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State-level COVID-19 outbreak and stock returns

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ABSTRACT

We use state-level data to evaluate the connection between outbreaks of COVID-19 and stock returns over the period January-June 2020. We show that daily increases in the number of infected cases, hospitalized cases, and deaths are negatively associated with next day stock returns of firms headquartered in the same state. The relationship is weaker among states with high levels of medical resources and states that are likely to get support from the federal government. In addition, we find that the negative effect is reduced for firms that report an expectation that an outbreak will increase revenues and for firms with a strong corporate social responsibility practice. We believe our study is the first paper to assess cross-sectional stock price reactions to COVID-19 as a function of the state-level impact of the pandemic outbreak.

1. Introduction

The COVID-19 pandemic has placed a significant negative effect on the U.S. society. As of September 2020, more than 6 million people in the U.S. have been infected with the coronavirus, more than 180,000 people have died, and tens of thousands of newly infected cases are reported daily.\textsuperscript{1} While the level of the impact of the disease on capital markets is without precedent (Baker et al., 2020; Demers et al., 2020), the exact mechanisms by which the pandemic affects security prices have largely remained unexplored. In this study, we investigate whether cross-sectional differences in the geographical dispersion of the pandemic affect asset prices. Specifically, we study if increases at the state level in: i) COVID-19 infected cases, ii) death cases, and iii) hospitalized cases relate to future security returns of U.S. firms headquartered in the same state.

Daily data on state-level infected cases, death cases, and hospitalizations are obtained from covidtracking.com over the period from January 22 to June 30, 2020. To measure state-level COVID-19 outbreak, we construct the ratio of daily increases in infected cases over the states' population, the ratio of deaths over the total number of confirmed cases for the state, and the ratio of daily increases in the number of hospitalized cases over the total number of confirmed cases for the state. Building on the premise that core business

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\textsuperscript{1} In this study, we focus on the U.S. experience. The scale of the COVID-19 shock is also unprecedented across the globe. As of September, 2020, the pandemic has infected more than 29.5 million people and claimed almost one million lives around the globe (WHO, 2020; available at: https://covid19.who.int/).

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activities of firms often occur within proximity to their headquarters (Pirinsky and Wang, 2006; Chaney et al., 2012) and asset prices exhibit a significant regional component (Coval and Moskowitz, 1999; Korniotis and Kumar, 2013), we match each firm’s location with measures of the state-level pandemic outbreak using the state in which the firm is headquartered.  

Our empirical results show that daily increases in: i) the number of infections at the state level, ii) the number of deaths, and iii) the number of hospitalizations are negatively associated with next day stock returns of firms headquartered in the same state. This relation is of large economic significance and cannot be explained by risks, firm characteristics, or state-level macroeconomics. For example, we document that a 1% increase in the number of new COVID-19 positive cases over the total state population results in an average decrease in next day market-adjusted stock returns of 310 basis points.

We find that the negative stock return impact of a COVID-19 outbreak within a state is less pronounced for firms headquartered in states with higher available capacity for treating COVID-19 patients. We conclude that the market views medical resources as important in how a state handles the outbreak. Next, we also find that the negative effect of a state-level COVID-19 outbreak on stock returns is weaker among firms headquartered in election battleground states or in states run by Republican governors. We suggest that the incumbent federal administration seeking re-election is more likely to provide federal support to battleground states during the 2020 election year and states led by Republican governors are more likely to be assisted by the Trump administration. Thus, these states are in a better position to fight against the COVID-19 outbreak.

We also document that firms who self-report expectations of a positive effect from COVID-19 and firms with strong CSR activities experience a less adverse impact of state-level COVID-19 outbreak on their stock returns. In our final avenue of inquiry, we conduct a battery of robustness tests with the separate inclusion of the following control variables in our baseline model: i) the proportion of state population whose age is 65 or above, ii) the stock-level daily trading turnover, and iii) the country-level economic policy uncertainty. Consistent with our main findings, after controlling for these variables, we continue to find that daily state-level increases in infected cases, deaths, and hospitalized cases are negatively related to next day stock returns of firms headquartered in the same state.

Our study offers two important contributions to the literature. First, contemporary research has uncovered several potential explanations for cross-sectional variations in stock market reactions to the COVID-19 pandemic. These include policy responses (Baker et al., 2020), liquidity access (Acharya and Steffen, 2020), and environmental and social ratings (Albuquerque et al., 2020; Demers et al., 2020). Our study shows that state-level factors have considerable effects on the cross-sectional reaction of stock prices to COVID-19 outbreaks.

Second, this paper contributes to the literature on the locality of firms and their stock returns. Pirinsky and Wang (2006) document that stock returns of firms headquartered in the same geographic area exhibit a strong degree of co-movement. This phenomenon can be explained by the geographic segmentation of the equity market where investors show a tendency of overweighting local firms in their portfolios (Coval and Moskowitz, 1999; and Korniotis and Kumar, 2013). Our findings suggest that there is a significant regional component of price formation in the equity market during the COVID-19 outbreak.

The rest of this paper is organized as follows. Section 2 describes our sample and data. In Section 3 we present our empirical methodologies and results, while Section 4 concludes the study.

2. Sample and data

We collect data on daily increases in the number of COVID-19 positive cases, death cases, and hospitalized cases from covid-tracking.com. The sample period is between January 22 and June 30, 2020.

We estimate three different measures of state-level COVID-19 outbreak. The first measure (Positive_Cases) is the number of new COVID-19 positive cases identified each day as a percentage of the population of a state. The second measure (Death_Cases) is the ratio of the number of COVID-19 related deaths each day over the total number of positive cases for a state. The third measure (Hospitalized_Cases) is the number of new hospitalizations for COVID-19 as a percentage of the total number of positive cases for a state.

Following the existing literature (Coval and Moskowitz, 1999; 2001; Pirinsky and Wang, 2006; Korniotis and Kumar, 2013), we use the state in which a firm has its headquarters as the location of the firm’s operations. We then match measures of state-level COVID-19 outbreak with firms’ locations based on the state in which the firm is headquartered.

We collect firm-level financial statement data from Compustat Fundamentals Annual. Daily stock returns are obtained from the Center for Research in Security Prices (CRSP) and data on Fama and French’s (2015) five factors are from Kenneth French’s data library. We control for state-level personal income growth, gross domestic product (GDP) growth, and personal consumption growth based on data collected from the U.S. Bureau of Economic Analysis.

Table 1 provides descriptive statistics for all variables used in this study. Overall, the main sample contains 393,097 observations for 3,562 U.S. publicly listed firms. The daily market-adjusted stock returns, which are calculated as daily stock returns minus CRSP value-weighted market returns, has a mean value of -0.035%. The daily ratios of new COVID-19 positive cases, death cases, and hospitalized cases have an average value of 0.005%, 0.128%, and 0.303%, respectively.

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2 Korniotis and Kumar (2013) document that expected returns for local stocks would rise during local adverse economic conditions because local risk aversion increases while local risk sharing abilities decrease. The authors argue that the return predictability based on local factors is predominantly based on a form of investor local bias.
3. Empirical analysis

3.1. State-level COVID-19 outbreak and stock returns

We perform the following ordinary least squares (OLS) regression of daily market-adjusted stock returns on state-level measures of COVID-19 severity:

\[
AR_{i,t+1} = \alpha_i + \beta_1 \text{COVID19}_{i,t} + \gamma \times \text{Controls}_{i,t} + \text{Ind} + \text{Month} + \varepsilon_{i,t+1}
\]

(1)

where \(i\) and \(t\) denote firm and day, respectively. \(\text{Ind}\) is the industry-fixed effects based on two-digit SIC code, \(\text{Month}\) is the month-fixed effects and \(\varepsilon\) is the error term. The dependent variable is market-adjusted stock returns \((AR)\). COVID19 is a vector for our main independent variables of interest, including Positive_Cases, Death_Cases, and Hospitalized_Cases. Controls is a vector for control variables.

Table 2 reports regression estimates for model (1). In column (1), we consider the relation between the state-level Positive_Cases and future market-adjusted stock returns \((AR)\). Column (2) shows the association between the state-level Death_Cases and future market-adjusted stock returns. In column (3), we utilize the state-level daily ratio of new hospitalized cases \((\text{Hospitalized_Cases})\). Irrespective of the measure used to capture the extent of each state’s outbreak of the COVID-19 pandemic, the results are largely consistent. We observe a significant negative relation between each of the state-level COVID-19 outbreak measures and future daily market-adjusted stock returns. All coefficients on COVID-19 outbreak measures are significant at the 1% level.

In column (4), we include all three measures of the extent of the COVID-19 outbreak for each state into the regression specification. Similarly, the results in column (4) indicate significant negative associations between all three COVID-19 severity measures and future market-adjusted stock returns. All coefficients on COVID-19 outbreak measures are significant at the 1% level.

3 In addition, we partition the hospitalized cases of COVID-19 into two groups, namely (i) Intensive Care Unit (ICU) and (ii) non-ICU hospitalized cases. ICU_Hospitalized_Cases is the ratio of daily increase in the number of COVID-19 cases admitted to ICUs over the total number of confirmed COVID-19 positive cases, for each state. Non-ICU_Hospitalized_Cases is the ratio of daily increase in the number of COVID-19 admitted to medical wards other than ICUs over the total number of confirmed COVID-19 positive cases, for each state. Our findings (untabulated) show negative and significant relation between the non-ICU hospitalized cases and the daily market-adjusted returns \((AR)\) at the 5% significant level. We do not document significant evidence in the case of ICU hospitalized cases.

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**Table 1** Summary statistics.

| Variables                  | N     | Mean  | Std. Dev | P25  | Median | P75  |
|----------------------------|-------|-------|----------|------|--------|------|
| Stock Returns              | 393,097 | -0.035 | 4.599    | -2.191 | -0.162 | 1.867 |
| COVID-19 Severity Measures |       |       |          |       |        |      |
| Positive_Cases (%)         | 393,097 | 0.005 | 0.008    | 0.000 | 0.003  | 0.006|
| Death_Cases (%)            | 393,097 | 0.128 | 0.323    | 0.000 | 0.031  | 0.153|
| Hospitalized_Cases (%)     | 393,097 | 0.303 | 2.080    | 0.000 | 0.000  | 0.053|
| Control Variables           |       |       |          |       |        |      |
| State                      | 393,097 | 6.987 | 2.106    | 5.536 | 6.995  | 8.362|
| Leverage                   | 393,097 | 0.286 | 0.284    | 0.066 | 0.244  | 0.432|
| Cash                       | 393,097 | 0.201 | 0.259    | 0.025 | 0.078  | 0.259|
| MTB                        | 393,097 | 1.025 | 5.840    | 1.156 | 1.982  | 3.984|
| Dividends                  | 393,097 | 0.019 | 0.215    | 0.000 | 0.003  | 0.025|
| ROA                        | 393,097 | -0.062 | 0.819   | -0.037 | 0.013  | 0.052|
| MKT                        | 393,097 | -0.000 | 3.066    | -1.440 | 0.270  | 1.410|
| SMB                        | 393,097 | -0.038 | 1.268    | -0.820 | -0.030 | 0.640|
| HML                        | 393,097 | -0.248 | 1.831    | -1.300 | -0.480 | 0.670|
| RMW                        | 393,097 | -0.010 | 0.617    | -0.390 | -0.090 | 0.330|
| CMA                        | 393,097 | -0.054 | 0.453    | -0.330 | -0.070 | 0.220|
| Income_Growth              | 393,097 | 0.008 | 0.005    | 0.004 | 0.007  | 0.009|
| GDP_Growth                 | 393,097 | 0.040 | 0.007    | 0.037 | 0.041  | 0.042|
| Consumption_Growth         | 393,097 | 0.051 | 0.008    | 0.044 | 0.053  | 0.057|
| Other Variables            |       |       |          |       |        |      |
| Hospital_Beds              | 393,097 | 0.002 | 0.001    | 0.002 | 0.002  | 0.003|
| Physicians                 | 391,987 | 0.003 | 0.001    | 0.003 | 0.003  | 0.004|
| Battleground_States        | 393,097 | 0.209 | 0.407    | 0.000 | 0.000  | 0.000|
| Rep_Gov                    | 393,097 | 0.391 | 0.488    | 0.000 | 0.000  | 1.000|
| COVID_Sentiment            | 305,126 | -0.253 | 0.513    | -0.418 | 0.000  | 0.000|
| ESG_Score                  | 236,139 | 50.877 | 7.488    | 45.770 | 48.410 | 53.880|
| Age_65 (%)                 | 391,987 | 15.727 | 1.857    | 14.300 | 15.900 | 16.500|
| Turnover                   | 393,097 | 0.014 | 0.165    | 0.004 | 0.008  | 0.018|
| EPU                        | 393,097 | 251.549 | 66.579  | 231.260 | 268.616 | 283.147|

This table reports the summary statistics of the dependent and independent variables. The main sample period of this study is from January 22 to June 30, 2020. Variable definitions and data sources are presented in Appendix A.
daily market-adjusted stock returns. The effect of COVID-19 on future stock returns is economically significant. For example, column (4) suggests that each 1% increase in the ratio of daily new COVID-19 positive cases over the total state population results in a decrease in the daily market-adjusted stock returns by 310 basis points.

Overall, the results from Table 2 suggest that firms headquartered in states that experience a higher level of the COVID-19 outbreak exhibit lower future stock returns.

3.2. Cross-sectional heterogeneity in the asset pricing implications of COVID-19 severity

3.2.1. Medical treatment capacity

In this section, we examine whether the market reaction to the outbreak of COVID-19 varies across states with different levels of medical treatment capacity. Naturally, we would expect the impact of the COVID-19 outbreak to be less pronounced in states with a greater medical treatment capacity. For this analysis, we utilize the ratio of the number of hospital beds in a state over the state population (Hospital_Beds) as a proxy for the state’s medical treatment capacity to handle new COVID-19 cases. A higher Hospital_Beds

\[ \text{Hospital_Beds} = \frac{\text{Number of hospital beds in a state}}{\text{State population}} \]

This table presents the regression estimates from model (1). The main independent variable is stock-level market-adjusted stock returns (AR). The main independent variables of interests are state-level COVID-19 severity measures including Positive_Cases, Death_Cases, and Hospitalized_Cases. We include a constant term, industry-fixed effects, and month-fixed effects. t-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.

We find SMB, HML, and GDP Growth positively drive returns while CMA negatively drives return. Given we use market-adjusted returns, we document that the coefficient estimates on MKT are negative.

Overall, the results from Table 2 suggest that firms headquartered in states that experience a higher level of the COVID-19 outbreak exhibit lower future stock returns.4

\[ \text{Hospital_Beds} = \frac{\text{Number of hospital beds in a state}}{\text{State population}} \]

4 We find SMB, HML, and GDP Growth positively drive returns while CMA negatively drives return. Given we use market-adjusted returns, we document that the coefficient estimates on MKT are negative.
indicates that the state’s medical facilities have higher available resources. We augment model (1) with interaction terms between each of the COVID-19 outbreak measures and Hospital Beds.

The results reported in Table 3 Panel A show positive and significant coefficients on all three interaction variables (Positive Cases*Hospital Beds, Death Cases*Hospital Beds, and Hospitalized Cases*Hospital Beds) at the 5% significant level or lower. These findings suggest that the effect of severe COVID-19 cases on stock returns is less pronounced among firms headquartered in states with more hospital beds per capita.

In addition, we employ the ratio of the number of physicians in a state over the state population (Physicians) as another proxy for the state’s medical resources. Higher Physicians suggests that the state has a greater medical treatment capacity. We incorporate model (1) with interaction terms between each of the COVID-19 severity measures and Physicians. As shown across all three columns in Table 3 Panel B, firms headquartered in states facing a greater level of COVID-19 severity experience a significant decrease in their stock

Table 3
COVID-19 Severity and state-level medical resources.

| Panel A: Hospital beds | Dependent Variable: AR | (1) | (2) | (3) |
|------------------------|-------------------------|-----|-----|-----|
| Positive_Cases         | -9.565**                |     |     |     |
|                        | (-2.536)                |     |     |     |
| Positive_Cases*Hospital_Beds | 229.427**             |     |     |     |
|                        | (2.204)                 |     |     |     |
| Death_Cases            | -0.493***               |     |     |     |
|                        | (-2.628)                |     |     |     |
| Death_Cases* Hospital_Beds | 11.389**              |     |     |     |
|                        | (2.017)                 |     |     |     |
| Hospitalized_Cases     | -0.190**                |     |     |     |
|                        | (-2.113)                |     |     |     |
| Hospitalized_Cases*Hospital_Beds | 9.832***             |     |     |     |
|                        | (3.068)                 |     |     |     |
| Hospital_Beds          | -6.297                  | -11,952 | -2.728 |
|                        | (-0.777)                | (-1.536) | (-1.023) |
| Control variables      | Yes                     | Yes  | Yes  | Yes  |
| Observations           | 393,097                 | 393,097 | 393,097 |
| Industry-fixed effects | Yes                     | Yes  | Yes  | Yes  |
| Month-fixed effects    | Yes                     | Yes  | Yes  | Yes  |
| Cluster by firm        | Yes                     | Yes  | Yes  | Yes  |
| Cluster by month       | Yes                     | Yes  | Yes  | Yes  |
| Adjusted R-squared     | 0.067                   | 0.067 | 0.067 |

| Panel B: Physicians | Dependent Variable: AR | (1) | (2) | (3) |
|---------------------|-------------------------|-----|-----|-----|
| Positive_Cases      | -24.026**               |     |     |     |
|                     | (-2.370)                |     |     |     |
| Positive_Cases*Physicians | 1376.704***         |     |     |     |
|                     | (2.815)                 |     |     |     |
| Death_Cases         | -0.457***               |     |     |     |
|                     | (-3.074)                |     |     |     |
| Death_Cases*Physicians | 19.597**               |     |     |     |
|                     | (2.367)                 |     |     |     |
| Hospitalized_Cases  | -0.236***               |     |     |     |
|                     | (-2.668)                |     |     |     |
| Hospitalized_Cases*Physicians | 10.256***          |     |     |     |
|                     | (3.045)                 |     |     |     |
| Physicians           | 7.778                   | 10.033 | 3.068 |
|                     | (0.271)                 | (0.769) | (0.385) |
| Control variables    | Yes                     | Yes  | Yes  | Yes  |
| Observations         | 391,987                 | 391,987 | 391,987 |
| Industry-fixed effects | Yes                   | Yes  | Yes  | Yes  |
| Month-fixed effects  | Yes                     | Yes  | Yes  | Yes  |
| Cluster by firm      | Yes                     | Yes  | Yes  | Yes  |
| Cluster by month     | Yes                     | Yes  | Yes  | Yes  |
| Adjusted R-squared   | 0.067                   | 0.067 | 0.067 |

This table presents regression results of stock-level market-adjusted stock returns (AR) on interaction terms between COVID-19 severity measures and state-level medical resource measures. In Panel A, we interact each of the COVID-19 severity measures with the ratio of the number of hospital beds in a state over the state population (Hospital Beds). In Panel B, we consider interaction terms between each of the COVID-19 severity measures and the ratio of the number of physicians in a state over the state population (Physicians). We include a constant term, industry-fixed effects, and month-fixed effects. t-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.
returns. However, the coefficients of interaction terms between each of the COVID-19 severity measures and Physicians are all positive and statistically significant. These results indicate that the negative relation between our COVID-19 severity measures and stock returns is weaker among firms headquartered in states with a higher number of physicians per capita.

Taken together, results from Table 3 suggest that the negative impact of the state-level COVID-19 outbreak on future stock returns is less pronounced among firms headquartered in states with a greater medical treatment capacity to handle COVID-19 patients.

3.2.2. Political factors

Prior literature documents that due to political goals, election battleground states tend to receive more federal support, especially during periods of disasters or election years (Hudak, 2011; Chen, 2013; Kriner and Reeves, 2015). Since the COVID-19 pandemic struck in an election year, the incumbent federal administration seeking re-election may seek to enhance their chances by providing more federal support to the battleground states to fight against the spread of COVID-19. Therefore, the adverse impact of the COVID-19

| Table 4 |
| COVID-19 Severity and political factors. |
| **Panel A: Presidential Election Battleground States** | Dependent Variable: AR |
| | (1) | (2) | (3) |
| Positive_Cases | -3.802** | -3.802** | -3.802** |
| Positive_Cases*Battleground_States | 5.323*** | 5.323*** | 5.323*** |
| Death_Cases | -0.052*** | -0.052*** | -0.052*** |
| Death_Cases*Battleground_States | 0.036* | 0.036* | 0.036* |
| Hospitalized_Cases | 0.014 | 0.014 | 0.014 |
| Hospitalized_Cases*Battleground_States | 0.014 | 0.014 | 0.014 |
| Battleground_States | -0.025 | -0.025 | -0.025 |
| Control Variables | Yes | Yes | Yes |
| Observations | 393,097 | 393,097 | 393,097 |
| Industry-fixed effects | Yes | Yes | Yes |
| Cluster by firm | Yes | Yes | Yes |
| Cluster by month | Yes | Yes | Yes |
| Adjusted R-squared | 0.067 | 0.067 | 0.067 |

| **Panel B: Republican Governors** | Dependent Variable: AR |
| | (1) | (2) | (3) |
| Positive_Cases | -4.197*** | -4.197*** | -4.197*** |
| Positive_Cases*Rep_Gov | 4.026** | 4.026** | 4.026** |
| Death_Cases | -0.094*** | -0.094*** | -0.094*** |
| Death_Cases*Rep_Gov | 0.094*** | 0.094*** | 0.094*** |
| Hospitalized_Cases | 0.014*** | 0.014*** | 0.014*** |
| Hospitalized_Cases*Rep_Gov | 0.014*** | 0.014*** | 0.014*** |
| Rep_Gov | -0.031 | -0.031 | -0.031 |
| Control Variables | Yes | Yes | Yes |
| Observations | 393,097 | 393,097 | 393,097 |
| Industry-fixed effects | Yes | Yes | Yes |
| Month-fixed effects | Yes | Yes | Yes |
| Cluster by firm | Yes | Yes | Yes |
| Cluster by month | Yes | Yes | Yes |
| Adjusted R-squared | 0.067 | 0.067 | 0.067 |

This table presents regression results of stock-level market-adjusted stock returns (AR) on interaction terms between COVID-19 severity measures and political factors. In Panel A, we interact each of the COVID-19 severity measures with a dummy variable for the 2016 presidential election battleground states (Battleground_States). In Panel B, we consider interaction terms between each of the COVID-19 severity measures and a dummy variable for states headed by Republican governors (Rep_Gov). We include a constant term, industry-fixed effects, and month-fixed effects. t-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.
outbreak is likely to be somewhat mitigated in battleground states due to potential greater federal support. To investigate this conjecture, we modify our baseline model (1) to include interaction terms between each of the state-level COVID-19 outbreak measures and the indicator variable for battleground states (Battleground_States). Based on the 2016 presidential election results, we define a battleground state as one where the absolute difference in voting results between Donald Trump and Hillary Clinton was equal to or less than 5%, and zero otherwise.

Table 4 Panel A column (1) shows that those firms headquartered in election battleground states are subject to a smaller COVID-19 impact on their stock returns. We document similar evidence in column (2) where the significant negative relation between Death_Cases and stock returns is less pronounced among firms from battleground states. Collectively, results from Table 4 Panel A suggest that the negative effect of the state-level COVID-19 outbreak on stock returns is weaker among firms headquartered in election battleground states.

Anecdotal evidence suggests that President Trump appears to provide more federal support to address the consequences of the pandemic. In Table 5, we explore the potential impact of corporate social responsibility (CSR) performance on the relationship between COVID-19 severity and stock returns. Table 5 Panel A reports regression results of stock-level market-adjusted stock returns on interaction terms between COVID-19 severity measures and firm-level factors. In Panel A, we interact each of the COVID-19 severity measures with Hassan et al.’s (2020) firm-level measure of COVID-19 net sentiment (COVID_Sentiment). In Panel B, we consider interaction terms between each of the COVID-19 severity measures and firm-level corporate social responsibility performance (ESG_Score). We include a constant term, industry-fixed effects, and month-fixed effects. t-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.

### Table 5
COVID-19 Severity and firm-level factors.

#### Panel A: COVID-19 Net Sentiment

| Dependent Variable: AR | (1) | (2) | (3) |
|------------------------|-----|-----|-----|
| Positive_Cases        | -3.162** |     |     |
| Positive_Cases*COVID_Sentiment | 2.456* |     |     |
| Death_Cases           |     | -0.066*** |     |
| Death_Cases*COVID_Sentiment |     | 0.272*** |     |
| Hospitalized_Cases    |     |     |     |
| Hospitalized_Cases*COVID_Sentiment |     |     |     |
| COVID_Sentiment       | 0.071* | 0.032 | 0.067** |
| Control Variables     | Yes | Yes | Yes |
| Observations          | 305,126 | 305,126 | 305,126 |
| Industry-fixed effects | Yes | Yes | Yes |
| Month-fixed effects   | Yes | Yes | Yes |
| Cluster by firm       | Yes | Yes | Yes |
| Cluster by month      | Yes | Yes | Yes |
| R-squared             | 0.085 | 0.085 | 0.085 |

#### Panel B: Corporate Social Responsibility

| Dependent Variable: AR | (1) | (2) | (3) |
|------------------------|-----|-----|-----|
| Positive_Cases        | -17.210* |     |     |
| Positive_Cases*ESG_Score | 0.421** |     |     |
| Death_Cases           |     | -0.210* |     |
| Death_Cases*ESG_Score |     | 0.002 |     |
| Hospitalized_Cases    |     |     |     |
| Hospitalized_Cases*ESG_Score |     |     |     |
| ESG_Score             | -0.004** | -0.004*** | -0.005*** |
| Control Variables     | Yes | Yes | Yes |
| Observations          | 236,139 | 236,139 | 236,139 |
| Industry-fixed effects | Yes | Yes | Yes |
| Month-fixed effects   | Yes | Yes | Yes |
| Cluster by firm       | Yes | Yes | Yes |
| Cluster by month      | Yes | Yes | Yes |
| R-squared             | 0.100 | 0.100 | 0.100 |

This table reports regression results of stock-level market-adjusted stock returns on interaction terms between COVID-19 severity measures and firm-level factors. In Panel A, we interact each of the COVID-19 severity measures with Hassan et al.’s (2020) firm-level measure of COVID-19 net sentiment (COVID_Sentiment). In Panel B, we consider interaction terms between each of the COVID-19 severity measures and firm-level corporate social responsibility performance (ESG_Score). We include a constant term, industry-fixed effects, and month-fixed effects. t-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.
COVID-19 outbreak to states led by Republican governors compared to those led by Democratic governors (Forgey, 2020; Rupar, 2020; Olorunnipa, 2020). Accordingly, we hypothesize that the negative effect of the state-level COVID-19 outbreak on stock returns is less pronounced among firms from states led by Republican governors. We include the interaction terms between each of the state-level COVID-19 outbreak measures and the indicator variable for states led by Republican governors (Rep_Gov).

Results from Table 4 Panel B column (1) indicate that the effect of Positive_Cases on stock returns is less pronounced among firms from states led by Republican governors. Similarly, column (2) indicates that the negative relation between Death_Cases and stock returns is also weaker among firms from states governed by Republican politicians.

Overall, these findings show that stock returns of firms from states led by Republican governors experience a lesser COVID-19 impact, possibly due to greater federal support to these states.

3.2.3. Firm-level factors

In this section, we examine whether the negative association between COVID-19 severity and stock returns varies with certain firm characteristics. In particular, we investigate whether the effect of COVID-19 on stock returns varies across firms with different sentiments on the potential impact of COVID-19 on their performance. Intuitively, the COVID-19 pandemic may have detrimental effects on the performance of firms in some industry sectors (e.g., hospitality, transport, oil, and gas) while creating considerable growth opportunities for others (e.g., pharmaceuticals, e-commerce, online entertainment).

We employ Hassan et al.’s (2020) firm-level COVID-19 net sentiment (COVID_Sentiment) as a measure of firms’ self-reported sentiment about the potential impact of COVID-19 on their performance. A positive (negative) value of COVID_Sentiment indicates that in general, firms have positive (negative) expectations regarding the effect of COVID-19 on their future cash flows. We incorporate interaction terms between each of our state-level COVID-19 outbreak measures and COVID_Sentiment in the baseline model (1). Results reported in Table 5 Panel A consistently indicate that the negative associations between measures of state-level COVID-19 outbreak and stock returns are less pronounced among firms with positive COVID_Sentiment. Collectively, these findings highlight that firms’ self-reported expectations about the effect of the COVID-19 pandemic on their future cash flows play an important role in moderating the adverse impact of the COVID-19 pandemic on their stock returns.

Recent studies provide mixed evidence regarding the role of corporate social responsibility (CSR) in alleviating the unfavorable impact of COVID-19 on stock returns.⁵ We, therefore, investigate whether CSR intensity can moderate the interplay between state-level COVID-19 outbreak and stock returns. We augment the baseline model (1) with interaction terms between each of our state-level COVID-19 outbreak measures and a firm-level environmental, social, and corporate governance (ESG) score.

Results from Table 5 Panel B column (1) show that the effect of Positive_Cases on stock returns is less pronounced among firms with better ESG scores. Similarly, in column (3), we find that the effect of Hospitalized_Cases on stock returns is also weaker among firms with higher ESG scores. Taken together, Table 5 Panel B suggests that CSR intensity plays a significant role in mitigating the effect of state-level COVID-19 outbreak on stock returns.

3.2.4. Robustness checks

We conduct a battery of tests to ascertain the robustness of our results. First, we consider the possibility that a state is more vulnerable to the negative effect of COVID-19 due to the greater proportion of its older population.⁶ Therefore, we include the proportion of the state population whose age is 65 or above (Age_65) in model (1). Results from Table 6 Panel A show that our main findings remain unchanged after controlling for the proportion of the population in each state that is more vulnerable to COVID-19.⁷

Second, given that the variation in the return patterns could be possibly driven by the daily trading volume, we control for the volume of trading in the baseline model and re-run our regression. Following Chiah and Zhong (2020), we measure the trading volume using the stock-level daily trading turnover (Turnover), computed as the ratio of daily trading volume divided by the number of shares outstanding as of that day. As reported in Table 6 Panel B, after controlling for Turnover, we continue to find negative and significant associations between all three COVID-19 severity measures and future daily market-adjusted stock returns.

Finally, we replace state-level GDP growth with the country-level economic policy uncertainty (EPU) index as a control variable in our regression model. Following prior studies (see, for example, Kang and Ratti, 2013; Pastor and Veronesi, 2013), we measure political uncertainty using the EPU index developed by Baker et al. (2016).⁸ Results from Table 6 Panel C suggest that our main findings remain qualitatively similar after controlling for economic policy uncertainty.

⁵ Albuquerque et al. (2020) and Ding et al. (2020) show that the impact of the COVID-19 pandemic on stock returns is weaker among firms with better CSR performance. However, Demers et al. (2020) challenge this view and document an insignificant role of CSR activities in mitigating firms’ exposure to the negative effect of the COVID-19 pandemic.

⁶ According to a report released by the Centers for Disease Control and Prevention (CDC) in October 2020, 78.2% of deaths associated with COVID-19 in the U.S. were among adults aged 65 or over (CDC, 2020). In a similar vein, recent studies in the medical literature examining critical cases of COVID-19 (see, for example, Palmieri et al., 2020; Pence et al., 2020; Shahid et al., 2020; Wang et al., 2020) show that older adults are at a higher risk of severe disease and death following infection from COVID-19.

⁷ In untabulated tests, we include the median age of the population for each state as a control variable in our model. Our findings remain qualitatively similar.

⁸ For details on how this index is constructed, please see Baker et al. (2016).
No previous infectious disease outbreak, including the Spanish Flu, has affected the stock market as forcefully as the COVID-19 pandemic (Baker et al., 2020). The COVID-19 pandemic has rapidly reverberated across the U.S. and left unprecedented damages in sickness, hospitalizations, and deaths. Our study investigates whether daily state-level outbreaks of the coronavirus are associated with cross-sectional security returns based on the notion that asset prices are subject to the locality of the pandemic outbreak.

### 4. Conclusion

This table reports regression results of stock-level market-adjusted returns (AR) on state-level COVID-19 severity measures with different sets of control variables. In Panel A, we control for the proportion of the state population whose age is 65 or above (Age_65). In Panel B, we control for stock-level daily trading turnover (Turnover). In Panel C, we replace state-level GDP growth with economic policy uncertainty (EPU). We include a constant term, industry-fixed effects, and month-fixed effects. \( t \)-statistics computed standard errors clustered at the industry and month-level (Petersen, 2009) are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Variable definitions and data sources are presented in Appendix A.
Using a dataset of U.S. security returns from January 22 to June 30, 2020, we find that daily state-level increases in infected cases, deaths, and hospitalized cases are negatively related to next day stock returns of firms headquartered in the same state. We also find that the effect is weaker among firms from states with higher medical resources and states that are likely to get more support from the federal government. Notably, firms’ self-reported sentiment towards the COVID-19 pandemic and CSR activities act as effective mitigating factors.

Taken together, our findings suggest the locality of the pandemic outbreak is an important contributing factor to stock price performance. Future research should investigate whether the locality of the pandemic outbreak may affect other market participants such as financial analysts and debt capital providers. Given our study shows that firm-level disclosures and CSR can mitigate the pandemic effect on stock returns, research to uncover what corporate policies and communication are most effective during a pandemic is undoubtedly vital.

CRediT authorship contribution statement

Anh Viet Pham: Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation, Formal analysis, Software, Methodology. Christofer Adrian: Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation. Mukesh Garg: Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation. Soon-Yeow Phang: Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation. Cameron Truong: Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation, Methodology.

Declaration of Competing Interest
None.

Appendix A: Variable definitions

| Variables                | Descriptions                                                                 | Data Sources                              |
|-------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Stock Returns           | Daily market-adjusted stock returns, calculated as daily stock returns minus daily CRSP value-weighted market returns. | CRSP                                      |
| **COVID-19 Severity Measures** |                                                                             |                                           |
| Positive Cases          | For each state, the ratio of the number of new COVID-19 positive cases for each day over the state’s population. | Covidtracking.com                         |
| Death Cases             | For each state, the ratio of daily new COVID-19 related deaths over the total number of confirmed COVID-19 positive cases. | Covidtracking.com                         |
| Hospitalized Cases      | For each state, the ratio of daily new COVID-19 hospitalized cases over the total number of confirmed COVID-19 positive cases. | Covidtracking.com                         |
| Control Variables       |                                                                              |                                           |
| Size                    | The natural logarithm of market capitalization                               | Compustat                                 |
| Leverage                | The ratio of total debts over assets                                        | Compustat                                 |
| Cash                    | The ratio of cash balances over assets                                       | Compustat                                 |
| MTB                     | The ratio of market value of equity to the book value of equity               | Compustat                                 |
| Dividends               | The ratio of cash dividends over market capitalization                        | Compustat                                 |
| ROA                     | The ratio of income before extraordinary items to total assets               | Compustat                                 |
| MKT                     | Daily Fama and French’s (2015) market risk premium                          | Kenneth French’s data library             |
| SMB                     | Daily Fama and French’s (2015) size factor                                  | Kenneth French’s data library             |
| HML                     | Daily Fama and French’s (2015) value factor                                 | Kenneth French’s data library             |
| RMW                     | Daily Fama and French’s (2015) profitability factor                         | Kenneth French’s data library             |
| CMA                     | Daily Fama and French’s (2015) investment factor                            | Kenneth French’s data library             |
| Income Growth           | For each state, personal income per capita growth                            | U.S. Bureau of Economic Analysis          |
| GDP Growth              | For each state, gross domestic product growth                               | U.S. Bureau of Economic Analysis          |
| Consumption Growth      | For each state, personal consumption growth                                 | U.S. Bureau of Economic Analysis          |
| Other Variables         |                                                                              |                                           |
| Hospital Beds           | The ratio of the number of hospital beds in a state over the state population | American Hospital Directory              |
| Physicians              | The ratio of the number of physicians in a state over the state population    | Association of American Medical Colleges  |
| Battleground States     | A state-level indicator variable taking the value of 1 for states where the absolute difference in voting results between Donald Trump and Hillary Clinton in 2016 is equal to or less than 5%, and 0 otherwise | uselectionatlas.org                       |
| Rep.Gov                 | A state-level indicator variable taking the value of 1 states whose governors are affiliated with the Republican party, and 0 otherwise | National Governors Association           |

(continued on next page)
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