCT	0.3198	0.7536	0.8559	0.8923
SPLRCL	-0.4526	-0.1024	0.7581	0.1912
SPLRCU	0.8425	0.5018	-1.4970	-0.9239
SPLRCREC	0.8769	0.1156	-1.3378	-0.7568

5.2 Cumulative Abnormal Return of GICS sector

There is an interesting observation that can be drawn from the CARs of the periods prior and after the event. The market may have acquired information about the earnings prior to the actual announcement and we can investigate this possibility by examining pre-event returns (MacKinlay, 1997). This statement in MacKinlay is alluding to the efficient market Hypothesis which states, "The current stock prices reflect all existing available information, making them fairly valued as they are presently" (Baldrige, 2022). The polarity of the CARs of indices in the window (-30, 0) and (0, 30) are broadly similar showing that the efficient market hypothesis holds in this context.

Most of the sectors experienced a downward trend in CARs after the event date as shown by the figures below. However, some sectors such as Consumer Discretionary, Information Technology, Utilities, and Real Estate experienced an upward trend after the event. The CARs for all the sector indices are presented in Table 4 and Table 5. The results are largely coherent with the existing literature. The event seems to have a significantly negative impact on the various sectors.

As expected, the energy sector seems to have been impacted to the greatest degree as the expectations for workplace and industry closedowns are correlated with a decrease in the demand for oil and gas. From Table 4 and 5, we can observe the drop of CARs from pre-event to post-event of energy index (SPNY) by statistically significant -2.3464 to -17.4570 respectively. The CARs of Energy, Materials, and Industrials seem to have a downward trend after the event and show no sign of recovery (see fig 2).

Table 4 CARs (-30, 0) event window

Indices (GICS)	CAR (-30, 0)	T-Test	P-value
SPNY	-2.3464***	6.8523	0.0000
SPLRCM	-4.2485***	-5.4687	0.0000
SPLRCI	-1.2850***	-6.5237	0.0000
SPLRCD	0.2592***	5.5399	0.0000
SPLRCS	-1.7328***	-10.5451	0.0000
SPXHC	-1.1093	-1.5964	0.1216
SPSY	-4.8070***	-6.7097	0.0000
SPLRCT	3.6622***	9.2058	0.0000
SPLRCL	0.3364***	-3.3705	0.0022
SPLRCU	5.8688***	5.9947	0.0000
SPLRCREC	0.7970***	-8.4924	0.0000

*, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively

Figure 3 appears more interesting than Figure 2 as we can see an effect of the second event over the first. The announcement of the Wuhan city lockdown appeared to have an abrupt impact on investor behavior in the Consumer Staples and Health Care sectors. This impact is evident in the continuation of the gradual downward trend observed after the event date, as illustrated in Figure

3. Following the second event, an abrupt upward shock was observed in the Consumer Staples and Health care sectors, while the Consumer Discretionary sector experienced a notable downward shock.

As expected, the sudden change in trajectory of Health Care can be attributed to the expectation of higher demand of pharmaceutical and other healthcare facilities with increasing fatal cases of COVID-19 infections. Similarly, in context with the lockdown-related speculation, the upward trend of Consumer Staples sectors is reasonable, which can be attributed to expectations of consumer hording of essential products and services. In contrast, the downward trajectory of Consumer Discretionary sector can be attributed to the investor speculation of consumers opting out of non-essential products and services with an expectation of a weaking economy.

Table 5 CARs in (0, 30) event window

Indices (GICS)	CAR (0, 30)	T-Test	P-value
SPNY	-17.4570***	-13.1960	0.0000
SPLRCM	-4.9265***	-35.3598	0.0000
SPLRCI	-3.2035***	-11.0004	0.0000
SPLRCD	3.1220***	10.3493	0.0000
SPLRCS	0.0692***	-11.0074	0.0000
SPXHC	-0.7106***	-17.4499	0.0000
SPSY	-11.8893***	-18.5144	0.0000
SPLRCT	8.5806***	23.6423	0.0000
SPLRCL	-0.3738	-1.3732	0.1806
SPLRCU	5.0807***	13.9991	0.0000
SPLRCREC	0.2734***	3.3678	0.0022

*, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively

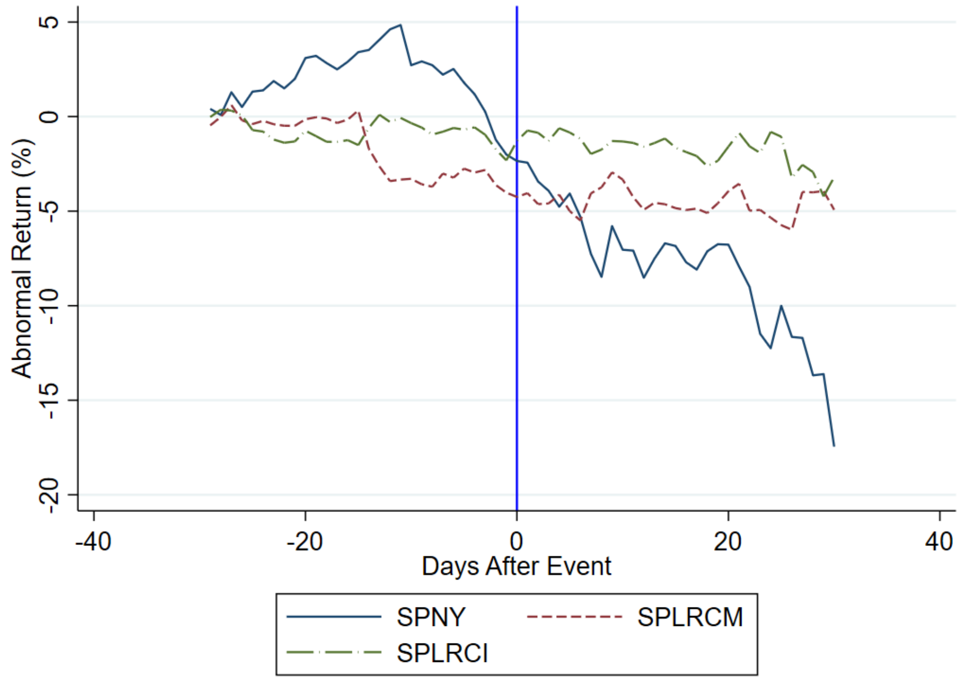

Figure 2: CARs on Energy, Materials, and Industrials

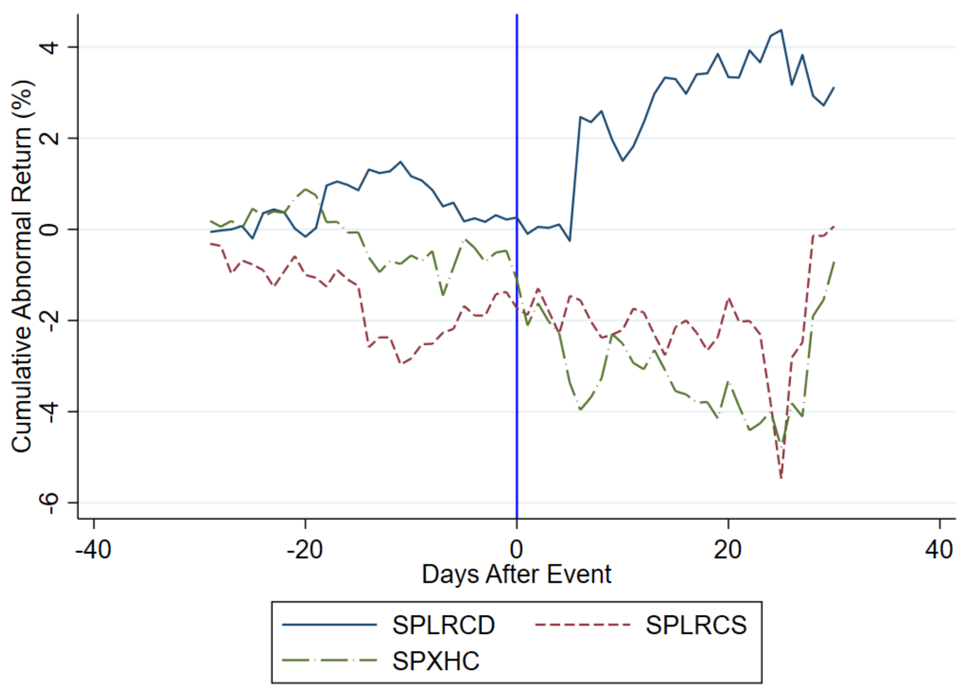

Figure 3: CARs on Consumer Discretionary, Consumer Staples, and Health Care

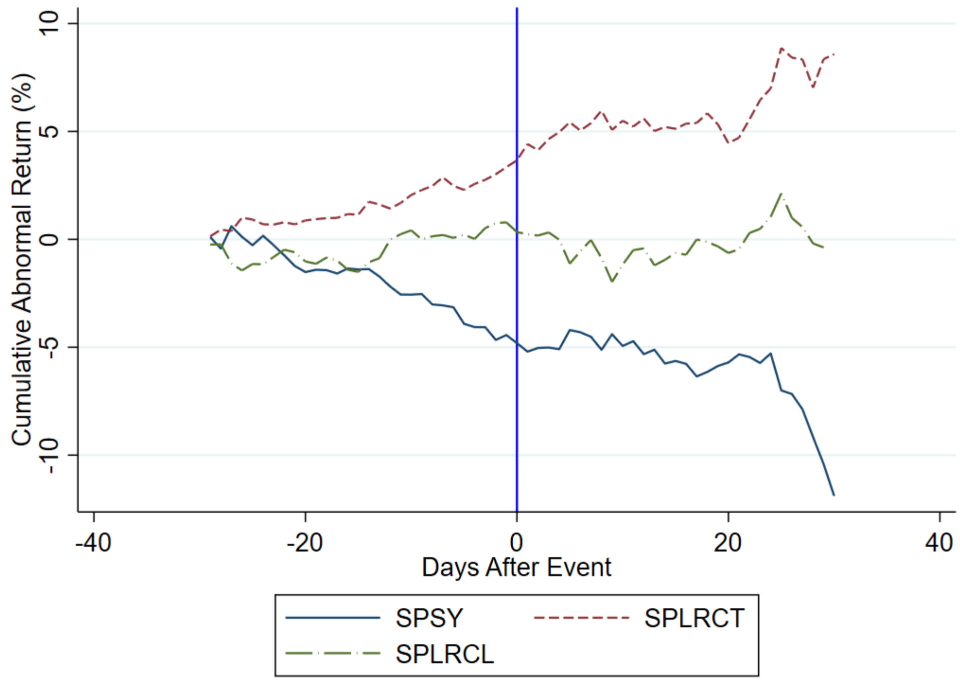

Figure 4: CARs on Financials, Information Technology, and Communication Services

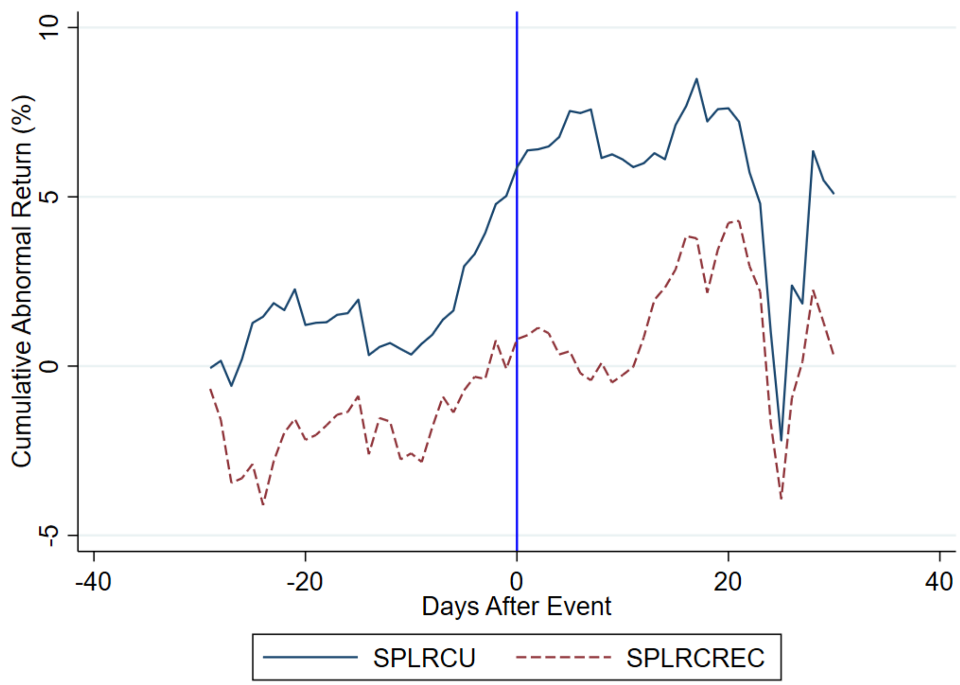

Figure 5: CARs on Utilities and Real Estate

6. Conclusion

This study analyzed the varied impact of the COVID-19 outbreak on various sectors. Some sectors were positively affected whereas others were negatively affected by the virus. The results indicate that the investor sentiment before the event was largely coherent to their sentiment after the event, indicating that their expectations about the future before the event were mostly accurate. The first event seems to have a relatively smaller impact to that of the second event, which was an announcement in the US. The pandemic had a significantly negative effect on the Energy, Financials, and Industrials Sectors. However, Consumer Staples, Information Technology, and Healthcare had a statistically significant response to the pandemic, looking at the effect of the second event.

The event study also revealed an increased volatility in the returns of the Sectors caused by the panic selling of investors. The investigation supports that the mitigation measures of the government had varied effects on various sectors. This research can be of use to strategic decision makers to make better decisions in future black swan events, events which are unexpected and come with severe consequences, like COVID.

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Appendix

A. Sector Composition

Table A1 Brief composition in GICS sectors (Source: wikipedia.org and msci.com)

Sector	Industries	Sector	Industries
Energy	Energy Equipment & Services	Health Care	Health Care Equipment & Supplies
	Oil, Gas & Consumable Fuels		Health Care Providers & Services
Materials	Chemicals		Health Care Technology
	Construction Materials		Pharmaceuticals
	Containers & Packaging		Life Sciences Tools & Services
	Metals & Mining	Financials	Financial Services
	Paper & Forest Products		Consumer Finance
Industrials	Aerospace & Defense		Capital Markets
	Building Products		Insurance
	Professional Services	Information Technology	Communications Equipment
	Air Freight & Logistics		Technology Hardware, Storage & Peripherals
	Passenger Airlines		Semiconductors & Semiconductor Equipment
	Marine Transportation	Communication Services	Diversified Telecommunication Services
	Ground Transportation		Wireless Telecommunication Services
Consumer Discretionary	Automobile Components		Media
	Automobiles		Entertainment
	Distributors		Interactive Media & Services
	Broadline Retail	Utilities	Electric Utilities
	Specialty Retail		Gas Utilities
Consumer Staples	Consumer Staples Distribution & Retail		Water Utilities
	Beverages		Independent Power and Renewable Electricity
	Food Products	Real Estate	Diversified REITs
	Tobacco		Hotel & Resort REITs
	Household Products		Office REITs
	Personal Care Products		Specialized REITs

B. Abnormal Return Calculation

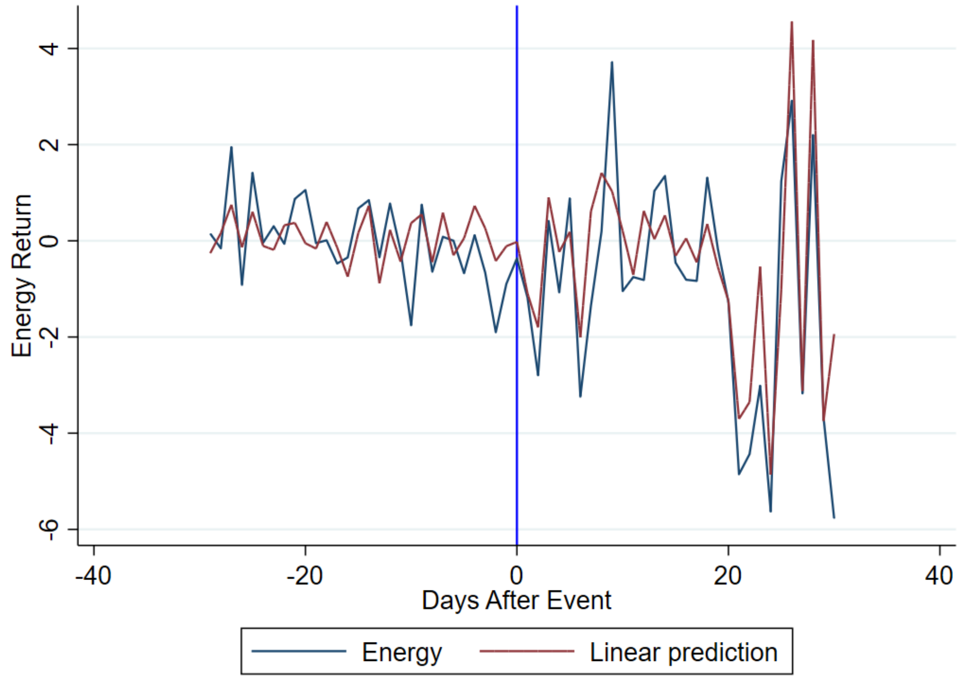


Figure B1

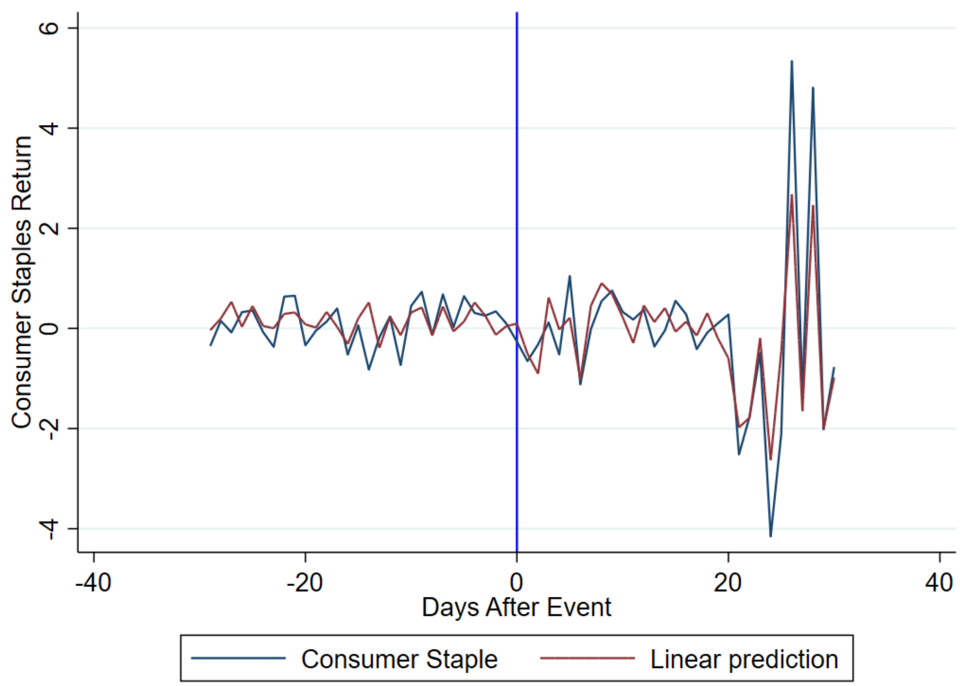


Figure B2

C. Abnormal Return Figures

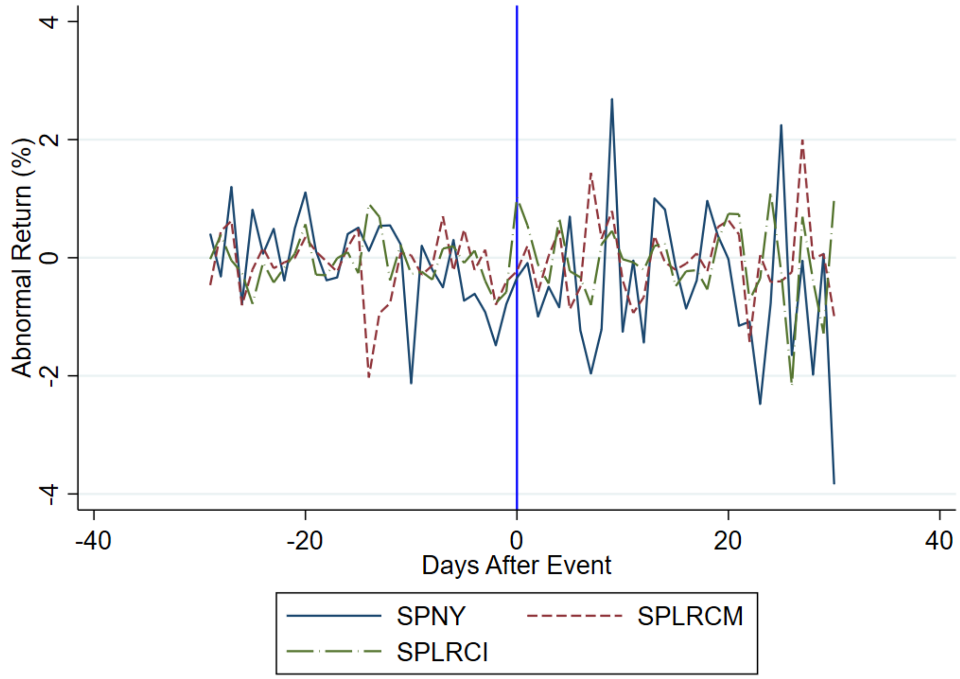


Figure C1 ARs on Energy, Materials, and Industrials

Figure C2 ARs on Consumer Discretionary, Consumer Staple, and Health Care

Figure C3 ARs on Financials, Information Technology, and Communication Services

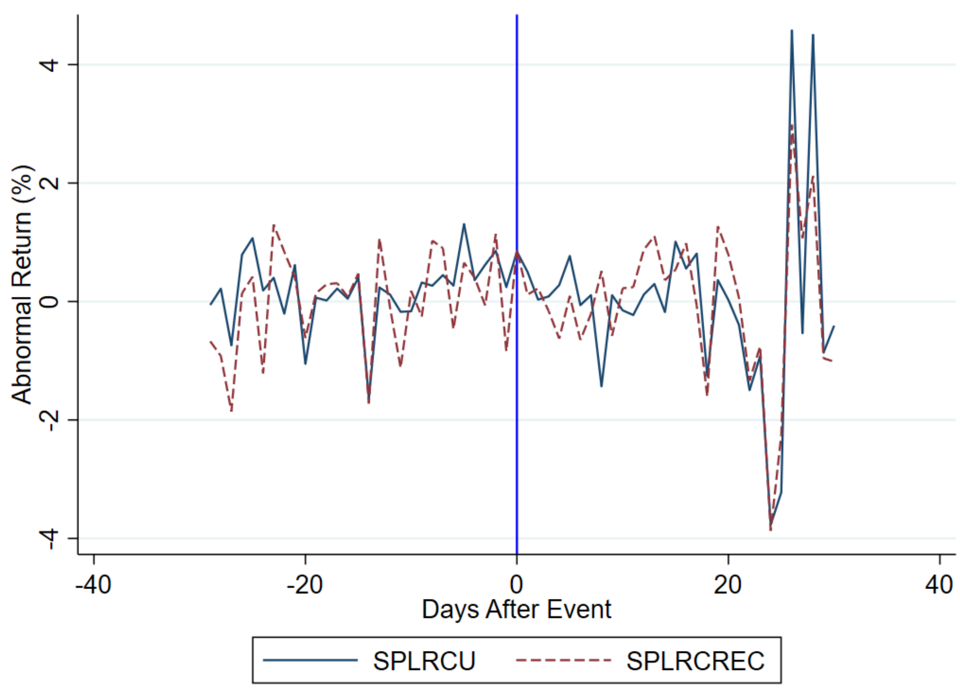
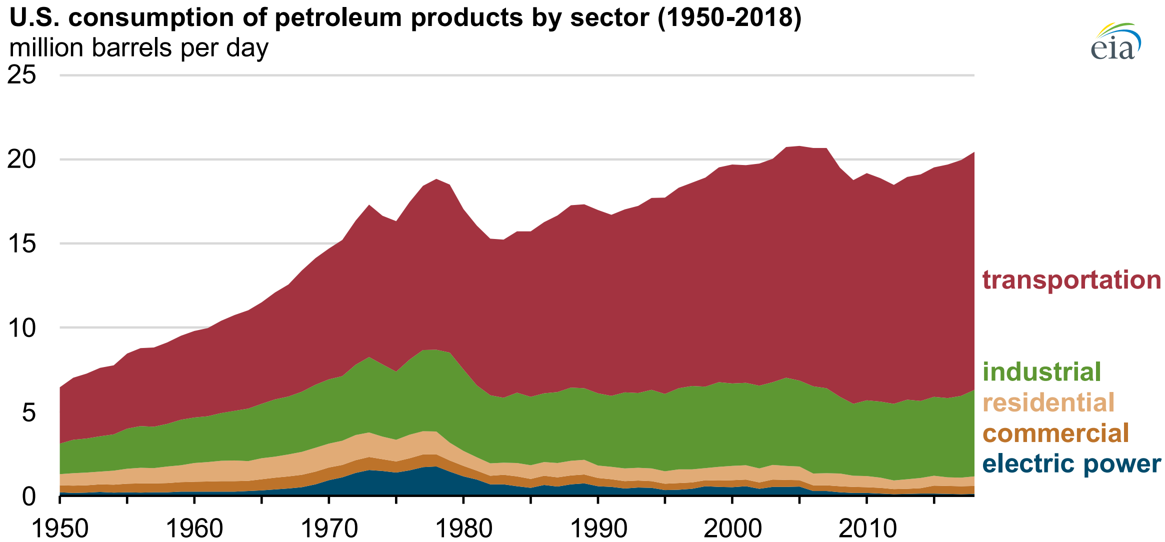


Figure C4 ARs on Utilities and Real Estate

D. Energy Sector Consumption



Source: U.S. Energy Information Administration, *Monthly Energy Review*