Firm Fundamentals in the COVID-19 Stock Market

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Abstract

The effects of the COVID-19 crisis allow for an opportunity to examine what types of firms are most durable to sudden and prolonged stock market shocks. Using data on the constituents of the Russell 3000, I find that firms with more capital-intensive operations, higher leverage, and larger cash balances were most prone to drops in daily return related to increases in the growth of COVID-19 infections. Larger, more profitable, and more liquid firms saw positive interactions between daily returns and COVID-19 infection growth. However, I also find a potential reversal of these trends as riskier and more leveraged firms exhibit higher cumulative abnormal returns off vaccine hopes, which may signal a renewed interest in riskier investment profiles as the world begins and continues to move past the COVID-19 pandemic. This study presents insight on daily stock return reactions to COVID-19 infection growth throughout the course of the virus.

1. Introduction

The economic and financial crisis triggered by COVID-19 has been and continues to be spectacular in nature. The American equity markets dropped as much as 35% in the early months of the pandemic's global spread while unemployment, jobless claims, and bankruptcies rattled American and global economic activity. The markets however exhibited an almost miraculous turn starting in late March 2020, where the major indexes and many individual securities reached record highs amidst the deterioration of consumer activity and a heightening of uncertainty created by COVID-19. These developments in the equity markets motivates research into the reaction of firms to such unprecedented and longstanding shocks. In particular, this paper attempts to determine how a firm's daily returns reacted to COVID-19 case growth based on their financial fundamentals.

Specifically, I examine the interaction of COVID-19 growth in the United States with financial characteristics of American public firms and this interaction's effect on daily stock returns. By investigating the connection between corporate characteristics and stock price reactions to the pandemic, this paper examines the factors shaping the response of investors to the global trends of the pandemic, thus allowing for potential insight into the most important factors investors consider during pandemics or prolonged periods of diminished economic activity. This can also allow for policy considerations of governments in determining which firms will be most affected valuation-wise by the pandemic when structuring pandemic-related relief and policies.

I utilize the firms included on the Russell 3000 at the beginning of 2020 as a study group. For each firm I record their daily stock returns in addition to firm characteristics which provide insight on each firm's capital structure, performance throughout the COVID-19 pandemic, and

operational efficiency among other factors. In addition, I observe the stock price reaction of these firms and some of their fundamentals to key dates where the markets reacted strongly to COVID-19 related developments. These include rallies around fiscal stimulus (which provided short term relief and opportunity for demand spikes following business closures and employee layoffs/furloughs), vaccine hopes (which signal an upcoming end to the restrictions enacted by the pandemic), and a market dip related to fears of prolonged lockdowns and a worsening of the spread of COVID-19.

In initial results, I find significant relationships between daily returns and the interactions between the growth of COVID-19 cases in the US and various financial metrics among Russell 3000 constituents. I find negative interactions between firms with more capital intensity, higher leverage, and larger cash balances with the growth of US COVID-19 cases on daily returns. Positive interactions are found between firms with larger market capitalizations, higher profitability, and more overall liquidity with the growth of US COVID-19 cases on daily returns.

These initial findings indicate that investors did consider the growth of COVID-19 cases as a significant factor in investment decisions, and that they were primarily concerned with a firm's ability to reduce costs and generate earnings. As a result, investors bid up firms with higher profits and an easier ability to quickly reduce costs via higher liquidity ratios, less leverage, and lower capital stocks. COVID-19's effects on consumerism have created substantial uncertainty surrounding continued performance and cash flow for many firms, which creates meaningful risks for firms with operations financed with a large proportion of debt. Meanwhile, fixed capital such as PPE becomes an increasingly sunk cost for firms as reductions in activity limits the amount of production necessary and the accessibility of those fixed assets.

Further analysis into the development of COVID-19 in the US indicates similar findings. Conducting event studies and then using firm cumulative abnormal returns (CARs) as a dependent variable, I find that highly leveraged and asset-heavy firms reacted negatively to a market date where fears over the virus sparked a downturn. A positive relationship was found between CARs and firms with higher earnings and market capitalizations on this date. This corroborates the aforementioned findings as fears over the virus drove investors away from asset-intensive and debt-saddled firms. Similar relationships were found between CARs and a market day where a rally was linked to the passage of a fiscal stimulus bill by the United States government. Fiscal stimulus does provide short-term relief, but it also legitimizes the notion that COVID-19 will have prolonged effects on consumption and productivity. Thus, investors had similar tastes compared to the onset of the virus as COVID-19 related uncertainty persisted.

However, the "end" of the pandemic and prospects of returning to pre-crisis levels of consumption have driven investors back towards smaller and more leveraged firms as I find a positive relationship between CARs with leverage and total assets and a negative relationship between CARs with market capitalization and net income on a market day where stocks rose on vaccine rumors and hopes. This indicates that investors were prepared to return to riskier, more speculative securities in the form of firms with higher leverage and without a proven track record of earnings, perhaps believing in a post-pandemic turnaround to provide great growth for these types of firms.

The remainder of this paper is organized as follows: sections 2 provides an overview of existing literature on COVID-19's effect on American equity markets and how this paper contributes to and differs from existing studies; section 3 describes the empirical methodologies

used for this study; section 4 provides an overview of the data; section 5 presents, interprets, and discusses the results from the empirical methodology; and section 6 concludes.

2. Literature Review

The sudden emergence and dramatic impact of COVID-19 on the global economy and consumption patterns has created a prime opportunity for researchers to study the effect of dramatic, exogenous shocks on economic activity. Regarding the US equity markets, a remarkable trend has formulated over 2020. The American markets exhibited a dramatic decline in the early months of 2020 as the reality of COVID began to sink in. However, starting in late March, the American markets began an extraordinary bull run through the rest of the year with many indexes and stocks reaching record highs. Thus, a robust and growing set of literature has emerged analyzing the effect of COVID-19 on market returns and individual firm securities.

A growing group of papers investigate COVID-19's effects on aggregate stock index returns in the US and across the globe. Alfaro et al. (2020) utilize logistic and exponential models to project COVID-19 infections and find that unexpected changes in the number of predicted infections significantly lowered index returns. Ru et al. (2020) look at stock index returns across 60 countries and find that country indexes which experienced negative effects from the 2003 SARS epidemic were less harmed by the onset of COVID-19. Capelle-Blancard and Desroziers (2020) consider a panel of 74 countries and examine stock market returns in different periods. They find that stock markets initially ignored the pandemic before reacting sharply to rapidly growing infections starting in late February and then rebounded strongly in late March following central bank interventions. They also find that country-specific characteristics did not appear to affect stock market returns, that investors were sensitive to the number of COVID-19 cases in neighboring countries, and that government interventions such as

lower rates and credit facilities mitigated COVID-19 induced stock drops. Sharma et al. (2020) find that strong co-movements exist between COVID-19 cases and stock market returns after controlling for exchange rate returns and temperature. Chan-Lau and Zhao (2020) find that markets react negatively to premature withdrawals of fiscal policy- where premature means an easing of fiscal policy during times when COVID-19 infections are still high compared to previous levels.

Firm level reactions to news have also been studied. A paper by Hassan et al. (2020) looks at transcripts of quarterly earnings of over 10,000 firms through March 2020 to investigate what effects and keywords associated with COVID-19 made firms cautious or pessimistic. The study finds that the main concerns were related to supply chain disruptions, closures, and employee welfare with a greater focus on demand shocks throughout executive rhetoric. Thorbecke (2020) finds that many sectors in the US economy, such as oil and retail, fell in the early weeks of the virus due to macroeconomic trends rather than idiosyncratic sector traits.

Studies on firm-level returns have found that returns differ according to a variety of factors including sector, financial stability, performance, etc. Ramelli and Wagner (2020) find that firms with large dependencies on China for supply chain purposes were significantly harmed by COVID-19 in early 2020. However, over time, the affected firms rebounded quite well in anticipation of the reopening of the Chinese economy. Furthermore, this study also finds that firms with more leverage and less liquidity suffered more so than others when controlling for industry. Ding et al. (2020) analyzes over 6000 firms across 56 countries to investigate which firms exhibited more “corporate immunity” to COVID-19. They find that returns were less negative throughout the early months of COVID-19 for firms with stronger pre-2020 finances, less exposure to global supply chains, higher CSR activity, lower hedge fund ownership, and

fewer entrenched executives. Fahlenbrach et al. (2020) find that firms with high financial flexibility (more liquidity and less debt) exhibited stock price drops lower by 26% compared to firms with low financial flexibility when controlling for industry. Gerding et al. (2020) find that individual firms in countries with higher debt-to-GDP ratios were more severely affected in the early weeks of the crisis. Hyun et al. (2020) find that firms with greater global connectedness (which provides diversification) and market power were more resilient to domestic pandemic shocks. Alfaro et al. (2020), in the same paper mentioned above, find that individual firms with higher capital intensity and leverage were more prone to drops from unexpected changes in the predicted number of infections. Various studies have also concluded that firms with stronger ESG ratings experienced better performance through COVID-19 (Albuquerque et al., 2020; Garel and Petit-Romec, 2020; Yang and Koci, 2020).

This paper attempts to expand upon the growing collection of studies examining the links between COVID-19 and the stock market. This paper looks at the interaction between daily returns, financial fundamentals, and increases in the number of cases. By doing so, I add to the existing literature by providing insight on what firms and firm characteristics were most sensitive to COVID-19 infections over time. By examining firm data across different quarters, I am able to provide insight on how returns continued to react to COVID-19 as firms adapted to the crisis and were fundamentally affected by COVID-19, as having data from multiple quarters allows for the analysis to cover a larger portion of the virus rather than smaller subsets. Furthermore, through the examination of the relationship between different fundamental firm factors to events, which can serve as proxies for turning points in the development of the crisis, I am able to provide detail on what firm characteristics were most sensitive to the onset of the crisis, short-term economic stimulus, and indications of the pandemic's end. This paper also adds to the extensive

body of literature which attempts to predict stock returns such as the famous papers by Fama and French (1988) and Campbell and Shiller (1988). This study analyzes a variety of firm factors which deal with efficiency, leverage, and performance to provide insight on what fundamentals are most sensitive to unexpected and exogenous shocks on the stock market.

Overall, this paper will add to the body of literature on COVID-19's effect on stock market returns by examining the interactions firm fundamentals have with COVID-19 infection growth over time, whereas other papers did not look at the interaction between COVID-19 and firm fundamentals or only looked at COVID-19 in a short period of time primarily focused on the very early months of 2020.

3. Methodology

To track COVID-19, I examine the growth of confirmed cases in the United States from January 22, 2020- the day of the first confirmed COVID-19 infection in the US- through September 30, 2020. September 30, 2020 is the end of the 3rd calendar quarter of 2020.

i. CovidGrowth

The variable I use to analyze the effect of the growth of confirmed COVID-19 cases on returns is named *CovidGrowth*. *CovidGrowth* is defined as:

$$CovidGrowth_t = ln(Confirmed\ Cases_{t-1}) - ln(Confirmed\ Cases_{t-2})$$

where t indexes day and $Confirmed\ Cases_t$ represents the cumulative number of cases in the United States on day t. $CovidGrowth_t$ essentially measures the daily growth of confirmed COVID-19 infections from the previous day. The reason I choose to look at the growth in infections of the previous day is to account for the fact that case data is updated daily and

numbers are often reported at the end of the day, usually after market close. As a result, using growth rate of infections on the current day would not be as effective an indicator to track market returns as the current day's data would not be reported in time to be accounted before market closing. The previous day's data would be reflected as it is known before the market opens on the current day. I note that results were more meaningful and significant when examining case growth of the previous day compared to case growth of the current day.

ii. Aggregate Market Returns

To study, the interaction between the development of COVID-19 infections and aggregate market returns, I use the following specification:

$$\Delta \ln(\text{Market Price}_t) = \beta_0 + \beta_1 * \textit{CovidGrowth}_t + \alpha * \chi_t + \varepsilon_t$$

Here, $\Delta \ln(\text{Market Price}_t)$ refers to either the daily log change in the open price or the daily log change in the closing price of the Russell 3000 index on day t. The Russell 3000 index is a capitalization-weighted index which captures about 98% of the American public equity market. I choose the Russell 3000 index for the breadth of the market it covers. $\textit{CovidGrowth}_t$ is described above.

χ_t denotes an array of control variables on day t. These include indicator variables for dates of major monetary/fiscal policy events, changes in the Oxford Government Response Index, the central bank policy rate (as sourced from BIS), and Google Trends data for COVID-19. The dates of monetary/fiscal policy include 3/3/2020 (the day the Federal Reserve announced a lowering of the target federal funds range to 1 to 1.25 percent), 3/6/2020 (the day which the "Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020" was signed into law which directed 8.3 billion dollars for the preparation of COVID-19 outbreaks in the

US), and for the dates between March 24, 2020 through March 27, 2020 (which were the dates where congress ramped up discussions on, voted on, and at-the-time US President Donald Trump signed the 2 trillion dollar "Coronavirus Aid, Relief, and Economic Security Act"). The Oxford Government Response Index measures policy responses by governments to the pandemic and considers containment measures such as lockdown, economic support, stringency (which measures how strict lockdown policies are), and an overall government response score.

iii. Firm Fundamentals, CovidGrowth, and Daily Returns

To study the interaction between COVID-19 confirmed infection growth and firm fundamental characteristics, the following specification is used:

$$\mathbf{Y_{i,t} = \beta_0 + \beta_1^{CovidGrowth} * \phi_{i,q} * CovidGrowth_t + \beta_1^{Market} * \Delta ln(Market\ Return_t) + \alpha * \chi_t + \delta_i + \varepsilon_{i,t}}$$

Here, $\mathbf{Y_{i,t}}$ refers to the daily return (the percent change between the open and close price) of firm i on day t from the range between January 22, 2020 and September 30, 2020. However, due to the way *CovidGrowth* is calculated, *CovidGrowth* begins having a value on January 24, 2020. $\boldsymbol{\phi_{i,q}}$ refers to an array of financial data and metrics for firm i in calendar quarter q.

The quarterly data is matched to the daily returns so that calendar Q1 2020 data is linked with the dates between 1/22/2020 and 3/31/2020, calendar Q2 2020 data is linked with the dates between 4/1/2020 and 6/30/2020, and calendar Q3 2020 data is linked with the dates between 7/1/2020 and 9/30/2020. Non-ratio financial data is transformed with inverse hyperbolic sine.

The third term on the right-hand side is adopted from the study by Alfaro et al. (2020). $\boldsymbol{\beta_1^{Market} * \Delta ln(Market\ Return_t)}$ accounts for the possibility that COVID-19 is the same as other aggregate shocks and that a firm's return during the pandemic is simply its co-movement with the market. $\boldsymbol{\Delta ln(Market\ Return_t)}$ is calculated as the change in the market open price from the

previous day. When this term is included, $\beta_1^{CovidGrowth}$ will represent a firm's return in excess of its covariance with the market.

χ_t refers to the same set of control variables as described above. δ_i refers to industry fixed effects for firm i. Industry fixed effects are based on a firm's 2-digit NAICS code.

iv. Cumulative Abnormal Returns Around COVID-19 Developments

To study the relationship between firm fundamentals and key COVID-19 developments I use the following specification:

$$\mathbf{CAR_{i,t} = \beta_0 + \beta_1 * \phi_{i,q} + \delta_i + \varepsilon_i}$$

Here, $\mathbf{CAR_{i,t}}$ refers to the cumulative abnormal return of firm i on day t, $\phi_{i,q}$ refers to an array of financial data and metrics for firm i in quarter q, and δ_i refers to industry fixed effects. Cumulative abnormal returns are calculated with an estimation window of 90 days, an event window of [-5,+5] days (to account for a full trading week before and after the event date), and is done using the market model with the Russell 3000 Index as the market index.

Cumulative abnormal returns are calculated for the dates March 16th, March 24th, and November 16th. Dates were picked based on days where sentiment regarding major events led to strong declines or increases in the markets. The reason that dates are based on sentiment rather than days of announcement or implementation is that the events marked in this paper- the spread of COVID-19, fiscal stimulus, and vaccine approval- were rumored heavily prior to their official announcements. As a result, it is likely that these events were already priced in before the actual announcements came. Thus, I search for dates where the market exhibited extreme drops or rises and search through reports and news articles about why such drops happened. The changes on the dates listed above were linked to the events I aim to investigate (fear of COVID-19 growth,

fiscal stimulus, vaccine progress). I note that results are more meaningful and robust for the selected dates rather than announcement dates for the events.

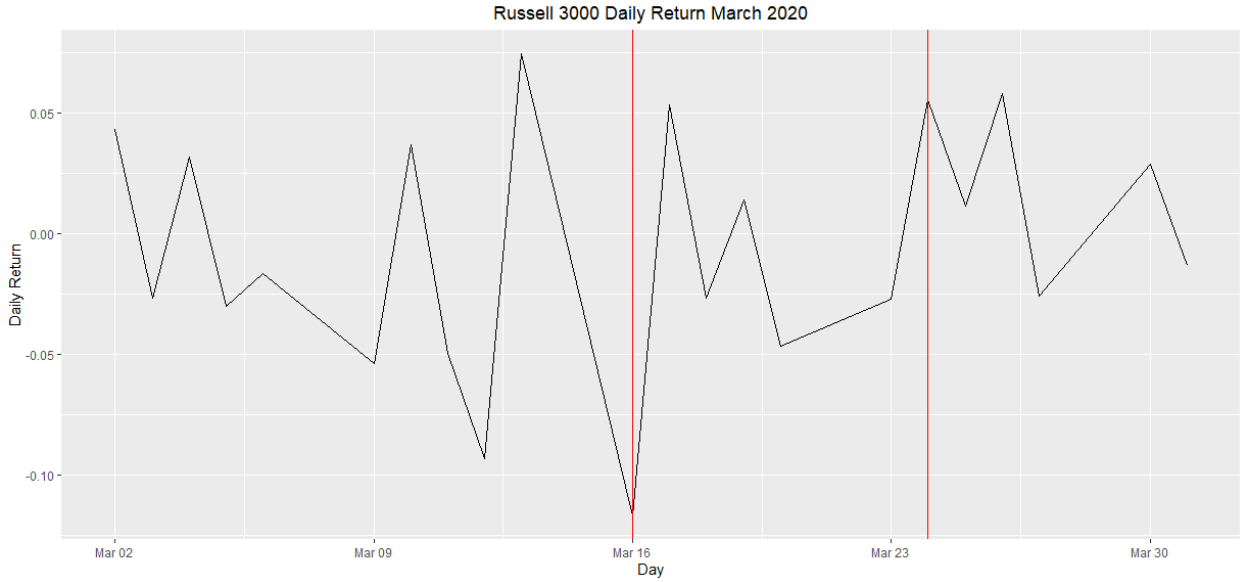
March 16th saw a steep drop across the American equity markets with the Russell 3000 falling 11.73% in a single day. This development in the stock market was heavily linked to fears of Coronavirus spreading across the US and the global community. This event serves as a proxy for the onset of the virus, to examine which firms were most affected by the gravity of COVID-19 becoming a reality.

March 24th saw a strong jump in the American equity markets with the Russell 3000 rising 5.5%. Articles and news reports linked this rise to hopes of fiscal stimulus being passed and signed into law by the US government, which included stimulus checks for American households, small business loans, and many other forms of fiscal relief. This event serves as a proxy for the beginning of a reality where government responses would step in to promote financial activity, but Coronavirus would remain a real and inhibiting feature for the global economy. Using this event allows for the investigation to which firms reacted best to such a reality.

November 16th saw a jump across many American equity markets with the Russell 3000 jumping 1.2%. Articles and news reports link this jump in the equity markets with strong prospects for the approval of a vaccine. This event thus serves as a proxy for the impending end of the COVID crisis and will allow for an investigation of which firms reacted best to such news and hopes.

Calendar Q1 2020 data is linked with the March 16th and March 24th events. Calendar Q3 2020 data is linked with the November 16th event.

Figure 1
Russell 3000 Daily Returns March 2020



Note: Vertical lines mark the March event dates. As can be seen in the plot, noticeable changes in daily returns are observed in the chosen March event dates

4. Data

COVID-19 case data is obtained from the Johns Hopkins University Center for Systems Science and Engineering (JHU CCSE). JHU CSSE has been compiling data from various sources such as the CDC and WHO since January 22, 2020. From here, I use the confirmed cumulative cases data to calculate *CovidGrowth* (discussed in section 3.i). Figure 2 provides plots for the cumulative number of COVID-19 cases daily during the timeframe of this study and the values of *CovidGrowth* during the timeframe of this study.

Daily stock price and financial data is obtained from Compustat via Wharton Research Data Services (WRDS). Figure 3 displays the daily return of the Russell 3000 Index during the timeframe of this study.

The financial metrics and ratios included in this analysis include total assets, market value, PPE (property, plant, and equipment), leverage ratio, cash, revenue, CAPEX (capital

Figure 2
US Confirmed Cumulative COVID-19 Cases and Daily Values for CovidGrowth

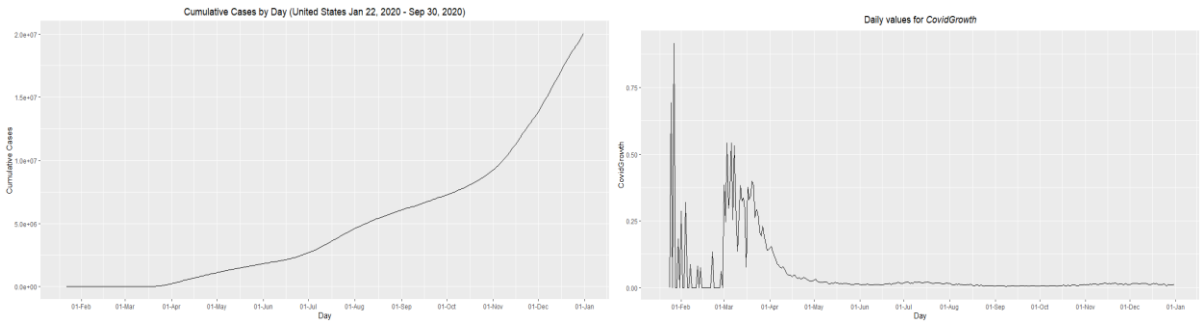
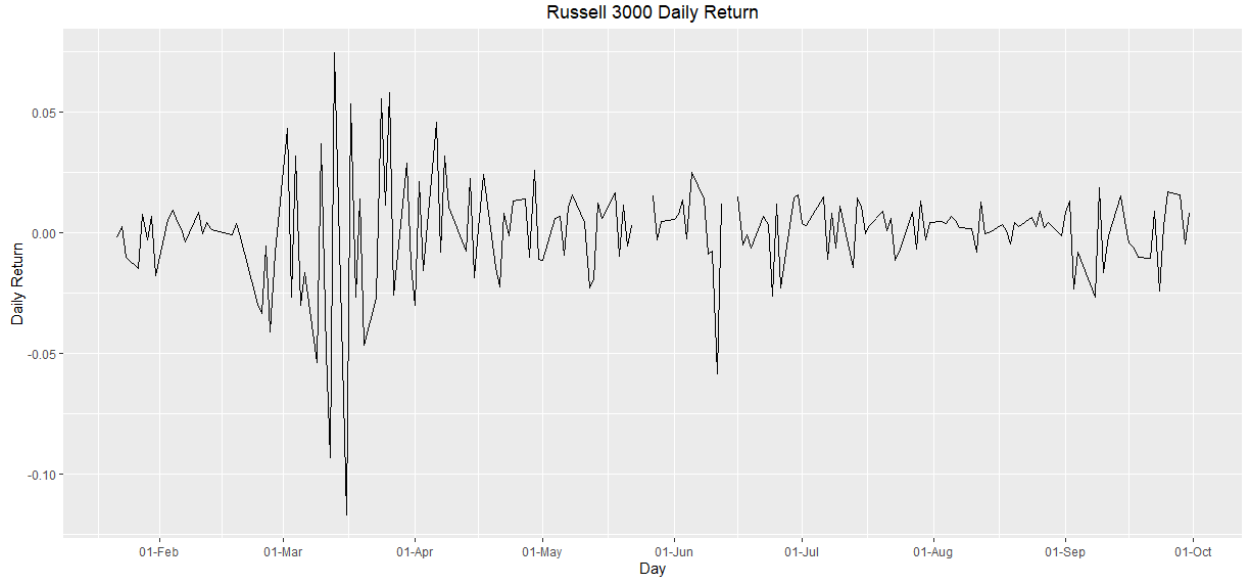


Figure 3
Russell 3000 Daily Return



expenditures), current ratio, total inventory, and net income. A table further describing each of these variables, and if applicable their calculations, is on appendix table A1. Summary statistics for *CovidGrowth* and daily returns across the timeframe of this study is found on table 1. Tables 2 and 3 provide summary statistics for the transformed and non-transformed financial metric/ratio data. Table 4 displays summary statistics for the cumulative abnormal returns calculated on selected event dates in the CAR regression study. Appendix figure A1 presents a correlation matrix of the studied variables. Appendix figures A2-A5 provide charts illustrating

the daily returns of firms by quartiles of total assets, net income, market value, and leverage ratio. Appendix figure A6 presents scatter plots of the studied variables against CARs on each event date.

Plots included in the figures and appendix were created using the R package *ggplot2* (Wickham 2016). Regression and summary statistics tables were created using the R package *Stargazer* (Hlavac 2018).

Table 1
Daily Returns and CovidGrowth Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Daily Return	522,480	-0.001	0.042	-0.876	-0.020	0.016	1.794
CovidGrowth	174	0.061	0.123	0.000	0.007	0.035	0.916

Note: Studied firms are the constituents of the Russell 3000 Index at the start of 2020. The time frame of this study occurs from January 22, 2020 to September 30, 2020. However, due to how CovidGrowth is calculated, values for CovidGrowth start from January 24, 2020

Table 2
Summary Statistics of Transformed Firm Characteristics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Total Assets	516,398	8.407	1.910	0.920	7.171	9.594	15.686
Cash	459,869	5.864	1.788	0.000	4.757	6.988	12.633
Total Inventory	503,719	3.449	3.107	0.000	0.000	6.093	13.687
Net Income	516,026	1.019	4.292	-11.508	-3.214	4.492	11.007
PPE	259,022	6.897	2.621	0.000	5.354	8.695	13.482
CAPEX	514,785	3.040	2.285	-8.542	0.987	4.630	10.832
Market Value	516,096	8.081	1.785	3.568	6.681	9.211	15.185
Leverage Ratio	516,398	0.311	0.258	0.000	0.088	0.464	3.123
Current Ratio	389,196	3.710	6.312	0.152	1.329	3.648	166.872
Revenue	458,807	5.827	2.478	-9.799	4.763	7.401	12.526

Note: The sample includes the Russell 3000 constituents at the start of 2020. Data is obtained from Compustat via Wharton Research Data Serivces. Each firm's value for each metric is recorded for each calendar quarter. The quarterly value for each of these firm characteristics is then linked to the market day and stock price performance corresponding to the quarter in which the value is recorded (e.g. Data for Calendar Q2 2020 is linked to the market days from April 1, 2020 to June 30, 2020). The non-ratio variables are transformed using inverse hyperbolic sine.

Table 3
Summary Statistics of Non-Transformed Firm Characteristics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Total Assets	516,398	17,266.930	108,759.700	1.055	650.384	7,335.700	3,246,076.000
Cash	459,869	983.336	4,545.776	0.000	58.217	541.825	153,201.000
Total Inventory	503,719	949.123	12,650.500	0.000	0.000	221.417	439,576.000
Net Income	516,026	63.426	928.743	-49,746.000	-12.422	44.654	30,137.000
PPE	259,022	6,038.880	21,624.740	0.000	105.709	2,987.600	358,343.000
CAPEX	514,785	152.506	780.624	-2,562.000	1.155	51.241	25,317.000
Market Value	516,096	11,151.500	59,555.900	17.702	398.493	5,005.033	1,966,079.000
Leverage Ratio	516,398	0.311	0.258	0.000	0.088	0.464	3.123
Current Ratio	389,196	3.710	6.312	0.152	1.329	3.648	166.872
Revenue	458,807	1,414.000	5,648.261	-9,010.000	58.546	818.800	137,742.000

Table 4
Summary Statistics of Cumulative Abnormal Returns

Date	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
March 16th	2,899	-0.0597	0.2548	-1.5131	-0.1846	-0.0363	0.0957	1.4154
March 24th	2,906	0.0803	0.1865	-1.2189	-0.0118	0.0858	0.1799	1.0328
November 16th	2,914	0.0212	0.1120	-0.4798	-0.0448	0.0092	0.0773	0.8570

Note: Summary statistics displayed are for cumulative abnormal returns. Date column indicates which date the ensuing CAR summary statistics are associated with.

5. Results

i. CovidGrowth vs. Aggregate Market Returns

Table 5 presents the results examining the effect of the *CovidGrowth* variable on aggregate market returns. *CovidGrowth* has a negative effect on market returns whether comparing open prices or closing prices. These results are similarly negative with controls. This corresponds with other papers that have detected negative effects on stock returns by the spread of COVID-19 infections such as in Alfaro et al. (2020). Although columns 1 through 3 are not statistically significant at conventional levels, I note that they all would be significant at a slightly higher level such as $P<0.15$. Regardless, the negative sign on the coefficient which holds between both open and close prices and when controls are added does fall in line with other studies.

Table 5
CovidGrowth vs. Changes in Aggregate Market Returns

	Dependent variable:			
	ΔLN(Market Price Open)		ΔLN(Market Price Close)	
	(1)	(2)	(3)	(4)
CovidGrowth	-0.028	-0.048	-0.035	-0.056*
	(0.023)	(0.029)	(0.023)	(0.029)
Constant	0.002	0.003	0.002	-0.003
	(0.001)	(0.007)	(0.001)	(0.008)
Controls	N	Y	N	Y
Observations	174	174	174	174
R^2	0.026	0.123	0.032	0.080
Adjusted R^2	0.020	0.097	0.026	0.053
Residual Std. Error	0.021 (df = 172)	0.021 (df = 168)	0.024 (df = 172)	0.024 (df = 168)
F Statistic	4.547** (df = 1; 172)	4.699*** (df = 5; 168)	5.705** (df = 1; 172)	2.939** (df = 5; 168)

Note: *P<0.1 **P<0.05 ***P<0.01

Δ(LN Market Price Open) and Δ(LN Market Price Close) are the daily log changes in the open and close prices of the Russell 3000 Index, respectively. Robust standard errors are in parenthesis. Sample period is January 22, 2020 to September 30, 2020. Although columns 1-3 are insignificant at conventional levels, I note that they would be conventional at slightly higher levels, such as p<0.15. Controls include indicators for fiscal/monetary policy dates, the fed policy rate, Google Trends for COVID-19, and changes in the Oxford Government Response Index

ii. CovidGrowth Interaction with Financial Characteristics vs. Daily Returns

Table 6 presents the results studying the effect of the interaction between different firm fundamentals and *CovidGrowth* on daily returns. In column 1, total assets, market value, leverage ratio, and net income are studied. I observe significant negative relationships between daily returns and interactions between *CovidGrowth* and total assets and between *CovidGrowth* and leverage ratio. I find significant positive relationships between daily returns and interactions between *CovidGrowth* and market value and between *CovidGrowth* and net income.

This indicates that investors were bidding down more leveraged firms and firms with higher total assets as COVID-19 grew in the United States. A negative interaction with leverage ratio corresponds with many other previous studies, which have also found that highly leveraged

Table 6
Daily Returns, Firm Fundamentals, and *CovidGrowth*

	Dependent variable:							
	Daily Return							
	(1)	(2)	(3)	(4)	(5)	(6)	Fever (7)	Post-Fever (8)
CovidGrowth	-0.00213	-0.01596***	-0.01262***	-0.02142***	-0.02112***	-0.03521***	0.00912	0.02535
	(0.00346)	(0.00495)	(0.00355)	(0.00545)	(0.00545)	(0.00553)	(0.01226)	(0.01756)
CovidGrowth*Total Assets	-0.00603***		-0.00771***	-0.00427***	-0.00430***	-0.00462***	-0.00019	0.01001***
	(0.00053)		(0.00076)	(0.00112)	(0.00112)	(0.00114)	(0.00264)	(0.00365)
CovidGrowth*Total Inventory		-0.00016						
		(0.00038)						
CovidGrowth*Market Value	0.00727***	0.00733***	0.01008***	0.00989***	0.00985***	0.00990***	0.00499***	0.00574**
	(0.00056)	(0.00101)	(0.00068)	(0.00091)	(0.00091)	(0.00092)	(0.00193)	(0.00292)
CovidGrowth*PPE		-0.00182***						
		(0.00064)						
CovidGrowth*Leverage Ratio	-0.02456***	-0.02222***	-0.01879***	-0.01215***	-0.01221***	-0.01227***	-0.00612	0.01230
	(0.00277)	(0.00424)	(0.00296)	(0.00331)	(0.00331)	(0.00334)	(0.00719)	(0.01087)
CovidGrowth*Net Income	0.00090***	0.00083***		0.00067***	0.00070***	0.00072***	0.00070*	0.00341***
	(0.00017)	(0.00024)		(0.00019)	(0.00019)	(0.00020)	(0.00040)	(0.00062)
CovidGrowth*Cash		-0.00443***		-0.00241***	-0.00236***	-0.00232***	-0.00386**	-0.00649***
		(0.00089)		(0.00078)	(0.00078)	(0.00079)	(0.00161)	(0.00246)
CovidGrowth*Revenue			-0.00012					
			(0.00046)					
CovidGrowth*CAPEX				-0.00252***	-0.00252***	-0.00227***	-0.00366**	-0.01078***
				(0.00074)	(0.00074)	(0.00075)	(0.00161)	(0.00234)
CovidGrowth*Current Ratio				0.00021*	0.00021*	0.00021*	0.00021	-0.00006
				(0.00012)	(0.00012)	(0.00012)	(0.00025)	(0.00040)
Constant	-0.00286***	-0.00495***	-0.00289***	-0.00294***			-0.02770***	-0.00295***
	(0.00031)	(0.00042)	(0.00033)	(0.00050)			(0.00376)	(0.00061)
Industry FE	N	N	N	N	Y	Y	N	N
Controls	N	N	N	N	N	Y	N	N
Observations	509,701	248,670	453,257	383,510	383,510	383,510	44,101	293,246
R^2	0.00619	0.00584	0.00591	0.00631	0.00664	0.01656	0.05142	0.01056
Adjusted R^2	0.00617	0.00579	0.00588	0.00627	0.00655	0.01646	0.05108	0.01050
Residual Std. Error	0.04246 (df = 509690)	0.04314 (df = 248655)	0.04289 (df = 453246)	0.04326 (df = 383493)	0.04326 (df = 383475)	0.04304 (df = 383471)	0.07033 (df = 44084)	0.03872 (df = 293229)
F Statistic	317.41640*** (df = 10; 509690)	104.37790*** (df = 14; 248655)	269.24610*** (df = 10; 453246)	152.31160*** (df = 16; 383493)	73.21717*** (df = 35; 383475)	165.59280*** (df = 39; 383471)	149.35890*** (df = 16; 44084)	195.56140*** (df = 16; 293229)
Note:								*P<0.1 **P<0.05 ***P<0.01

This table presents the interaction between COVID and various financial characteristics and metrics for the firms in this study from January 22, 2020 to September 30, 2020. Sample firms are those included on the Russell 3000 Index at the start of 2020. The dependent variable is daily stock return and is calculated as the change between the open and close prices for the day of a firm' stock. Robust standard errors are reported in parenthesis. Controls used in this analysis are the same as in the analysis presented in table 5. Industry fixed effects are based on 2-digit NAICS codes. A more detailed description of variables can be found on Appendix table A1.

firms have fallen more than their peers, likely due to fears that decreased economic consumption would hamper their ability to satisfy debt obligations and due to the constraints that highly leveraged firms' lack of financial flexibility would impose. A potential explanation for the negative coefficient on total assets is that investors feared that firms with high total assets would be unable to efficiently utilize their existing assets, which could lead to financial waste or operational inefficiencies.

The positive coefficient on net income indicates that profitable firms, and firms that were able to maintain profitability through the range of this study, saw higher returns as Covid-19 cases grew in the United States. This indicates an affinity by investors for profitable and stable businesses as COVID-19 infections grew. The positive coefficient on market value makes sense intuitively, as investors would likely have exited from riskier, smaller stocks to larger and safer ones amidst uncertainty created by pandemic-related lockdowns and restrictions.

In column 2, I investigate assets further by dividing total assets into PPE, cash, and inventory. Here, I observe significant negative coefficients on PPE and cash and an insignificant coefficient for inventory. An explanation for this result with respect to PPE is that investors were more inclined to bid down capital intensive firms with high fixed costs due to the difficulty required to cut these types of costs. While firms could reduce variable costs such as labor through furloughs or layoffs, avenues to reduce costs dedicated to fixed plants and equipment were significantly more difficult or impossible, thus leading towards a negative relationship between daily returns and the interaction between PPE and Covid-19 case growth. The negative coefficient on cash indicates that firms with larger cash balances were bid down as COVID-19 infections grew. This is a surprising finding as past studies have found excess cash to have a positive effect on future stock returns (Simutin, 2009). This is intuitive as higher cash firms

would have more liquid capital to invest in future projects or repay shareholders in the form of dividends or buybacks in the future, which would drive up share prices due to the growth prospects. In the context of COVID-19, cash could also be an attractive feature for investors as it would allow firms to better fulfill obligations despite the restrictions on economic activity imposed by COVID-19 related regulations.

However, early studies into COVID-19 have found differing effects of cash balances on stock returns in the presence of COVID-19. Ding et al. (2020) find a significant positive coefficient on the interaction between pre-pandemic cash levels and weekly COVID-19 infection growth while taking cross-country characteristics into account (this study also looks at international stocks and stock markets). However, similarly to the study in this paper, Alfaro et al. (2020) observes a significant negative coefficient on the interaction between pre-pandemic cash levels and unexpected changes in the predicted number of US COVID-19 infections. A possible explanation for the negative relationship between daily returns and the interaction between COVID-19 case growth and cash levels is the regulatory response of the United States government and Federal Reserve to the pandemic. In response to fears of a market crash, the Federal Reserve has kept rates at near-zero levels from March 2020 through the rest of the year. As a result, cash becomes a less valuable holding as low rates would reduce returns on cash and make new investments easier due to the lower cost of borrowing via low interest rates. Subsequently, investors may have bid down higher cash-reserve firms due to the inefficient use of their capital in a near-zero interest rate market or perhaps fears may have existed over firms holding large cash balances due to fears they were doing so in anticipation of reduced future cash flow due to COVID-19 related lockdowns and regulations. Zero-interest rate policy (ZIRP) is a rather novel phenomenon in the context of the American public equity markets, and further

examination into the effects of ZIRP on investor attitudes towards assets whose value are heavily affected by interest rates, such as cash, is a future exploration for the world of financial economics.

I note that the other coefficients in this specification maintain their significance and sign.

In column 3, I use the specifications from column 1 but replace net income with revenue. Total assets, leverage ratio, and market value maintain their signs and significance with revenue included instead of net income. Revenue however does not exhibit a significant coefficient like net income does in column 1. This indicates that investors were more concerned with profitability and efficiency rather than just pure revenue and sales as COVID-19 developed.

In column 4 I look at an array of variables which include total assets, market value, leverage ratio, net income, cash, CAPEX, and current ratio. Total assets, market value, leverage ratio, net income, and cash maintain their signs and significance from previous specifications. CAPEX exhibits a significant and negative coefficient while current ratio exhibits a positive and significant coefficient. The negative coefficient on CAPEX is expected and indicates that investors bid down firms which continued to spend larger sums on physical assets as COVID-19 cases grew. This makes sense intuitively and is consistent with my previous specifications as firms which needed to continue to spend high amounts of fixed assets, even as regulations shut down many activities, were accumulating sunk costs in unused fixed capital and likely had trouble reducing their costs. The positive coefficient on current ratio corresponds with other studies which have found that firms with more liquidity, and subsequently more financial flexibility, have performed better through COVID-19 (Fahlenbrach et al., 2020). Interestingly, this result also shows that overall liquidity and a firm's ability to satisfy short-term obligations remained an attractive element for investors, even though cash by itself appears to be a

negatively viewed asset in these specifications. Thus, it appears that the ability to quickly shed costs rather than just the volume of cash a firm has is what matters more to investors in the context of liquidity.

Columns 5 and 6 test the robustness of the specification from column 4 by including fixed effects and controls. I note that results maintained their signs and significance at conventional levels with these inclusions.

Columns 7 and 8 divide the crisis into fever and post-fever periods. Ramelli and Wagner (2020) identified a fever period where investors fled the market due to fears of the implications of a worsening COVID-19 situation. This period encompasses the range from February 24th, 2020 to March 20th, 2020. Following this period, fiscal and monetary stimulus was initiated by the government which subsequently led to a market turnaround and bull run. I utilize the same fever period and define post-fever as the dates after March 20th, 2020. I note that some variables lose their significance across columns 7 and 8, which indicates less meaningful interactions in subsets of the pandemic for this methodology. The significant interactions in the previous specifications thus indicate that certain subsets of the pandemic may have experienced less reaction by investors to COVID-19 growth but that COVID-19 infection growth has been a meaningful interaction with firm fundamentals through the crisis as a whole. The sign on total assets remains significant but flips its sign in the post-fever period. This indicates that firms with higher assets during the period associated with lower interest rates and the introduction of fiscal policy measures were bid up by investors. A possible explanation for this development is investor hopes that high asset firms would be able to utilize their capital intensity or unload their inventories in the post-fever period.

Although insignificant, the estimates for *CovidGrowth* flip in sign in the fever and post-fever subsets. For the post-fever period, the positive coefficient may indicate that higher COVID-19 infection growth actually made investors bid up firms as the presence of *CovidGrowth* would lead to hopes of more stimulus along with the Federal Reserve maintaining their near-zero interest rates, thus driving investors towards the equity markets. In the fever period, the unintuitive positive coefficient may simply be attributed to the poor testing infrastructure the United States had in the early days of the COVID-19 crisis, which would lead to inadequate data. Regardless, these two estimates are not significant, so their interpretation is not statistically meaningful, but they are interesting to note, nonetheless.

iii. Cumulative Abnormal Returns and Financial Characteristics

In table 7, I examine firm reactions to certain events as a function of their total assets, net income, market value, and leverage ratio.

March 16th, which is a date related to a steep market decline linked to COVID-19 fears, serves as a proxy for an "event" where investors and firms realize the gravity of the COVID-19 situation. In this specification, I observe negative coefficients on total assets and leverage ratio and positive coefficients on net income and market value. The negative coefficient on total assets indicates that firms with high amounts of capital and other assets reacted negatively to fears of COVID-19. These results are expected based on the findings from section 5.ii.

As mentioned in section 5.ii, this negative relationship between total assets and COVID-19 growth, or in this case fears, indicates that investors bid down firms with higher asset totals as they would have trouble reducing fixed capital costs and efficiently utilizing their asset base amidst government regulations and reduced consumer activity. The negative coefficient on

Table 7
Firm Fundamentals vs. CARs

	Dependent variable:					
	CAR					
	March 16	March 16	March 24	March 24	November 16	November 16
	(1)	(2)	(3)	(4)	(5)	(6)
Total Assets	-0.033***	-0.034***	-0.027***	-0.030***	0.022***	0.027***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.002)
Net Income	0.004***	0.005***	0.003***	0.002**	-0.006***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market Value	0.051***	0.049***	0.017***	0.019***	-0.031***	-0.037***
	(0.004)	(0.005)	(0.003)	(0.004)	(0.001)	(0.002)
Leverage Ratio	-0.201***	-0.175***	-0.060***	-0.065***	0.022***	0.014*
	(0.018)	(0.020)	(0.013)	(0.015)	(0.008)	(0.008)
Constant	-0.119***		0.191***		0.091***	
	(0.023)		(0.018)		(0.010)	
Industry FE	No	Yes	No	Yes	No	Yes
Observations	2,893	2,893	2,900	2,900	2,912	2,912
R^2	0.116	0.190	0.051	0.213	0.183	0.250
Adjusted R^2	0.114	0.184	0.050	0.207	0.182	0.244
Residual Std. Error	0.239 (df = 2888)	0.236 (df = 2870)	0.182 (df = 2895)	0.181 (df = 2877)	0.101 (df = 2907)	0.099 (df = 288
F Statistic	94.351*** (df = 4; 2888)	29.273*** (df = 23; 2870)	38.779*** (df = 4; 2895)	33.891*** (df = 23; 2877)	163.250*** (df = 4; 2907)	41.913*** (df = 23;
Note:						*P<0.1 **P<0.05 ***P

This table presents the relationship between cumulative abnormal returns between selected market days in 2020 and firm characteristics/metrics. Discussion of the selection of market days can be found in section 3. Industry fixed effects are based on 2-digit NAICS codes. Robust standard errors are in parenthesis.

leverage ratio falls in line with other studies which find that highly leveraged firms were more affected by COVID-19 fears and growth. The positive coefficients on market value and net income indicate similar reasonings as mentioned in 5.ii. Investors likely fled smaller, riskier stocks to larger and more profitable stocks amidst the uncertainty created by COVID-19, subsequently leading to a positive relationship between CAR with market value and net income around a date linked to fearful sentiments regarding COVID-19.

March 24th, which is a date linked to a market rise due to stimulus hopes, serves as a proxy for the entrance of government relief into the economy, but not the end of the pandemic. In this specification, I observe the same signs for each coefficient as in the March 16th specification. This indicates that although fiscal stimulus raised market levels, it did not change overall investor sentiment on the types of firms which would be attractive investments throughout the pandemic. This is expected as although stimulus would provide relief, the

uncertainty raised by COVID-19 related lockdowns remained and subsequently investor attitudes towards types of firms would not drastically change.

November 16th, which is a date linked to a positive market date due to vaccine hopes, serves as a proxy for an upcoming end to the virus. Here, the signs on each estimate flips. This indicates a reversal of investor tastes compared as COVID-19 related regulations and fears wane, and that COVID-19 did indeed transform many investor preferences and behaviors. The positive coefficient on total assets indicates that investors bid up firms with large capital intensities which could begin to utilize their capital and unload their inventory in a post-COVID rebound. The positive coefficient on leverage ratio indicates that investors bid up firms with more leveraged operations. More leverage offers the potential of higher returns despite the risk associated with debt. Thus, this result indicates that investors reallocated more towards riskier, more speculative investments as sentiment for a potential beginning for the end of COVID-19 arose. These types of results would be expected in a speculative market, and the prospects of the end of pandemic-related slowdowns in economic activity would be a driver for speculation on riskier firms which could thrive in a post-pandemic rebound.

The negative coefficient on net income and market value indicates that investors fled safer, larger, and more profitable stocks following this news. This is expected based on and consistent with the interpretation of the flip in sign of leverage ratio on this date. This further indicates that investors were ready to speculate on riskier stocks as indications of the end of the pandemic began emerging.

Each of these results were tested for robustness using industry fixed effects and maintained their signs and significance in each specification.

6. Conclusion

The effect of COVID-19 on firm returns and investor appetites has been and will be an interesting question to consider. This paper attempts to tackle this relationship by examining the interactions between COVID-19 case growth and firm characteristics, along with analyzing which types of firms reacted most significantly to dates in the market linked to rumors of major COVID-19 developments. I find that firms with large capital and cash balances and more leveraged operations were most prone to negative interactions with the growth of COVID-19 cases. Firms with larger market caps, consistent solid earnings, and better overall liquidity acted as more attractive places for investors to flock towards as COVID-19 swept across America. Thus, it appears that investors were mainly concerned with firm abilities to reduce costs and generate earnings as COVID-19 cases grew. However, this trend initially does not seem to be permanent, as more leveraged and speculative stocks saw a positive jump as vaccine rumors- which may signal a near-future end to the virus- entered the market. This study contributes to the existing literature on COVID-19 by exploring the interaction between daily returns and COVID-19 over time, thereby also taking into account the evolution of firm fundamentals and performance throughout the COVID-19 crisis, and by studying the reaction of different types of firms to positive and negative shocks within the overall shock of COVID-19.

The analysis in this study could be improved upon and expanded in future publications by further isolating the effect of COVID-19 on the stock market. While COVID-19 has been the dominant story of the beginning of the 2020's, the separation of trends between the stock market and the overall economy has been an interesting development as well. US stocks rallied and hit record highs despite a pandemic ravaging throughout the nation, millions being laid off or furloughed, and countless businesses forced into closure. Government reactions such as

lockdowns which limited the avenues of spending and monetary policy such as the zeroing of interest rates and injection of liquidity into the market has certainly been a main driver of the stock market's 2020 bull run.

Thus, methods which can effectively control for such macro-developments would allow for a better analysis of the micro-developments and relationships between firms and COVID-19 that affected the markets. Investors in certain situations may have reacted to such trends rather than the variables and firm characteristics studied in this paper, and thus methods to further isolate financial fundamentals from macro trends would be an area of further improvement in similar studies. Furthermore, alternative COVID-19 tracking methods such as predictive models could be utilized rather than case growth to examine a smoother interaction. Case growth data has limitations in that large values will exist in the beginning days due to the low number of cumulative cases (as can be seen in figure 2). The United States also had poor testing infrastructure in the early weeks of the virus, which may have led to COVID-19 statistics which underestimated the true number of cases.

Overall, these results shed light on the drivers of investor appetite throughout the course of a prolonged period of consumer restraints and as such a crisis begins to fade. My findings highlight firm fundamentals which most significantly reacted to COVID-19 developments which may be important considerations for firm targeting in pandemic-related relief policies and investor strategies.

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Appendix

Table A1. Description of Variables Used in Analysis

Variable	Definition	Calculation (if not directly sourced from Compustat via WRDS)
Daily Return	The percent change between a firm's stock's open price and close price	$\text{Daily Return}_{i,t} = (\text{Closing Price}_{i,t} - \text{Open Price}_{i,t})/(\text{Open Price}_{i,t})$
CovidGrowth	The rise in reported COVID-19 cases in the United States on the previous day	$\text{CovidGrowth}_t = \ln(\text{Confirmed Cases}_{t-1}) - \ln(\text{Confirmed Cases}_{t-2})$
Total Assets	The book value of a firm's total assets	
Total Inventory	The book value of a firm's total inventory	
Market Value	The market value of a firm's equity	
PPE	The book value of a firm's property, plant, and equipment	
Leverage Ratio	The ratio of a firm's assets to its debts	(Total Assets)/(Total Debt)
Net Income	A firm's income minus cost of goods sold, expenses, depreciation, amortization, interest, and taxes for a quarter	
Cash	A firm's cash reserves	
Revenue	A firm's generated revenue for a quarter	
CAPEX	Money spent by a firm acquiring or maintaining fixed assets	
Current Ratio	A metric describing the ease at which a firm can satisfy its short-term obligations	(Total Short-Term Assets)/(Total Short-Term Liabilities)

Figure A1. Correlation Matrix of Examined Variables

	Total Assets	Cash	Total Inventory	Net Income	PPE	CAPEX	Market Value	Leverage Ratio	Current Ratio	Revenue
Total Assets	1	0.731	0.573	0.339	0.901	0.866	0.808	0.277	-0.351	0.863
Cash	0.731	1	0.409	0.228	0.561	0.561	0.748	0.121	-0.100	0.607
Total Inventory	0.573	0.409	1	0.286	0.604	0.557	0.397	0.174	-0.290	0.651
Net Income	0.339	0.228	0.286	1	0.312	0.326	0.419	-0.007	-0.193	0.442
PPE	0.901	0.561	0.604	0.312	1	0.905	0.633	0.326	-0.476	0.841
CAPEX	0.866	0.561	0.557	0.326	0.905	1	0.693	0.244	-0.391	0.781
Market Value	0.808	0.748	0.397	0.419	0.633	0.693	1	0.095	-0.167	0.678
Leverage Ratio	0.277	0.121	0.174	-0.007	0.326	0.244	0.095	1	-0.309	0.289
Current Ratio	-0.351	-0.100	-0.290	-0.193	-0.476	-0.391	-0.167	-0.309	1	-0.538
Revenue	0.863	0.607	0.651	0.442	0.841	0.781	0.678	0.289	-0.538	1

Figure A2. Daily Returns by Quartiles of Total Assets

This figure outlines the aggregate daily returns across firms in this study by quartiles of Total Assets. Quartiles are in ascending order (1st quartile being the bottom 25% and 4th quartile being the top 25%). Time frame is from January 22, 2020 to September 30, 2020.

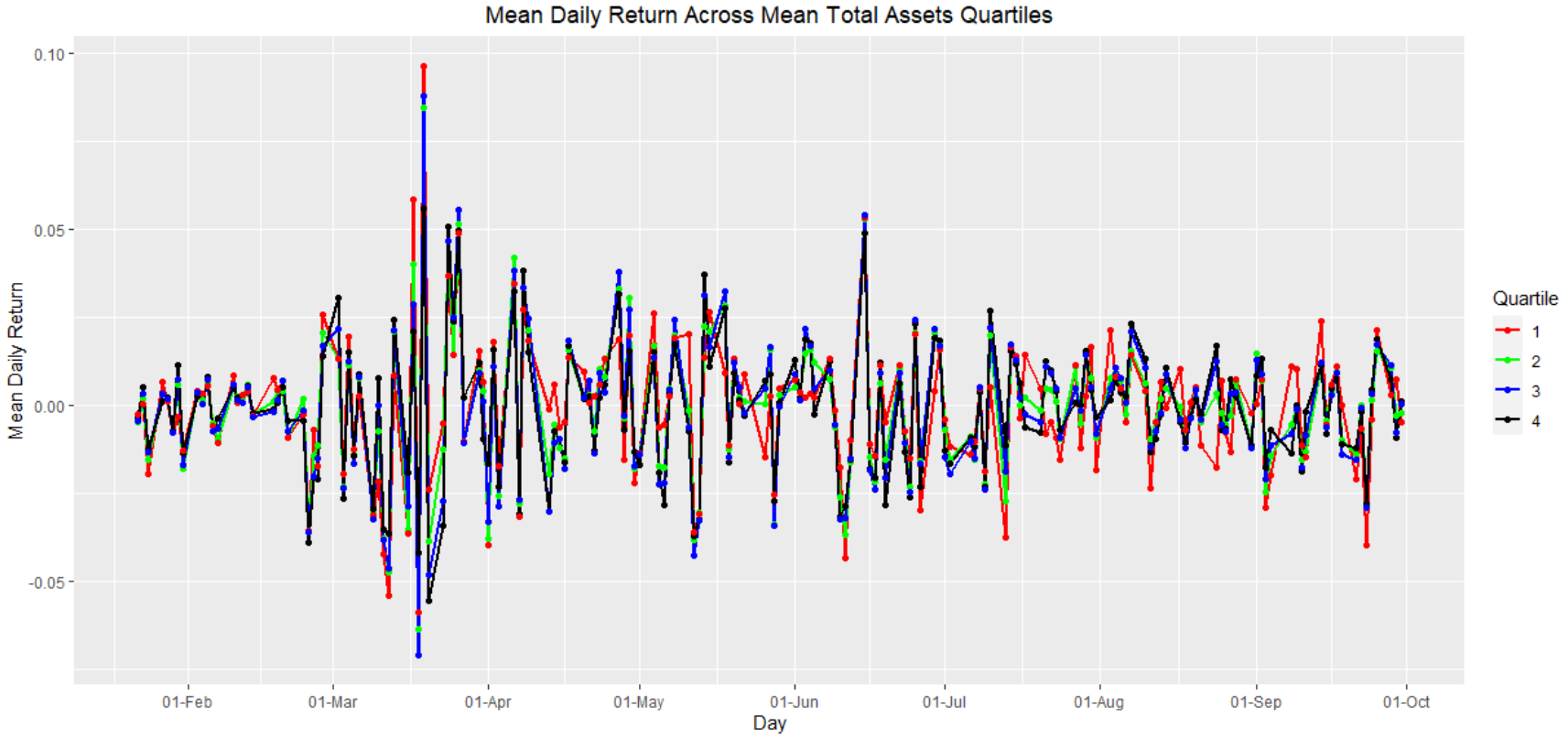

Figure A3. Daily Returns by Quartiles of Market Value

This figure outlines the aggregate daily returns across firms in this study by quartiles of Market Value. Quartiles are in ascending order (1st quartile being the bottom 25% and 4th quartile being the top 25%). Time frame is from January 22, 2020 to September 30, 2020.

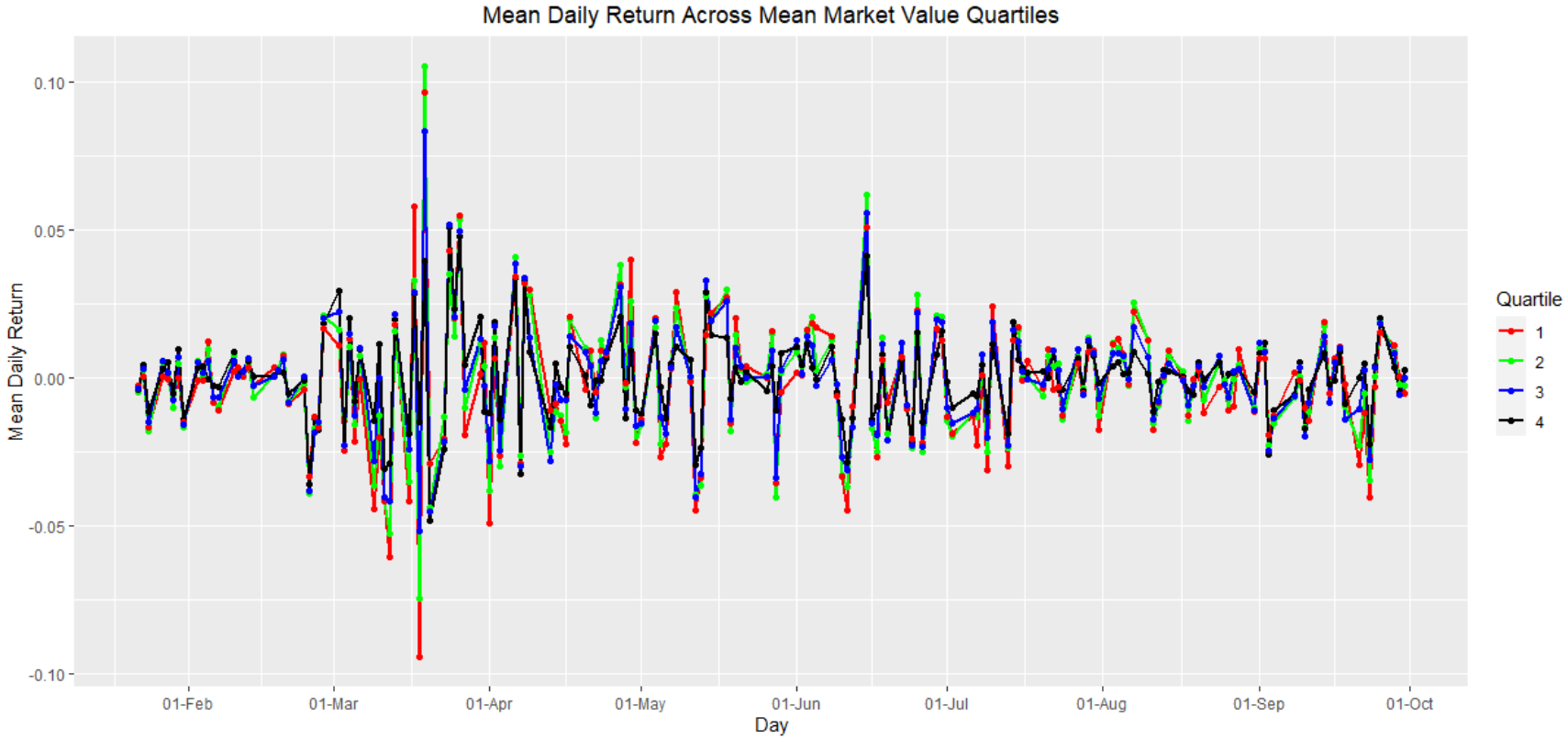

Figure A4. Daily Returns by Quartiles of Net Income

This figure outlines the aggregate daily returns across firms in this study by quartiles of Net Income. Quartiles are in ascending order (1st quartile being the bottom 25% and 4th quartile being the top 25%). Time frame is from January 22, 2020 to September 30, 2020.

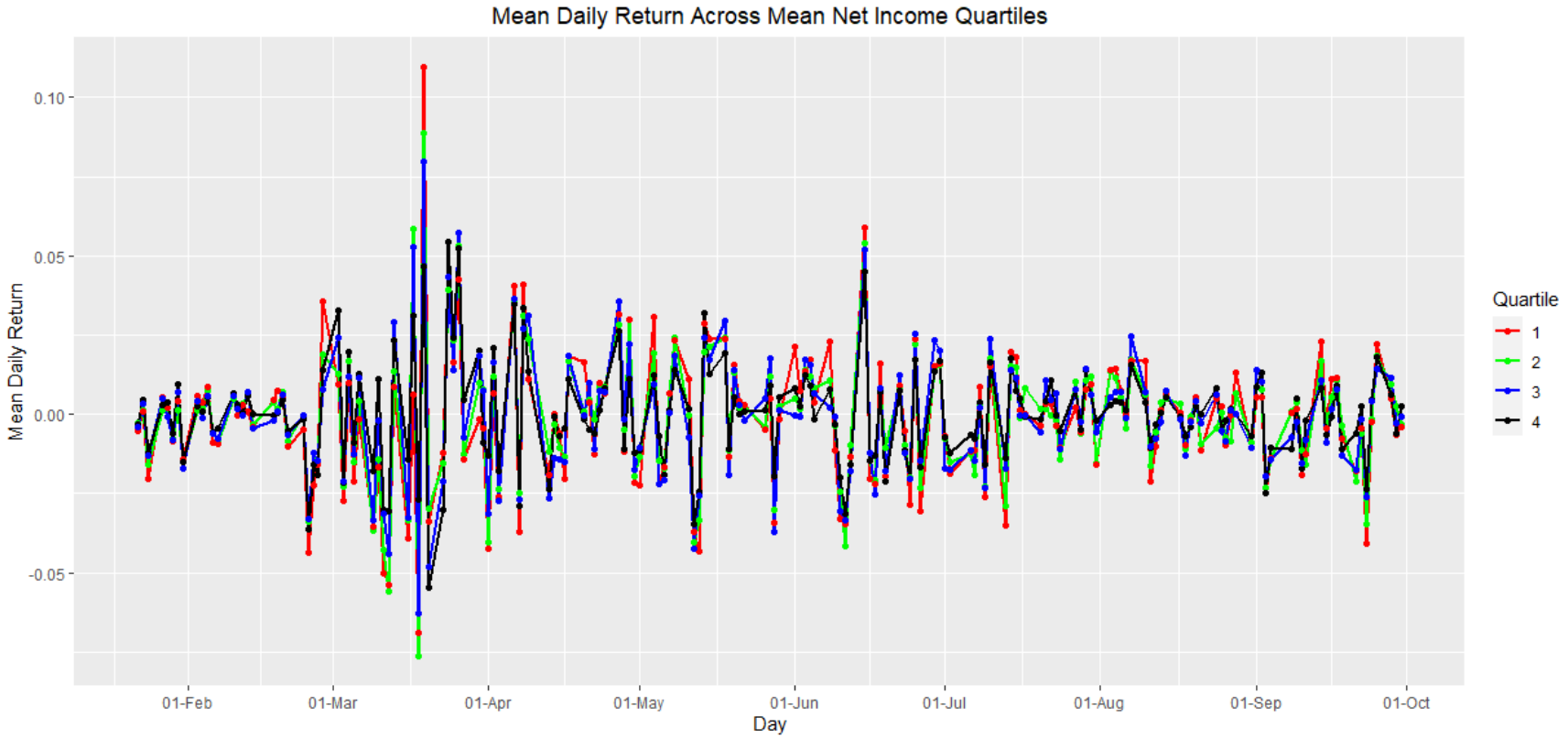

Figure A5. Daily Returns by Quartiles of Leverage Ratio

This figure outlines the aggregate daily returns across firms in this study by quartiles of leverage ratio. Quartiles are in ascending order (1st quartile being the bottom 25% and 4th quartile being the top 25%). Time frame is from January 22, 2020 to September 30, 2020.

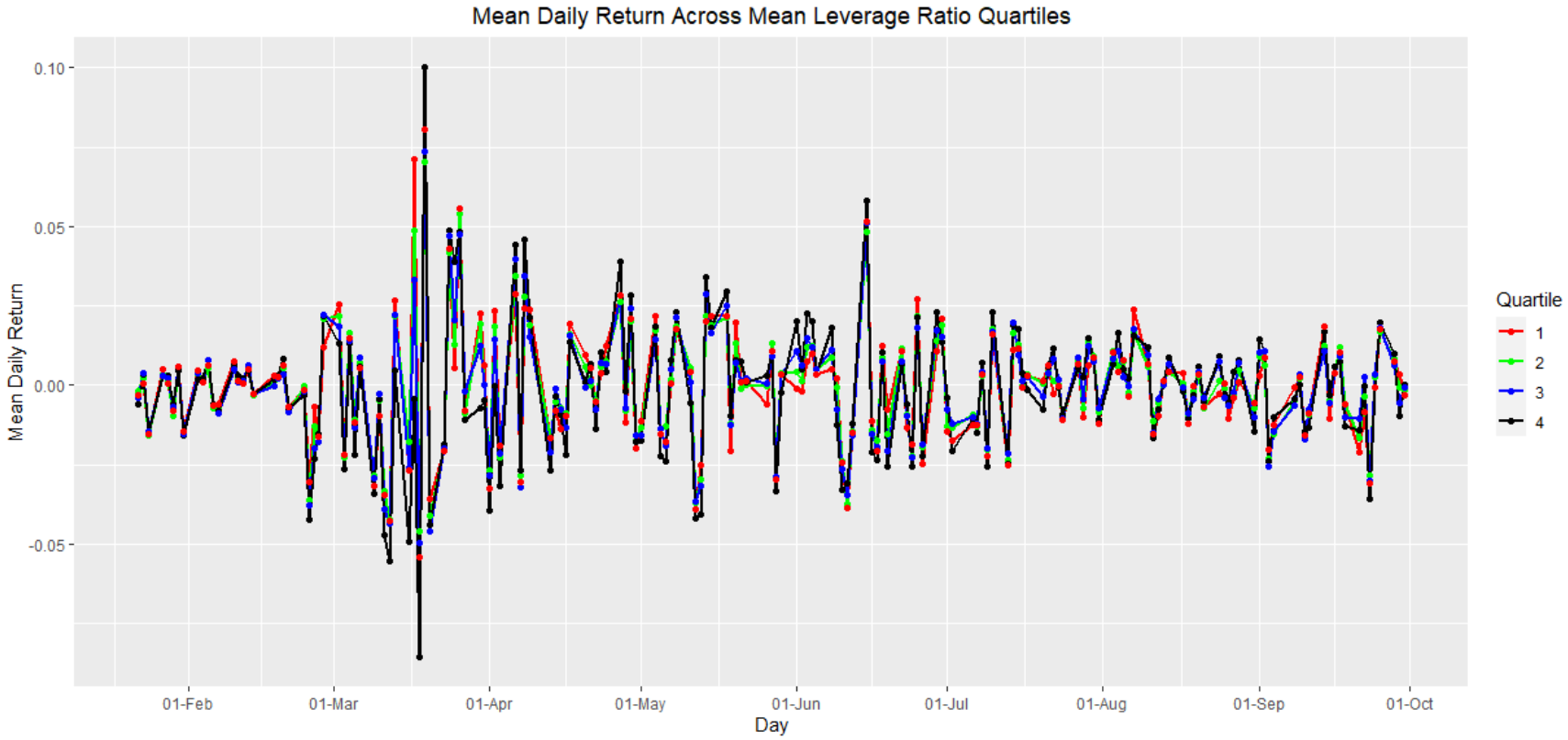

Figure A6. Scatter Plots of CAR and Studied Variables

The following plots present scatter plots of the studied variables for the CAR regression and CARs. The first row presents the scatter plots for total assets, the 2nd row for market value, the third row for net income, and the fourth row for leverage ratio. For the leverage ratio plots, 1 outlier (leverage ratio = 3.12) was removed in the March 16th and March 24th plots and for the November 16th plot (leverage ratio = 2.68). Metric values are reported in the transformed state.