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COVID-19 impact on digital companies' stock return: A dynamic data analysis

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ABSTRACT

The coronavirus crisis impact on the digital sector is undoubtedly an important issue that deserves to be studied. Researchers mostly focused on specific sectors such as tourism, healthcare sector, or the economy. This paper used a dynamic panel model to examine the COVID-19 crisis impact on the digital companies, stock return. The findings indicate that both of the monthly growth in total infected cases and total death cases caused by COVID-19 have significant positive effects on stock returns across digital companies. This novel results contradicts previous research findings and highlights that this crisis is slowing down all the economic sectors.

1. Introduction

The ongoing viral epidemic coronavirus, labeled COVID-19, had its outbreak in Wuhan, China in early December 2019. On March 11, 2020, the World Health Organization (WHO) proclaimed the coronavirus a pandemic, which has become one of the most lethal contagious infectious diseases in human history (WHO, 2020a). Being one of the most serious public health problems, the outbreak will continue spreading in the world population, resulting in over 9.8 million confirmed cases as well as over 494000 deaths across the globe as of June 27, 2020, WHO (2020b).

Several studies link COVID-19 data to the world stock markets. Most of these studies currently focus on specific countries, namely the United States and China. Analyzing COVID-19 data, Baig et al. (2020) found that the increase in the number of confirmed cases and deaths from the coronavirus is associated with a significant increase in the illiquidity and volatility of the US stock markets. Similarly, Al-Awadhi et al. (2020) explored the impacts of the coronavirus disease on the Chinese stock market. Their findings indicate that the increase in the total number of confirmed cases and deaths caused by COVID-19 has significant negative effects on the stock returns of all companies on the Chinese stock market.

In response to this health crisis, the emerging coronavirus literature confirmed that stock market investors behavior is characterized by unprecedented volatility during COVID-19 crisis (Al-Awadhi et al., 2020; Ashraf, 2020; Albulescu, 2020; Baker et al., 2020; Baig et al., 2020; Zaremba et al., 2020; Zhang et al., 2020). Furthermore, stock markets have reacted more proactively and negatively to the growth in the number of confirmed cases of COVID-19 (Ashraf, 2020). As stated by Klibanoff et al. (1998), Tetlock (2007) and Su et al. (2017), upon the occurrence of such major event, investors have become increasingly anxious and fearful about holding higher-risk securities, and, as a result, they were less certain about what to expect. Accordingly, one might, forward the idea that the COVID-19 pandemic has a considerable impact on investment decisions, stimulates portfolio rebuilding

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and abnormal business activity (Zaremba et al., 2020), which, in turn, ultimately would lead to market destabilization (Blau et al., 2014).

Faced with this global crisis, all activities between people including economic, financial, commercial, and social ones have shifted to the digital world via digital channels communication like Skype, Zoom and Loop Up among others. The increasing use of digital devices and communication methods to exchange ideas in such fields as the economy, financial markets and health systems has created advantages in the new form of communication made possible from digital technologies. Particularly, the Internet of Things (IoT) which provides a platform for public health organizations to access data that facilitate the establishment of an ecosystem highly interconnected digital device to monitor the COVID-19 pandemic (Ting et al., 2020).

In the face of this crisis, digitalization was, then, a priority in every area. Indeed, digitalization with its numerous advantages and very significant contribution to managing the COVID-19 crisis turned into a safe haven for investors and then for the economy. It provides digital tools and communication methods facilitating populations daily life and opening growth opportunities. However, previous studies have not investigated the impact of the COVID-19 pandemic on the digital sector that has played this highly relevant role internationally during the COVID-19 period. After the COVID-19 pandemic, most of the economic sectors have deteriorated because of the imposition of movement restrictions. What is more, the impact of COVID-19 on the performance of digital companies remains an empirical question. The circumstances of our study are the ability of the digital sector to react and adapt to an unexpected general crisis.

In this study, however, we hypothesized that the COVID-19 pandemic had a positive impact on stock returns across digital companies. Owing to the significantly positive relationship between Market-to-Book and expected market returns (Lewellen, 1999), and given that the Market-to-Book forecasts economically and statistically significant temporal variations in expected returns (Pontiff and Schall, 1998), we also hypothesized that the COVID-19 pandemic had a positive impact on Market-to-Book. We explicitly hypothesized that the monthly growth in total confirmed cases and in total death caused by COVID-19 have positive impacts on both stock returns and Market-to-Book. Therefore, the main objective of this study was to investigate the relationship between the COVID-19 pandemic on one hand, and both of the digital companies' stock return and the Market-to-Book ratio on the other. The remainder of this paper was structured as follows. Section 2 introduced the data and methodology. Section 3 revealed and discussed our empirical findings while Section 4 was dedicated to draw the main conclusions of the paper.

2. Data and methodology

In this study, we used both of the monthly stock return ($MR_{i,t}$) and the Market-to-Book ratio ($MtB_{i,t}$) for ninety (90) top digital companies, located in twenty-four (24) countries worldwide. These data were used as dependent variables together with their corresponding variables COVID-19 (C19) data. In addition, the data on global coronavirus cases were obtained from Roser et al. (2020). The COVID-19 data includes both the total number of confirmed cases and the total number of deaths per million. Moreover, it should also be noted that unlike other studies (Al-Awadhi et al., 2020; Zhang et al., 2020) — we preferred to use "per million" adjustment, to forestall a potential inclination toward more populated countries. The growth in coronavirus-related data was calculated in a similar way:

$$GC19_{i,t} = \ln\frac{Cases_{i,t}}{Cases_{i,t-1}} \tag{1}$$

$$GD19_{i,t} = \ln\frac{Deaths_{i,t}}{Deaths_{i,t-1}} \tag{2}$$

In this study, the stock return ($MR_{i,t}$) and Market-to-Book ratio ($MtB_{i,t}$) were used as a function of the additional control variables that could inherently influence not only the performance and value of each company, but also the COVID-19 cases for the period January–July 2020. We estimated both $MR_{i,t}$ and $MtB_{i,t}$ ratio as follows:

$$MR_{i,t} = \alpha_0 + \alpha_1 MR_{i,t-1} + \alpha_2 MtB_{i,t-1} + \alpha_3 C19 + \alpha_4 X_{i,t-1} + V_{i,t} + \epsilon_{i,t} \tag{3}$$

$$MtB_{i,t} = \beta_0 + \beta_1 MtB_{i,t-1} + \beta_2 MR_{i,t-1} + \beta_3 C19 + \beta_4 X_{i,t-1} + V_{i,t} + \epsilon_{i,t} \tag{4}$$

where, $X_{i,t-1}$ is a vector of a digital company-specific characteristic introduced on the right-hand side of (3) and (4) to avoid the models' specification error. This vector includes (i) the natural logarithm of the total number of common shares (NOSH) representing the company's capital, (ii) the corporate risk factor "BETA" of a stock which expresses the relative change for a given market movement, indicating whether the stock is likely to under-or overreact, and (iii) the historical volatility (VOL) of a share, which represents the fluctuation degree of the stock share price in the previous 12 months. According to the "DataStream" database, the corporate risk factor "BETA" was estimated through the least-squares regression between the adjusted share price and the stock market index.

The variables $V_{i,t}$ and $\epsilon_{i,t}$ represent the unobserved heterogeneity and the random error term, respectively, and α and β are the model parameters to be estimated. These regressions are run to understand whether there is a relationship between a company-specific digital characteristic and its stock returns movements in response to COVID-19 announcements.

It is noticeable that both models (3) and (4) are not based on a particular asset pricing model. A panel regression model, which exploits both the variable of interest (COVID-19 in our case) and the control variables such as the company-specific digital characteristics (vector X), was used to investigate the dynamic causal link between COVID-19 pandemic and stock returns. We noted that without these control variables added to the model, it might not sufficiently reflect the real effect of the COVID-19 pandemic

Table 1
Summary statistics, January 1 to July 17, 2020.

Statistics	MR	MtB	GC19	GD19	NOSH	BETA	VOL
Observation	630	630	630	630	630	630	630
Mean	0.041	4.103	0.574	0.365	6.049	0.995	0.302
Median	0.011	2.875	0.224	0.033	6.016	0.965	0.286
SD (St. Dev)	0.077	6.302	0.097	0.759	0.630	0.434	0.103
Maximum	0.228	27.950	0.343	0.291	7.486	2.680	0.723
Minimum	−0.431	−28.540	0.001	0.000	4.612	0.030	0.107
Skewness	1.570	0.585	2.338	2.381	0.124	0.649	1.072
Kurtosis	6.916	10.019	7.305	8.168	2.595	5.147	4.975

Note: MR is the monthly stock return, MTB is the monthly market-to-book ratio, GC19 is the monthly growth in total confirmed cases, GD19 is the monthly growth in total death cases, NOSH is the total number of common shares, BETA is the digital companies' risk, and VOL is the historical volatility.

Table 2
The Pearson correlation coefficients between the variables and their corresponding significance in brackets. MR stands for the monthly digital companies' stock returns, MtB stands for the monthly market-to-book ratio, GC19 is the monthly growth in total confirmed cases, GD19 is the monthly growth in total death cases, NOSH represents the total number of common shares, BETA is the digital companies' risk, and VOL represents the historical volatilities.

	MR	MtB	GC19	GD19	NOSH	BETA	VOL
MR	1						
MtB	0.106	1					
	(0.008)						
GC19	0.646	0.006	1				
	(0.000)	(0.874)					
GD19	0.581	0.008	0.901	1			
	(0.000)	(0.850)	(0.000)				
NOSH	−0.021	−0.077	−0.040	−0.046	1		
	(0.608)	(0.054)	(0.314)	(0.247)			
BETA	−0.022	0.038	0.019	0.036	−0.214	1	
	(0.574)	(0.340)	(0.625)	(0.369)	(0.000)		
VOL	0.019	−0.102	−0.029	0.036	−0.197	0.622	1
	(0.636)	(0.011)	(0.458)	(0.367)	(0.000)	(0.000)	

on the stock returns. These control (independent) variables also explain the stock returns variations and should be specified in the model to (i) control their effects and (ii) avoid biased estimates due to omitted these control variables.

The dataset was obtained from the DataStream database. In total, we used 630 observations issued from two-dimensional panel data such that 90 individual digital companies and 7 monthly temporal data. Furthermore, we did not use classical event study methodologies, such as static panel data analysis. We rather applied a dynamic panel regression, with a two-step GMM-in-system estimator, to examine the relative digital stock returns under coronavirus impacts. The main advantage of this approach is its ability to reduce biased estimations, control heterogeneity, and to examine the time relationship between dependent and independent variables (Roodman, 2009a,b; Wintoki et al., 2012). The summary statistics of all variables mentioned above are presented in Table 1.

Table 1 shows that the maximum monthly stock return during the study period is 22.77% and the minimum is −43.10%. Similarly, the maximum monthly market-to-book ratio during the same period was 27.95 and the minimum is –28.54. The highest growth in monthly total confirmed cases was 34.31% and the highest growth in monthly total cases of death caused by COVID-19 was 29.10%. The skewness for this dataset is strictly positive, meaning that the data are skewed to the right. We should carefully note that, during the COVID-19 outbreak, digital companies are more likely to make gains than losses.

3. Results

Table 2 reports on the correlation between the variables and their significance. What is striking is that the stock returns, MR, is significantly positively correlated with monthly growth in confirmed cases per million, GC19 (0.646) on the one hand, and with monthly growth in total cases of deaths, GD19 (0.581) on the other. The results of the dynamic panel data regressions are reported in Table 3. First, it can be clearly observed that the Hansen and serial-correlation tests do not reject the null hypothesis of correct specification (P-values of Hansen test and AR (2) test of Arellano and Bond are larger than 5%), lending support to our estimation results.

Table 3 shows that an increase in both of the number of total confirmed cases per million, CG19, and the total cases in deaths per million, GD19, have significant positive effects on the monthly digital company stock returns, MR, and significant positive effects on the Market-to-book ratio, MtB. Most importantly, the effect of GC19 on monthly stock returns is almost twice larger than that of GD19. So, the effect of monthly growth in total deaths has a lower effect on the digital company stock returns than the monthly growth in total confirmed cases. There is a possible epidemiological explanation for the substantial effect we found of GC19 compared with GD19. One might argue, however, that this might have arisen from the number-of-cases data, which is an early warning signal and already provides a rough idea of the future death cases. Nonetheless, even if the number of death

Table 3
This table presents dynamic panel regressions for 90 digital companies from January 1 to July 17, 2020. The dependent variable for regressions (1) is the monthly company stock returns, MR, and for (2) is the monthly market-to-book ratio, MtB. The numbers in brackets are the associated 95% confidence intervals.

Parameter	Dependent variable: MR (3)		Parameter	Dependent variable: MtB (4)	
	(1)	(2)		(1)	(2)
α_0(Const.)	0.227**	0.173***	β_0(Const.)	0.215	−0139**
	[0.191; 0.264]	[0.143; 0.204]		[– 0.111; 0.542]	[– 0.483; –0.204]
α_1(MR)	0.251**	0.113***	β_1(MR)	0.920**	1.018***
	[0.239; 0.261]	[0.106;0.120]		[0.803; 1.037]	[1.018; 1.019]
α_2(MtB)	0.027***	0.023**	β_2(MtB)	1.021***	1.250**
	[0.025; 0.030]	[0.021; 0.026]		[1.021; 1.022]	[1.149; 1.351]
α_3(GC19)	0.043***		β_3(GC19)	0.241**	
	[0.032; 0.055]			[0.232; 0.250]	
α_4(GD19)		0.019**	β_4(GD19)		0.369***
		[0.011; 0.029]			[0.359; 0.378]
α_5(NOSH)	0.046**	0.039***	β_5(NOSH)	−0.114**	3.814*
	[0.041; 0.052]	[0.034; 0.044]		[– 0.166; – 0.062]	[3.681; 3.948]
α_6(BETA)	−0.206***	−0.176**	β_6(BETA)	−0.187***	−0.883**
	[– 0.217; –0.194]	[–0.181; –0.171]		[–1.262; –1.113]	[–0.947; –0.820]
α_7(VOL)	0.807**	0.706**	β_7(VOL)	4.955**	0.814***
	[0.793; 0.821]	[0.694; 0.718]		[4.770; 5.139]	[0.681; 3.948]
Observation	630	630		630	630
F-Statistics	2.946**	4.221***		8.792**	0.4.553**
Instruments	106	106		106	106
Groups	90	90		90	90
P-value of AR(2)	0.176	0.248		0.612	0.780
P-value of Hansen	0.736	0.114		0.758	0.391

*Represent 10% significance level.
**Represent 5% significance level.
***Represent 1% significance level.

cases is irrelevant, it might stand as a piece of strong new information. Individuals, who primarily see the danger in the crisis (Death and contagious infectious coronavirus) usually overreact emotionally and operate bearing in mind the restrictions imposed by the social distanciation. This situation makes personal interaction impossible, enforces lockdowns, and makes people adapt to new digital workflows and technologies. As a consequence, the demand for classical industries has vanished, whereas demand in digital companies, such as those employed in our study, has suddenly skyrocketed.

Moreover, the one-month moving MTB (L.MtB) is positive and significant with its level (MtB) value in both equations (3) and (4). Finally, the regressions of both MR and MtB ratio on specific-firm characteristics suggest that the coefficient of the digital companies' risk (BETA) is negative and significant in both equations (3) and (4). This is not the case for volatility (VOL); its coefficient is positive and significant in both equations (3) and (4). Similarly, the effect of the total number of common shares (NOSH) seemed to be positive and significant, except for the MtB ratio in Eq. (1).

All in all, digital companies experience increases in both returns and MtB ratio in response to an increase in COVID-19 cases growth. One could argue, however, that this might be because most people have been confined to their homes and have evolved around the use of new digital workflows and technologies, developed by digital companies. Thus, these results might be attributable to a natural excess in digital companies' demand during the COVID-19 crisis. This argument is eliminated by the classical firms, where the growth in stock returns might be caused by different economic and financial environments of the countries.

4. Conclusion

Analyzing the impact of COVID-19 on stock returns and the market-to-book ratio of ninety digital companies through January 1 — July 17, 2020, we found out that this pandemic interacts positively with both of them. Specifically, the stock returns are significantly positively related to both of the monthly growth in total confirmed cases and the monthly growth in total death cases caused by COVID-19. One might therefore support that the digital sector has strengthened against the other sectors. This could be the evidence that investors, or at least the majority of them, believe that the digital sector is a safe haven for their investments even during the COVID-19 crisis. Overall, it should be noted that the digital sector has become a reality and an alternative solution primarily for kick-starting economic growth, the creation of new jobs and the retention of the existing ones during the corona crisis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Al-Awadhi, A.M., Alsaifi, K., Al-Awadhi, A., Alhammadi, S., 2020. Death and contagious infectious diseases: impact of the COVID-19 virus on stock market returns. J. Behav. Exp. Finance 27.

Albulescu, C., 2020. Coronavirus and financial volatility: 40 days of fasting and fear. SSRN Accessed April 18, 2020.

Ashraf, B.N., 2020. Stock markets' reaction to COVID-19: cases or fatalities? Res. Int. Bus. Finance 101249.

Baig, A., Butt, H.A., Haroon, O., Rizvi, S.A.R., 2020. Deaths, panic, lockdowns and US equity markets: The case of COVID19 pandemic. Available at SSRN 3584947.

Baker, S., Bloom, N., Davis, S.J., Kost, K., Sammon, M., Viratyosin, T., 2020. The unprecedented stock market reaction to COVID-19. Covid Econ.: Vetted Real-Time Pap. 1 (3).

Blau, B.M., Brough, T.J., Thomas, D.W., 2014. Economic freedom and the stability of stock prices: A cross-country analysis. J. Int. Money Finance 41, 182–196.

Klibanoff, P., Lamont, O., Wizman, T.A., 1998. Investor reaction to salient news in closed-end country funds. J. Finance 53 (2), 673–699.

Lewellen, J., 1999. The time-series relations among expected return, risk, and book-to-market. J. Financ. Econ. 54 (1), 5–43.

Pontiff, J., Schall, L.D., 1998. Book-to-market ratios as predictors of market returns. J. Financ. Econ. 49 (2), 141–160.

Roodman, D., 2009a. A note on the theme of too many instruments. Oxf. Bull. Econ. Stat. 71 (1), 135e158.

Roodman, D., 2009b. How to do xtabond2: an introduction to difference and system GMM in stata. STATA J. 9 (1), 86e136.

Roser, M., Ritchie, H., Ortiz-Ospina, E., Hasell, J., 2020. Coronavirus disease (COVID-19). Published online at OurWorldInData.org. Accessed April 24, 2020.

Su, Z., Fang, T., Yin, L., 2017. The role of news-based implied volatility among US financial markets. Econom. Lett. 157, 24–27.

Tetlock, P.C., 2007. Giving content to investor sentiment: The role of media in the stock market. J. Finance 62 (3), 1139–1168.

Ting, D.S.W., Carin, L., Dzau, V., Wong, T.Y., 2020. Digital technology and COVID-19. Nat. Med. 26 (4), 459–461.

WHO, 2020a. Director-general's opening remarks at the media briefing on COVID-19-11 2020? Available online: https://www.who.int/dg/speeches/detail/who-director-generals-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (accessed on 4 April 2020).

WHO, 2020b. Coronavirus disease 2019 (COVID-19). In: Situation Report – 64. (2020-03-25), https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200324-sitrep-64-covid-19.pdf?sfvrsn=703b2c40-2.

Wintoki, M.B., Linck, J.S., Netter, J.M., 2012. Endogeneity and the dynamics of internal corporate governance. J. Finance Econ. 105 (3), 581e606.

Zaremba, A., Kizys, R., Aharon, D.Y., Demir, E., 2020. Infected markets: Novel coronavirus, government interventions, and stock return volatility around the globe. Finance Res. Lett. 101597.

Zhang, D., Hu, M., Ji, Q., 2020. Financial markets under the global pandemic of COVID-19. Finance Res. Lett. 101528.