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Have Medical and Political Countermeasures Mitigated Investor Fears during the COVID-19 Pandemic?

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Abstract: Yes. We contrast the impacts of COVID-19 shocks and medical and political countermeasures in an otherwise standard model of financial market return determinants. During the pandemic, fears about COVID-19 can replace the economic sentiment to have a lasting negative impact on the stock market, especially in the first wave of the virus spreading. Medical research and government policies contribute to the stimulations of financial markets; however, efficient vaccines, when not developed, tend to negatively impact future stock returns and exacerbate the negative influence of COVID-19 sentiment on the stock market. Instead, such situations can be eased once medical research becomes advanced, helping the reconstruction of investor confidence. Public attention to the political support promoting economic and financial recovery has a positive impact on stock market returns and mitigates the shock of COVID-19 sentiment on the stock market.

Keywords: Investor Sentiment, COVID-19 Pandemic, Vaccination Programs, Government Acts, Stock Market.

1. Introduction

An unprecedented amount of financial resources and human capital has been devoted to fighting the COVID-19 pandemic. Research groups, including universities and private companies, entered a fierce competition to find a medical solution. Governments approved and put in place economic recovery plans whose dimensions have been never seen before: to give a couple of examples, the research and development (R&D) expenditure of Pfizer, whose collaborated developed vaccine is the first to be approved, in 2021 has been increased by 65% since 2019, and the United States (US) government has allocated approximately $7 trillion in fiscal allocations. The rare events, including the pandemic, vaccination programs, and political countermeasures are more likely to significantly affect stock market performance, as psychological bias exists in extreme conditions [1].

We ask whether, and eventually, by how much, the above activities have interacted to mitigating the investor fears of the pandemic as far as the financial markets are concerned. Two are the main questions of interest: First, have the COVID-19 fears substituted the economic sentiment during the COVID-19 pandemic in shaping the financial markets? Second, and possibly more importantly, have medical and political countermeasures eased the investor fears about the COVID-19? To answer these questions, we observe the US financial markets for a sufficiently long-time span and include the pre-pandemic period. We build a daily COVID-19 sentiment index; an economic sentiment index; a Vaccine attention index; and an Act attention index, include them all into an otherwise standard model

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for studying the impact of economic sentiment on financial market returns, and examine both the assumption that during the pandemic, news related to COVID-19 is more likely to sway investor sentiment in the financial market, and the assumption that attention to the medical and political countermeasures can promote a lessening of the pandemic effects on the financial markets.

Results show that, during the pandemic period, COVID-19 sentiment replaces the economic sentiment in shaping the stock market returns. Higher pessimism toward the pandemic is associated with lower contemporaneous excess returns during the first wave of the pandemic period. The predictability of future excess returns on COVID-19 sentiment remains negative. The well-documented influence of economic sentiment [2] on the financial market disappears. In subsequent waves, the stock market's responses to COVID-19 sentiment are delayed and less sensitive. Early vaccine attention index has a negative shock on stock market returns, reflecting public concerns about the capability to develop and the time to distribute an effective vaccine. Once the vaccines are successfully developed and the vaccination program is effectively promoted, not only can the vaccine attention-triggered negative stock market returns be improved, but exacerbated shocks of COVID-19 sentiment to the stock market, due to the vaccine attention can be alleviated. Finally, public attention to the political measures contributes to the recovery of financial markets in the early stages of the pandemic, discovered by its role in the softened impacts of COVID-19 sentiment on the stock market.

We offer two main contributions. The first contribution relates to the importance of considering additional fears when studying responses of the stock market to the COVID-19 pandemic. Baker et al. [3] use the number of news articles containing terms related to the pandemic to assess the responses of the stock market. Loughran and McDonald [4] evaluate the companies' views on COVID-19 through annual reports. Hanspal et al. [5] study the reaction of different types of investors to the stock market volatility triggered by the pandemic. Hassan et al. [6] believe that negative sentiment about COIVD-19 reported in the conference calls reduces the stock returns. These studies analyze the pandemic event, and possibly compare it with other pandemics [7]. However, they lack a complete perspective of the market around the pandemic, including either a comparison of the normal period before COVID-19 or the analysis of medical and political countermeasures. There is no research, to the best of our knowledge, that provides a systematic assessment of relative impacts upon the financial markets of the economic sentiment, the pandemic, the vaccines, and the recovery plans.

The second contribution is that we offer political recommendations, as asked by Ramelli and Wagner [8], for investors and policymakers. During the global health crisis, the role of crisis-related sentiment substitutes that of the general economic sentiment, so that the general economic sentiment has a lower impact on the stock market during the pandemic period. Moreover, medical and political countermeasures help restore investor confidence. After the successes of vaccine developments, public attention to the medical measures lightens people's anxiety, and attention to the political support contributes to the increases in stock returns. The research inspires investors to keep sensitive to special events, pays attention to the law of events, and makes timely decision-making adjustments in face of event shocks. Research also provides a reference for the government to respond to crises in the future, especially public health crises, using fiscal measurements to encourage corporate R&D to relieve life-threatening threats and to help the recovery of the economy and stock market. In addition, the paper provides a paradigm for the subsequent studies of non-financial induced economic recessions.

2. Data

Our sample spans from May 2019 to February 2022. Data comprise information for some pre-pandemic period, defined as D_0, and six waves of pandemic-spreading periods, building on the confirmed new cases provided by the Our World in Data and the dominant shares (the most shares) of virus variants collected from the CoVariants. The first wave (D_1) is from January 21st, 2020 to

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May 31st, 2020; the second wave (D_2) is from June 1st, 2020 to September 9th, 2020; the third wave (D_3) is from September 10th, 2020 to April 4th, 2021; the fourth wave (D_4) is from April 5th, 2021 to June 27th, 2021; the fifth wave (D_5) is from June 28th, 2021 to December 12th, 2021; and, finally, and the sixth wave (D_6) is from December 13th, 2021 to February 28th, 2022–**Error! Reference source not found.**. The first to the sixth waves of the pandemic-spreading period are distinguished by colors. Source: Our World in Data and CoVariants.

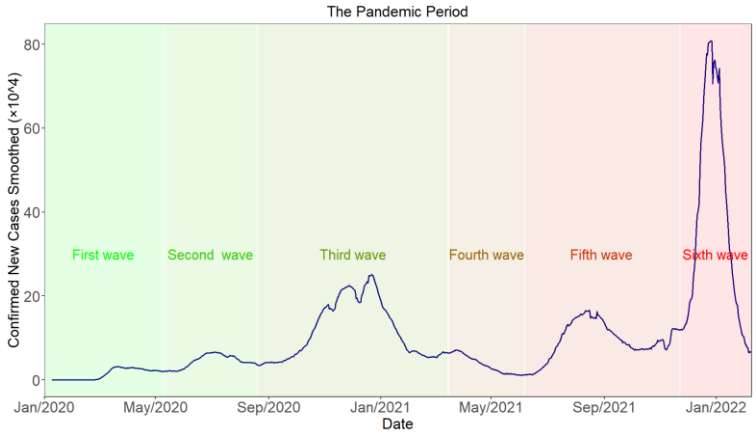

Figure 1: Confirmed New Cases in the United States from January 21st, 2020, to February 28th, 2022.

The COVID-19 sentiment index builds on the level of pessimism in daily newspaper articles discussing COVID-19 from January 21st, 2020, to February 28th, 2022. Considering that the novel coronavirus disease was not officially named "COVID-19" by the WHO until February 11th, 2020, we use the word "coronavirus" as our search term to prevent missing relevant news. We use the public New York Times (NYT) Article Search Application Programming Interface to identify coronavirus-related news and find a total of 40,879 news articles. Similar to Garcia [9], we collect news articles published in the NYT's Business, Opinion, and New York columns. These columns contain the main information that traders need: for example, the Business column publishes news related to Wall Street and economics—topics that are relevant to investors. Second, these columns contain summaries of the most important news stories in the US, and investors are likely to choose these columns to read. Like, news articles included in the Opinion column are published on the front page of the NYT's website. After filtering the columns, we obtain 9,705 news articles referring to "coronavirus". We also use the word "COVID-19" to search the news with the same requirements for column types and find that all news articles mentioning "COVID-19" are included in the sample we are left with.

During our sample period news articles are updated in real-time. On a given day, the stock market may have been closed when some news is released. Therefore, news published on day t may not generate sentiment until day t+1. To identify the date of the news sentiment, we treat the sentiment of news articles published after 16:00 Eastern Time (ET) as the next day's sentiment. The quantities of news articles discussing COVID-19, grouped by time of day and day of the week, are reported in Fig. 2. Most coronavirus-related news is released around 04:00 ET on weekdays, which means that investors can obtain most news before the stock market opens. We adopt the Loughran and McDonald (LM) word list to extract sentiment from COVID-19 news articles [10]. We construct COVID-19 sentiment as:

$$COVID_t = \begin{cases} \sum_{i=1}^{n}(N_{t,i} - P_{t,i})/n, & if\ day\ t-1\ is\ a\ trading\ day \\ \sum_{j=0}^{C}\left(\sum_{i=1}^{n}(N_{t-j,i} - P_{t-j,i})\right)/m & if\ day\ t-1\ is\ not\ a\ trading\ day \end{cases} \quad (1)$$

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where N and P indicate negative and positive scores calculated by using the LM word list, n denotes the amount of news for a single day, C indicates the number of days on which the market was closed immediately prior to day t, and m is the number of news published from day t-C to t. Table 1 and Fig. 3(a) show that all COVID-19 sentiment values are above zero. The average values are 1.990 and 1.935 in the first- and second-wave periods, 1.683 and 1.485 in the third- and fourth-wave periods, and 1.706 and 1.761 in the fifth- and sixth-wave periods. Statistics therefore suggest that the COVID-19 news articles are more pessimistic at the beginning of the COVID-19 pandemic and when the virus variants arrive.

To measure public attention to the medical and political countermeasures, we source public search volumes for "vaccine" and acts' names referring to the economics and public finance listed in Table 2 from Google Trends [11]. Since the outbreak of the pandemic, companies such as Pfizer, Moderna, and Johnson & Johnson have developed COVID-19 vaccines. We use "vaccine" as the search term- "COVID-19 vaccine" gives similar results. Furthermore, a series of acts adopted in the field of economics and public finance was enacted by the US Congress to stimulate the economy and help families and businesses. Vaccine and Act attention are defined as the log differences in search volumes on the topic of vaccines and the sum of log differences in search volumes on the topic of different acts. We regard $PostVaccinated_t$ and $PostLaw_t$ as dummy variables, which equal 1 after the first person got vaccinated and after the Paycheck Protection Program and Health Care Enhancement Act became law, respectively – Fig. 3(b) and (c). Adopting the dummy variable, which equals 1 after the CARES act became law, gives similar results.

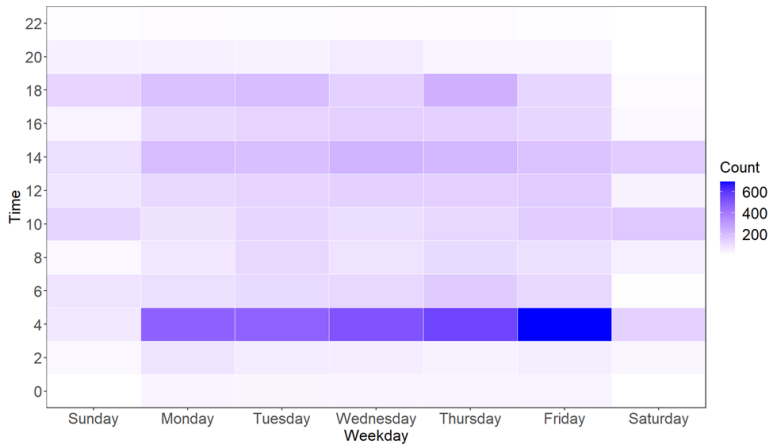

Figure 2: The Number of COVID-19-related News based on Time of the Day and Day of the Week.

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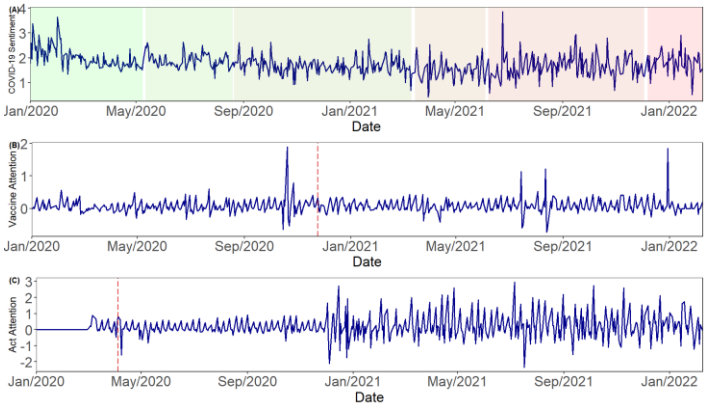

Figure 3: COVID-19 Sentiment, Vaccine Attention and Acts Attention from January 21st, 2020 to February 28th, 2022.

Panel A reports different waves of the pandemic-spreading period are distinguished by the colors. In Panel B and C, red lines shape the time dummies of either after the first people got vaccinated or after the Paycheck Protection Program and Health Care Enhancement Act became law, respectively.

We choose all news articles published in the Business column to capture the general economic sentiment. There are 9,698 news articles published from May 2019 to February 2022. We use excess S&P500 return (ER), the difference between S&P 500 return and one-month treasury bill rate, to represent the stock market. Table 1 presents that both economic sentiment and excess returns also perform differential during the initial and sixth waves, becoming more pessimistic and lower than zero, respectively. The economic environment is measured as Aruoba-Diebold-Scotti Busi-ness Conditions Index (ADS) from the Federal Reserve Bank of Philadelphia [12]. It contains various seasonally adjusted economic indicators. A higher ADS value indicates a more prosperous business environment [13]. The economic policy uncertainty index (EPU), proposed by Baker et al. [14], counts the news items archived in the NewsBank database that contain terms relating to all three of the following categories: the economy, policy, and uncertainty. Based on information from 10 newspapers, the EPU includes both reports about uncertain events and discussions of the subsequent effects. Hence, the index can be viewed as a proxy of economic uncertainty influenced by policy [3]. To obtain further information about this special period, we also refer to the changes in West Texas Intermediate oil prices (WTI). 2020 Saudi Arabia-Russia oil price war and the 2022 Russian-Ukraine war caused the price of crude oil to plunge by more than 20% and soar to the highest prices over the last more than ten years, respectively, which incur more uncertainties in the stock market [15]; we, therefore, include changes in WTI to control for oil price shocks.

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Table 1: Descriptive Statistics.

	Mean	Median	Q1	Q3	S.D.	Obs.
First-wave (January 21st 2020–May 31st 2020)						
COVID	1.990	1.924	1.706	2.133	0.409	91
ER	-0.048	0.023	-1.593	1.310	3.284	91
Economic	1.990	1.953	1.732	2.180	0.500	91
Second-wave (June 1st 2020-September 9th 2020)						
COVID	1.935	1.894	1.737	2.138	0.294	71
ER	0.164	0.361	-0.368	0.874	1.317	71
Economic	1.885	1.799	1.535	2.192	0.499	71
Third-wave (September 10th 2020–April 4th 2021)						
COVID	1.683	1.666	1.480	1.875	0.345	141
ER	0.124	0.102	-0.460	0.814	1.033	141
Economic	1.654	1.552	1.318	2.038	0.519	141
Fourth-*wave (April 5th 2021–June 27th 2021)*						
COVID	1.485	1.462	1.180	1.756	0.428	59
ER	0.109	0.077	-0.233	0.547	0.713	59
Economic	1.358	1.346	1.131	1.587	0.332	59
Fifth-wave (June 28th 2021-December 12th 2021)						
COVID	1.706	1.696	1.353	1.974	0.508	117
ER	0.085	0.165	-0.320	0.431	0.757	117
Economic	1.596	1.587	1.277	1.956	0.481	117
Sixth-*wave (December 13th 2021–February 28th 2022)*						
COVID	1.761	1.791	1.444	2.075	0.448	53
ER	-0.133	-0.150	-1.014	0.686	1.221	53
Economic	1.813	1.759	1.490	2.060	0.441	53
Entire time span (May 21st 2019–February 28th 2022)						
ER	0.070	0.137	-0.437	0.727	1.473	700
Economic	1.762	1.731	1.384	2.102	0.546	700

Table 2: Act Names (Policy Area: Economics and Public Finance).

Consolidated Appropriations Act, 2021
Paycheck Protection Program and Health Care Enhancement Act
CARES Act
Extending Government Funding and Delivering Emergency Assistance Act
American Rescue Plan Act of 2021
Consolidated Appropriations Act, 2022

3. Methodology

We build upon Da et al. [2], and run the following model:

$$ER_{t+\mathrm{i}} = \sum_{d=1}^{6} \beta_d \times D_d \times COVID_t + \sum_{d=0}^{7} \gamma_d \times D_d \times Economic_t + \sum_j \mu_j Control_{j,t} + \varepsilon_{t+i}, \quad (2)$$

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where $ER_{t+\mathrm{i}}$ denotes S&P 500 excess returns on day $t+i$ ($i = 0$ to 4). $COVID_t$ and $Economic_t$ are the standardized coronavirus and economic sentiment indexes on day t, respectively. D_d is a time dummy representing the pre-pandemic period, first-wave, second-wave, third-wave, fourth-wave, fifth-wave, and sixth-wave of the pandemic period, respectively. The set of control variables ($Control_{j,t}$) contains the products of lagged excess returns, the changes in the ADS, EPU, and WTI, and dummy variables for the different subperiods. We then augment version of Eq. (2), where $Vaccine_t$ and Act_t are included in the set of regressors.

$$ER_{t+\mathrm{i}} = \alpha + \pi_1 Vaccine_t + \pi_2 PostVaccinated_t + \pi_3 Vaccine_t \times PostVaccinated_t + \theta_1 Act_t + \theta_2 PostLaw_t + \theta_3 Act_t \times PostLaw_t + \beta_1 COVID_t + \gamma_1 Economic_t + \sum_j \mu_j Control_{j,t} + \varepsilon_{t+\mathrm{i}}. \quad (3)$$

$$ER_{t+\mathrm{i}} = \alpha + \pi_1 Vaccine_t + \pi_2 PostVaccinated_t + \pi_3 Vaccine_t \times PostVaccinated_t + \pi_4 Vaccine_t \times COVID_t + \pi_5 PostVaccinated_t \times COVID_t + \pi_6 Vaccine_t \times PostVaccinated_t \times COVID_t + \theta_1 Act_t + \theta_2 PostLaw_t + \theta_3 Act_t \times PostLaw_t + \theta_4 Act_t \times COVID_t + \theta_5 PostLaw_t \times COVID_t + \theta_6 Act_t \times PostLaw_t \times COVID_t + \beta_1 COVID_t + \gamma_1 Economic_t + \sum_j \mu_j Control_{j,t} + \varepsilon_{t+\mathrm{i}}. \quad (4)$$

4. Results

Table 3 reports results when estimating Eq (2). Standard errors are Newey-West corrected for all models. Results shown in Column (1) suggest that, during the pre-pandemic period, a one standard deviation increase in economic pessimism corresponds to 0.130 declines in excess returns—significant at the 1% s.l. These results suggest a negative contemporaneous relationship between economic sentiment and excess returns when the market is not affected by an unusual event. However, this relationship is not statistically significant after COVID-19 started spreading across the US. Instead, it is COVID-19 sentiment that has a negative contemporaneous impact on excess returns during the first wave and fifth wave. Specifically, a one standard deviation increase in COVID-19 sentiment is associated with a 0.766 and 0.167 reduction in excess returns, respectively—significant at the 1% and 5% s.l., respectively. This finding is unsurprising because COVID-19, as a global health crisis, its initial spread, and subsequent virus variants, trigger higher pessimism, which correlates with lower stock market returns. The rest of the columns in Table 3 report the influences of the two sentiments on future stock market returns. Column (2) shows that economic sentiment has only a short-term negative relationship with stock returns. A one standard deviation increase in economic sentiment predicts 0.086 increases in excess returns on day t+1 during the pre-pandemic period—significant at the 10% s.l., suggesting that the negative correlation between economic sentiment and stock market returns reverses the next day. Such short-term reversal is similar to the findings observed by Da et al. [2]. Both liquidity shocks and noise traders can be used to explain this evidence. By contrast, we find that the relationship between COVID-19 sentiment and stock returns is consistently negative in the following days during the initial pandemic periods. For example, a one standard deviation increase in COVID-19 sentiment is associated with decreases of 1.021 in excess returns and 0.412 on day t+1 in the first- and third-wave periods—significant at the 5% and 10% s.l., respectively. Interestingly, during the fifth-wave period, COVID-19 sentiment can predict a delayed future short-term return reversal. A one standard deviation rise in COVID-19 sentiment predicts 0.298 increases in excess returns on day t+4—significant at the 1% s.l. We believe that while the evolution of the COVID-19 variant of the virus may heighten concerns, the concerns reflected in the stock

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market can be eased within a week, and even the emergence of a more contagious variant will not cause a greater stock market reaction.

Overall, during the pre-pandemic period, we find a short-term reversal between economic sentiment and stock returns; during the initial pandemic period, COVID-19 sentiment appears to supersede the role of economic sentiment on the stock market and predict further declines in the stock returns; in the following waves of the pandemic, although when virus variant delta dominates, COVID-19 sentiment correlates with contemporaneous negative returns, the impacts of COVID-19 sentiment on the stock market is corrected or even disappears.

We then focus on the roles of medical and political countermeasures in financial markets during the spread of the pandemic. Panel A and B of Table 4 illustrate that vaccine attention negatively predicts excess returns, while action attention is positively correlated with future excess returns. These indicate that medical research and policy support will have various impacts on the stock market. To explore further, we include two dummy variables, $PostVaccinated_t$ and $PostLaw_t$, and the results are shown in Panel B. A one standard deviation increase in vaccine attention predicts a decrease of 0.227 in excess returns on day t+3—significant at the 1% s.l. When the Vaccine index is multiplied by $PostVaccinated_t$, the coefficient of the interaction term becomes positive. This shows that when vaccines against COVID-19 are not available, public attention to the vaccine will trigger a decline in the stock market in the future, and negative predictability of excess return can be eased with the development and popularization of vaccines. As for Act attention, it has a positive contemporaneous relationship with stock market returns after government proposes rescue plans. A one standard deviation increase in the Act attention corresponds with a contemporaneous increase of 2.821 (significant at the 5% s.l.) in excess returns. The stock market can absorb the good news of the government's announcement of policy support and economic assistance for COVID-19 in time. This result appears reasonable because financial subsidies can help alleviate and control the financial strain on firms and individuals during the pandemic. However, the negative coefficient of the interaction term between the Act index and $PostLaw_t$ indicates that the impacts of public attention to the policies in response to COVID-19 on the stock market diminish in the long run.

The dependent variable is the S&P 500 excess return ("ER"). "COVID" is a sentiment index for news discussing COVID-19. "Business" is a general economic sentiment index. D_0 to D_6 are time dummy variables that equal one if day t belongs to the normal period, first-wave, second-wave, third-wave, fourth-wave, fifth-wave, and sixth-wave, respectively, and zero otherwise. "ADS," "EPU," and "WTI" respectively represent the Aruoba-Diebold-Scotti Business Conditions Index, economic policy uncertainty index, and West Texas Intermediate oil prices. "D" is time dummies and "Lagged ER" is the product of lagged excess return and time dummies (e.g. ERt-1×D1). Newey-West corrected standard errors are shown in parentheses.

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Table 3: COVID Sentiment, Economic Sentiment, and Stock Market Excess Returns.

	(1) ER_t	(2) ER_{t+1}	(3) ER_{t+2}	(4) ER_{t+3}	(5) ER_{t+4}
$COVID_t \times D_1$	-0.766***	-1.021**	-0.131	-0.715**	-1.164*
	(0.277)	(0.397)	(0.373)	(0.349)	(0.6)
$COVID_t \times D_2$	0.186	0.649	-0.455**	0.05	0.346
	(0.307)	(0.513)	(0.222)	(0.387)	(0.216)
$COVID_t \times D_3$	0.001	-0.412*	-0.101	-0.329	-0.083
	(0.179)	(0.217)	(0.157)	(0.231)	(0.147)
$COVID_t \times D_4$	-0.094	0.104	-0.04	-0.078	-0.178
	(0.162)	(0.107)	(0.221)	(0.131)	(0.242)
$COVID_t \times D_5$	-0.167**	0.119	-0.112	-0.135	0.298***
	(0.069)	(0.136)	(0.071)	(0.117)	(0.096)
$COVID_t \times D_6$	-0.291	0.467	-0.319	-0.126	-0.002
	(0.291)	(0.417)	(0.251)	(0.246)	(0.37)
$Economic_t \times D_0$	-0.130***	0.086*	0.042	-0.053	0.041
	(0.048)	(0.048)	(0.043)	(0.056)	(0.025)
$Economic_t \times D_1$	-0.163	0.007	-0.157	0.29	-0.444*
	(0.248)	(0.343)	(0.154)	(0.39)	(0.242)
$Economic_t \times D_2$	0.063	-0.068	0.173	0.007	-0.035
	(0.153)	(0.175)	(0.362)	(0.15)	(0.162)
$Economic_t \times D_3$	0.032	-0.028	-0.141*	-0.062	0.006
	(0.078)	(0.114)	(0.085)	(0.13)	(0.078)
$Economic_t \times D_4$	-0.254	-0.038	0.064	0.085	0.05
	(0.221)	(0.169)	(0.132)	(0.136)	(0.136)
$Economic_t \times D_5$	0.007	0.028	0.138*	0.044	-0.069
	(0.068)	(0.075)	(0.075)	(0.085)	(0.063)
$Economic_t \times D_6$	0.228	0.067	0.099	-0.136	0.051
	(0.179)	(0.184)	(0.136)	(0.207)	(0.164)
ADS_t	0.002	0.012***	-0.026***	-0.014***	-0.009**
	(0.006)	(0.004)	(0.007)	(0.004)	(0.004)
EPU_t	0.042	0.060	0.055	-0.022	0.159*
	(0.069)	(0.078)	(0.06)	(0.068)	(0.086)
WTI_t	0.016**	0.011***	-0.006**	0.005	-0.004***
	(0.008)	(0.003)	(0.003)	(0.004)	(0.001)
D	Yes	Yes	Yes	Yes	Yes
Lags of ER	Yes	Yes	Yes	Yes	Yes
Obs.	695	694	693	692	691
Adj. R^2	0.146	0.158	0.157	0.130	0.196

*p < 0.1; **p < 0.05; ***p < 0.01.

These findings show that attention to the medical and political methods have different effects on the stock market. We further adopt interaction terms to examine whether the impact of COVID-19 sentiment on the financial market is conditional on the Vaccine and Act attention levels. Table 5 reports the results. When there are no vaccines, more attention to the vaccines is more likely to instead exacerbate the negative impact of COVID-19 sentiment on the stock market, which can be effectively mitigated by the success of vaccine development. The interactions between COVID-19 sentiment and

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act attention before and after acts becoming laws also present similar results. More public attention to government rescue announcements in the early stages of the pandemic is associated with a reduction in the negative impact of COVID-19 sentiment on the stock market, but the role of Act attention becomes less pronounced afterward.

Overall, we find that when progress is made in the research and development of medical research, attention to medical measurements helps alleviate stock market fluctuations caused by COVID-19 sentiment. Also, at the beginning of the pandemic period, the disclosure of government policies contributes to a certain extent to the stock market recovery and partially relieves the stock market fluctuations caused by COVD-19 sentiment.

"Vaccine" and "Act" are attention indexes about the vaccines and acts."PostVaccinated" and "PostLaw" are time dummies, which equals to 1 after the first people got vaccinated and after the Paycheck Protection Program and Health Care Enhancement Act became a law, and zero otherwise. Control variables include "ADS", "EPU", "WTI" and a constant. Panel C also adds time dummies as control variables. The rest see Table 3.

Table 4: COVID Sentiment, Vaccine Attention, Acts Attention, and Stock Market Excess Returns.

Panel A: Full Sample					
	(1)	(2)	(3)	(4)	(5)
	ER_t	ER_{t+1}	ER_{t+2}	ER_{t+3}	ER_{t+4}
$Vaccine_t$	-0.095	-0.028	-0.077	-0.090*	0.018
	(0.061)	(0.039)	(0.053)	(0.046)	(0.038)
Act_t	0.083	0.018	-0.044	0.084*	-0.042
	(0.053)	(0.051)	(0.031)	(0.046)	(0.052)
$COVID_t$	-0.051	-0.048	-0.024	-0.054	-0.039
	(0.043)	(0.063)	(0.038)	(0.042)	(0.06)
$Economic_t$	-0.041	0.009	-0.016	-0.026	-0.067
	(0.051)	(0.045)	(0.05)	(0.058)	(0.069)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	695	694	693	692	691
Adj. R^2	0.135	0.133	0.145	0.133	0.164
Panel B: Pandemic-spreading Period					
	(1)	(2)	(3)	(4)	(5)
	ER_t	ER_{t+1}	ER_{t+2}	ER_{t+3}	ER_{t+4}
$Vaccine_t$	-0.107	-0.037	-0.080	-0.110**	0.030
	(0.069)	(0.045)	(0.061)	(0.052)	(0.045)
Act_t	0.092	0.019	-0.056	0.097*	-0.057
	(0.06)	(0.058)	(0.035)	(0.053)	(0.06)
$COVID_t$	-0.116**	-0.067	-0.072	-0.102*	-0.017
	(0.049)	(0.089)	(0.054)	(0.052)	(0.096)
$Economic_t$	0.026	0.009	-0.016	0.022	-0.121
	(0.066)	(0.065)	(0.073)	(0.084)	(0.078)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	527	526	525	524	523
Adj. R^2	0.149	0.145	0.156	0.138	0.173

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Table 5: COVID Sentiment, Vaccine Attention, Acts Attention, and Stock Market Excess Returns (continued).

Panel C: Pandemic-spreading Period with Time Dummies					
	(1)	(2)	(3)	(4)	(5)
	ER_t	ER_{t+1}	ER_{t+2}	ER_{t+3}	ER_{t+4}
$Vaccine_t \times PostVaccinated_t$	0.004	-0.095	0.126	0.202**	0.124
	(0.15)	(0.091)	(0.145)	(0.09)	(0.105)
$Vaccine_t$	-0.091	0.023	-0.149	-0.227***	-0.037
	(0.142)	(0.075)	(0.128)	(0.088)	(0.086)
$Act_t \times PostLaw_t$	-2.767**	-1.275	-0.827	0.435	-0.584
	(1.111)	(0.879)	(0.551)	(0.626)	(0.383)
Act_t	2.821**	1.284	0.754	-0.341	0.516
	(1.119)	(0.876)	(0.552)	(0.628)	(0.372)
$COVID_t$	-0.093**	-0.048	-0.060	-0.100**	-0.015
	(0.042)	(0.073)	(0.064)	(0.05)	(0.089)
$Economic_t$	0.012	0.005	-0.019	0.019	-0.132*
	(0.062)	(0.075)	(0.068)	(0.083)	(0.07)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	527	526	525	524	523
Adj. R^2	0.135	0.133	0.145	0.133	0.164

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Table 6: COVID Sentiment, Vaccine Attention, Acts Attention, and Stock Market Excess Returns: Inter-action Analysis. See Table 4 for details.

	(1) ER_t	(2) ER_{t+1}	(3) ER_{t+2}	(4) ER_{t+3}	(5) ER_{t+4}
$COVID_t \times Vaccine_t \times PostVaccinated_t$	0.153	0.084	0.149	0.332**	-0.067
	(0.168)	(0.136)	(0.148)	(0.139)	(0.166)
$COVID_t \times Vaccine_t$	-0.112	-0.062	-0.075	-0.348**	0.111
	(0.164)	(0.134)	(0.14)	(0.135)	(0.158)
$Vaccine_t \times PostVaccinated_t$	0.011	-0.105	0.137	0.198**	0.104
	(0.14)	(0.1)	(0.135)	(0.084)	(0.105)
$Vaccine_t$	-0.085	0.033	-0.143	-0.223***	-0.012
	(0.13)	(0.086)	(0.126)	(0.079)	(0.097)
$COVID_t \times Act_t \times PostLaw_t$	-6.137***	-1.562	-3.763	-1.753	-1.818
	(2.016)	(3.217)	(4.983)	(2.521)	(2.709)
$COVID_t \times Act_t$	6.173***	1.637	3.770	1.688	1.843
	(2.013)	(3.217)	(4.985)	(2.519)	(2.706)
$Act_t \times PostLaw_t$	-3.705***	-1.290	-1.421	0.214	-0.295
	(0.932)	(1.3)	(1.531)	(0.72)	(0.485)
Act_t	3.761***	1.312	1.344	-0.144	0.229
	(0.938)	(1.298)	(1.534)	(0.718)	(0.47)
$COVID_t \times PostVaccinated_t$	-0.244**	0.055	0.146	0.266**	-0.051
	(0.098)	(0.125)	(0.152)	(0.133)	(0.142)
$COVIDt \times PostLaw_t$	-0.938**	0.080	-0.800	-0.413	0.739*
	(0.413)	(0.754)	(1.191)	(0.66)	(0.435)
$COVID_t$	1.075***	-0.112	0.642	0.097	-0.588
	(0.369)	(0.776)	(1.182)	(0.633)	(0.451)
$Economic_t$	-0.016	0.001	-0.015	0.026	-0.142*
	(0.064)	(0.076)	(0.07)	(0.08)	(0.083)
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	527	526	525	524	523
Adj. R^2	0.189	0.150	0.154	0.146	0.202

5. Conclusion

This paper analyzes the impact of sentiment regarding the COVID-19 pandemic and related countermeasures on stock market performance. Evidence suggests that during the pre-pandemic period, the economic sentiment index explains a short-term reversal in excess stock returns, among others, Da et al. [2]. However, it is not statistically significant during the pandemic period. We find that the more pessimistic the investor sentiment regarding the pandemic, the lower the contemporaneous and future excess returns during the first wave of the pandemic period. As the pandemic progresses into the second, third, and fourth waves, the stock market's responses to COVID-19 sentiment tend to be delayed, even statistically insignificant. During the fifth wave, COVID-19 sentiment experiences a delayed reversal within a week in the excess returns due to the increased but controlled cases. By the sixth wave, the impact of COVID-19 sentiment on the stock market returns to a stage of statistical insignificance. Then, we believe that public attention to less ineffectual medical treatment will decrease stock returns. However, when an effective vaccine is available, not only can

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the impacts of public attention on the stock market be mitigated, but the negative impacts of COVID-19 sentiment on the stock market are also alleviated because of this attention. In addition, attention to government policies that support companies and individuals is associated with increased stock market returns and can reduce the impact of COVID-19 sentiment on the stock market, albeit attenuated over time.

The findings make the following contributions to the literature. First, when a rare event occurs, sentiment regarding a specific subject (here, the COVID-19 pandemic) tends to have a greater impact on the stock market than, and can even replace, general economic sentiment. Differently from the general economic sentiment that predicts return reversals, the pessimistic nature of this rare event negatively impacts the stock market returns over the same period and in the future. Second, the continued negative impacts of COVID-19 sentiment on the future stock returns confirm the theory that investors are more likely to underreact to the news [16]. Finally, by introducing attention indexes for medical and political measures, we provide new ideas for studying the impact of countermeasures on the stock market in the context of major public health events.

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