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THE EMERGENCE OF COVID-19 AND CAPITAL MARKET REACTION: AN EMERGING MARKET SCENARIO ANALYSIS

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ABSTRACT

This paper investigates the capital market reaction to the first detection of the COVID-19 in Bangladesh. Using a sample of 314 listed firms in Dhaka stock Exchange (DSE), this study employed the event study methodology (ESM) to find any abnormal return (AR) associated to the first COVID-19 detection announcement. Three different return models namely mean-adjusted return, market-adjusted return and market model have been used to calculate the abnormal return and test the statistical significance using both parametric crude dependence and standardised cross-sectional T-test along with non-parametric generalised sign-test and Corrado rank-test. The findings suggest that, despite the perceived weak market efficiency, the announcement of the first COVID-19 detection has a significant negative impact on overall market return on the event day. Additionally, the result exhibits the indifferent market reaction of different industry segments such as manufacturing, service, financial, non-financial, pharmaceuticals and IT and telecommunication sectors. The results would be useful for investors, industrial and financial analysts in accessing volatile systemic risk and building an optimal portfolio to solve the pandemic dilemma effectively.

Keywords: COVID-19 pandemic, capital market, event study, Bangladesh

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INTRODUCTION

The COVID-19, an infectious disease caused by a new kind of SARS-CoV 2 (Vukkadala et al., 2020), causes panic around the global economy since it was first identified at Wuhan city of the Hubei province in China at the beginning of 2020. According to World Health Organisation (WHO), more than 6.7 million reported infections and 395,000 deaths in 216 countries were caused by the coronavirus by the end of May 2020 and the numbers are still growing (WHO, 2020). The epidemic has evident economic implications. The economy is significantly limited in the short term since many countries have adopted stringent quarantine policies such as closing the borders, restricting air and intercity movement, closing offices, restaurants and academic institutions (Ashraf, 2020). Mass unemployment and corporate failures might be the longer-term effects of this pandemic (Dunford et al., 2020).

The COVID-19 pandemic is widely acknowledged to be not only an extreme public health crisis, not only does it cause human infections and deaths, but also created an unparalleled shock to the global financial markets (Shen et al., 2020). With the announcement of COVID- 19 by the WHO as a pandemic, stock markets around the world began to plunge. The proof of panic buying and increased volatility in national and foreign stock markets due to increased fear and panic trading has been recorded in a number of COVID-19 studies analysing share price movements. Baker et al. (2020a) documented that no prior epidemic of infectious disease, including Spanish flu and SARS influenced the stock market as much as the COVID-19 pandemic. For instance, the Dow Jones Industrial Average (DJIA) plummeted 6,400 points in just four trading days, an equivalent of around 26%.

With the crash in the United States, the European and Asian financial markets have also plummeted. The major stock indices in the UK, FTSE100 dropped by more than 10% to its lowest since 1987, while the DAX 30 in Frankfurt also plummeted dramatically due to the epidemic. Response to the pandemic, Asia's main capital indices such as SENSEX (India), NIKKEI (Japan) and STI (Singapore) experienced significant instability (Ye & Florescu, 2020). The volatility index (VIX) showed a significant increase, signalling a shift towards increased compared to previous high-risk cases such as the 9/11 terrorist attack (41.75), the global financial crisis of 2008 (46.72), the US debt crisis of 2011 (48), and even the most recent US-China trade conflict in 2018, the COVID-19 with a VIX score of 84.57 is seen as a critical challenge for markets (36.06) (Nguyen, 2020).

In line with the global financial turmoil triggered by the COVID-19 pandemic, Dhaka Stock Exchange (DSE), the biggest and oldest capital market in Bangladesh, has encountered its largest one-day decline since 2013, just one day after Bangladesh reported the first three COVID-19 cases for the first time. DSEX, the DSE's general index, has decreased by 6.51%, the largest decrease since the index was launched in 2013 (*The Independent*, 2020). A decrease has been seen too in overall market capitalisation. This drastic decline indicates that Bangladesh has not really been impervious to the fear of viruses that churn the financial system around the world (*The Daily Star*, 2020).

A variety of networks, such as job markets, production systems and consumption patterns, can be impacted by the pandemic, all of which eventually can affect the world's economy. Among these networks, the capital markets are undoubtedly one of the most essential segments (Al-Awadhi et al., 2020). Emerging markets have relatively little resources to cope with the effects of the pandemic, considering the slowest growth rate of the economy and the lack of capital inflows, and are thus likely to experience the worst possibilities (Topcu & Gulal, 2020).

Although many articles have been published for several years relating to capital market reaction, not much is known about how pandemic conditions affect the capital market of the developing nations therefore, leaving a gap in literature that future research needs to fill. Thus, a niche for further research is therefore available for examining the impact of the pandemic human disease on the stock market responses. This research intent to analyse the effect of the COVID-19 pandemic on stock values of Bangladesh's publicly traded firms. The aim of this study is to examine whether or not the first detection of COVID-19 pandemic has had a significant influence on the movements in stock prices of publicly listed companies in small emerging markets like DSE. This paper focuses on Bangladesh and its capital market unique distinctiveness.

Bangladesh is an emerging economy country located in South East Asia, the second largest economy in the region and ranked 41st among the world economy (The Daily Star, 2019). The annual GDP growth rate has been phenomenal at 8.2% in 2019 which was more than that of two biggest world economy, China (6.1%, 2019) and India (4.2%, 2019) (Trading Economics, 2019; World Bank, 2019). The recent strategic alliance between the DSE and the Chinese conglomerate of the Shenzhen Stock Exchange and the Shanghai Stock Exchange has also given the market more global exposure and linkage (Habib, 2019) and policy and financial strength (Ovi & Mahmud, 2018).

This study applies the event study methodology (Brown & Warner, 1980; Fama et al., 1969) to estimate the effect of disease outbreaks in the stock market of Bangladesh by capturing abnormal changes of firms' value after the first case of COVID-19 has been identified in Bangladesh on 8 March 2020. Outcome of the study revealed that, despite the perceived weak co-integration with other Asian markets (Subhani et al., 2011) and having weak market efficiency (Mobarek & Keasey, 2000), the domestic stock market is heavily affected by the gravity of the situation. Overall stock market reacted strongly with negative returns to the announcement of first confirmed cases which was statistically significant and consistent with that of other capital markets in the region (Phan & Narayan, 2020).

This study makes contributions to the literature in several aspects. Primarily, this article provides a primary summary of the consequences of the COVID-19 pandemic, which will broaden the scope of literature based on investors' reactions to unusual events such as earthquakes (Shan & Gong, 2012) and the spread of contagious diseases (Ichev & Marinč, 2018). However, the pandemic in COVID-19 has a bigger impact than all of this. Moreover, this study focuses on the stock market reaction to COVID-19 pandemic in the developing economy while majority of the concurrent studies scrutinise the impacts of COVID-19 on the developed capital markets such as Baker et al. (2020b) and Alfaro et al. (2020) and the study of Onali (2020) analysed the effect of COVID-19 on the stock markets of the US and other developed nations. Although it is generally assuming that stock market return and volatility are homogeneous, share returns and sector-level volatility are likely to be diverse based on the degree to which a particular sector is exposed to pandemic risk from COVID-19. This research also exhibited the segregated market reactions of financial versus nonfinancial and service versus manufacturing firms. The study also tries to evaluate the specific industry response, such as pharmaceuticals, IT and telecommunication industry to COVID-19, which will eventually help investors in efficient portfolio decision.

LITERATURE REVIEW

In addition to the basic valuation of stocks, crises will have an effect on the psychological and cognitive aspects of investors, according to the theory of behavioural finance, which will in turn have an important impact on share prices. The study of Haroon and Rizvi (2020) and Ortmann et al. (2020), argued that investor confidence would minimise the volatility of earnings, while investor's anxiety would increase the instability of earnings. The outbreak of COVID-19 would also have an impact on the investment climate, which will influence investor's confidence, triggering shifts in stock prices.

In the recent pioneering study, Goodell (2020) has done a comprehensive literature study on the economic consequences of natural catastrophes, such as nuclear wars, global climate change and localised catastrophes. He argued that the pandemic can have a wide range of impact in the financial sector, including capital markets, banking and insurance industry, and is a prospective research area. Since the global pandemic has caused severe confusion about how lethal a pandemic actually is, when and where people will get a cure, what consequences government policy will have, how people will adapt, and so on (Ramelli & Wagner, 2020; Zhang et al., 2020), the stock market investors' response could be combined with unparalleled instability (Baker et al., 2020b).

The efficient market hypothesis (EMH) implies that any new knowledge can respond to the capital market. The news of the discovery and spread of the global pandemic was also supposed to have an impact on global capital markets (Malkiel & Fama, 1970), The prior findings from the literature, however, demonstrated conflicting outcomes regarding the capital market reaction to global epidemics such as prominent study by Nippani and Washer (2004) tried to show the impact of SARS outbreak in the major stock exchanges of Canada, China, Singapore, Hong Kong, Indonesia, Philippines, Thailand and Vietnam. They tried to compare whether there was any significant difference in stock return of selected indices between pre-outbreak period and outbreak period as well as with the S&P global market index. They unexpectedly found that, apart from China and Vietnam, other stock markets are unaffected due to SARS pandemic. In his effort to identify the impact of SARS epidemic on more specific industry data set specifically the airline industry of the affected countries, Loh (2006) considerably complemented and extended the findings of earlier study by Nippani and Washer (2004). In particular, the study not only explored the influence of SARS on stock returns but also their effects on stock return volatility. Furthermore, it also evaluated the effects of SARS on the systemic risk aspect of airline stocks. The author found that SARS does not affect average returns of airline stocks neither the main stock market index of affected countries by applying multi-level econometric testing to twelve (12) airline stocks listed at stock markets of six (6) SARS affected nations. Moreover, research findings showed that the disease did not have any significant effect on market return volatility except Singapore. It has, however, led to a major boost in the volatility of major airlines' stocks, which may not have resulted in lower equity returns but to greater financial risk factors. Different outcomes were noticed by Chen et al. (2007) while analysing the effect of the SARS outbreak on the performance of the Taiwanese tourism industry measured by the hotel stocks using an event study methodology.

The study found seven (7) publicly traded hotel operators experienced significant drops in revenue and stock values during the SARS outbreak period. Chen et al. (2009) also conducted an event study on the Taiwanese capital market to identify comparative impact scenario of the SARS outbreak on multiple industry segment. The study showed that the pandemic influences the tourism, wholesale and retail industries negatively, but it has had a positive effect on the stock prices linked to the biotechnology sector in Taiwanese stock exchange (TSE). Similarly, Wang et al. (2013) considerably extend the research context by studying the impact of several other major contagious diseases such as ENTEROVIRUS 71, DENGUE FEVER, SARS and H1N1 on the performance of biotechnology industry listed in TSE in terms of stock value. They have identified significant upward surge in the market value of biotechnology stocks in the initial stage of contamination however, adjusted later. Identical findings have also shown by Chong et al. (2010) in different market context, Chinese stock exchanges where, significant abnormal increases in pharmaceutical stocks price caused by SARS pandemic were seen while tourism stocks experienced decline in value.

Pendell and Cho (2013) examined the effects of five foot-and-mouth disease (FMD) spreads on the share value of 18 different firms in South Korea between 2000 and 2010, from five different industry segments. They showed that five outbreaks in Korea triggered both anticipated and unanticipated share market responses to specific firms in various industries. Market reactions to the FMD breakouts appeared more incremental than immediate. Besides, the FMD outbreaks tend to increase the volatility of the daily returns where the smaller firms confronted the biggest volatility changes.

Jiang et al. (2017) tried to analyse the association between the daily registered cases of human avian influenza A (H7N9) and selective sector-based indices in Chinese stock exchanges. They have identified that there has been a negative relationship exists between the number of reported new cases and the starting value of the Shanghai Composite Index and closing value of the H7N9 influenza sector index. Furthermore, Funck and Gutierrez (2018) studied the effect of Ebola news reports on capital markets in the US by analysing daily trade data for Ebola-impacted industry stocks, such as airlines, cruise ships, groceries, pharmaceuticals and restaurants, which were highly mentioned in the media. The analysis revealed that the overall negative news reports of Ebola have no influence on aggregate stock return, but specific industry portfolios are significantly affected by both the favourable and unfavourable news reports of Ebola.

The maximum and final effect of the COVID-19 pandemic has yet to be fully discovered as the pandemic is still persisting in many parts of the world and countries are still drastically decreasing economic and financial activities. However, most analysts have attempted to capture the immediate effects on the financial markets of the deadly coronavirus.

Baker et al. (2020b) estimated, through content analysis, the impact of daily reported COVID-19 cases and fatalities on the volatility of the Dow Jones index returns. The study established that COVID-19 has a much greater effect on stock market fluctuation than other related viral infections, including Spanish flu and Ebola. Previous infectious diseases, in fact, have left only modest impressions on the U.S. capital market. The study also indicates that the possible causes of the unparalleled intense reactions of U.S. financial markets to the COVID-19 pandemic compared to previous pandemics are governmental restrictions on economic activities and voluntary social isolation. Onali (2020) also tried to examine how the number of COVID-19 cases and fatalities in states that were primarily affected (such as the U.K., China, Spain, Iran, France and Italy) impacted the return and volatility of the U.S. share market's Dow Jones and S&P 500 indexes. The results suggested that new cases and deaths of COVID-19 did not impact the return on the U.S. stock market and in all six countries, except China. However, the VAR models showed that the number of reported fatalities in Italy and France had a negative impact on Dow Jones' returns but had a positive effect on volatility.

Study by Al-Awadhi et al. (2020) also provided evidence that all companies listed in the Shanghai Stock Exchange and Hang-Seng stock exchange composite index have a large negative effect on stock value. The results further show that the information technology (IT) and pharmaceutical industries outperform than others during the epidemic. In their analysis on the same market, similar results were also given by Liew and Puah (2020) that certain sectoral stocks proved to be COVID-19 pandemic resistant. However, Aravind and Manojkrishnan (2020) observed substantial negative returns experienced by listed pharmaceutical companies in India during pandemic. A recent study in context of Bangladesh, Adnan et al. (2020) showed that, first domestic detection of COVID-19 significantly affect stock market return and there has been no broader industrial difference between financial and non-financial or even manufacturing or service, however, they did not exhibit the specific sectoral performance such as IT and pharmaceutical. Additionally, Nguyen (2020) has expanded the results by demonstrating that the reaction of investors to COVID-19 is dissimilar across organisations and regions. They showed that, in all countries except the U.S., Japan and Italy; communications, consumer goods, medical care, IT and infrastructure performed better compared to other industries, while the energy sector has suffered most in U.S. and Japan. Similarly, He, Sun et al. (2020) showed that the COVID-19 pandemic has a serious effect on China's traditional industries, such as logistics, mining, power and energy, and climate. On the other side, it has provided opportunities for the growth of the engineering, information technology, education and healthcare services reacted to the pandemic positively.

An interesting observation was presented by Ru et al. (2020) when analysing the stock exchange reactions of 65 nations to both SARS and COVID-19. They concluded that while all economies have responded negatively to both diseases, countries with previous SARS experience have been less affected than countries without previous SARS experience. In general, it can be argued that outbreak of infectious diseases most often impacts investor behaviour in the capital market by influencing market confidence, which eventually influences equity prices. Moreover, the reactions are diverse between industry segments.

METHODOLOGY

As clarified by Fama et al. (1969), event studies may provide a good picture of the intensity at which prices are changed to information. Investigating the equity prices around the dates of the incident will also put focus on the properties of the market response to the announcement and, same time, the market efficiency. This study adopted the event study methodology (ESM) to evaluate the response of the stock market (such as Dhaka stock exchange) to the first official announcement of the case of COVID-19 in Bangladesh. In prior and contemporary seminal studies, ESM has been widely adopted to assess the impact of a specific case on accounting, finance and economic research (such as Nippani & Washer, 2004; Hasan et al., 2017; Ibrahim et al., 2019; He, Liu et al., 2020, Huo & Qiu, 2020; Singh et al., 2020).

Data, Event Period and Estimation Window

The study sample in this research is from the Dhaka Stock Exchange (DSE) and comprises of 314 listed companies. The individual stock returns of the companies and detailed market returns come from the archive of the DSE. This analysis uses the regular closing stock prices of all sectors other than the debentures and mutual funds. DSE general index (DSEX) is used as the market performance standard. The analysis divided the overall sample into six separate sub samples, such as manufacturing (195) versus service (118) and financial (99) versus non-financial (214). In order to scrutinise the outbreak announcement effect, the study further subdivides the manufacturing industry into pharmaceuticals (25) and non-pharmaceuticals manufacturing firms (167) and the service industry into IT and telecommunications firms (10) versus non-IT and telecommunication firms (103).

The official confirmation by the Institute of Epidemiology, Disease Control and Research (IEDCR) of the Government of Bangladesh (GoB) of the first case of COVID-19 infections in Bangladesh on 8 March 2020 is recognised to be the exact event date used in this study and the event period is considered to be 21 trading days covering the period from 23 February 2020 to 23 March 2020. This short-term influence of the COVID-19 outbreak on stock market returns has been examined in many recent studies (Nippani & Washer, 2004; Chen et al., 2007; Wang et al., 2013; Chen et al., 2009; Ichev & Marinč, 2018). The estimation window is 250 trading days from day 260 to day 10, (shown in Figure 1) before the day of the event when news about the COVID-19 circulated on the stock exchange (MacKinlay, 1997). The estimation window starts 31 January 2019, and ends 20 February 2020).

Measuring Abnormal Returns

Until an unexpected return can be calculated, the models designed to produce expected returns must be specified. Various methods have been developed, tested and/or applied in practice to measure the typical rate of return and then to produce abnormal return estimates (Peterson, 1989). Here, it is very popular to use more than one standard model to obtain normal returns in case analysis studies, since it enables the robustness of the results to be calculated according to model estimation (Banz, 1981; Kliger & Gurevich, 2014). This research is focused on three general models of generating normal ex-ante returns, as discussed previously in groundbreaking literature (Brown & Warner, 1980; MacKinlay, 1997; Strong, 1992). The models are: (i) mean adjusted returns, (ii) market adjusted returns, and (iii) market model. The ability of the three approaches to accurately forecast the presence of unusual performance is quite consistent argued by Dyckman et al. (1984), although they demonstrated a small bias for the market model. Similarly, Brenner (1979) and Klein and Rosenfeld (1987) both agreed that it is justifiable to exercise multi models.

Mean Adjusted Return Model (MAR)

The mean adjusted return model (MAR) assumes that for a given stock *i* the ex-ante normal return is equal to the simple mean return of the daily yield of the stock *i* in the estimation process, which may differ between stocks. The abnormal return of AR_{it} (Equation 1) is proportional to the residual sum after the normal return has been removed from the actual observed return of R_{it} (Ahern, 2009; Masulis, 1980).

$$AR_{it} = R_{it} \ldots \bar{R}_i \tag{1}$$

where AR_{it} is the abnormal return; is the simple average of security i's average return in the estimation period and R_{it} is the return of security i in period t.

The measurement of these returns R_{it} is calculated as follows:

$$R_{it} = \ln \frac{P_t}{P_{t-1}} \tag{2}$$

where R_{it} is individual stock return, P_t is current price, $P_{t\text{-}1}$ is prior day price.

Although the method of constant mean return is certainly the simpler solution, Klein and Rosenfeld (1987) argued that when a bull or bear market happens on the event day, the MAR model has a significant deviation.

Market Return Model (MRM)

The MRM assumes that the usual return on all securities is the return on the market as determined by a broad stock market index such as the U.S. S&P 500 and U.K. FTSEALL (Cable & Holland, 1999). This methodology takes market-wide adjustments into account, unlike the mean adjusted return process (Kothari & Warner, 2007). The abnormal return volatility (AR_{it}) is the difference between the return on the sample stock (R_{it}) and the corresponding return on the market index (R_{mt}) (see Equation 3).

$$AR_{it} = R_{it} - R_{mt} \tag{3}$$

where R_{mt} is the market portfolio/index return on day t.

Market Model (MM)

Market models are the most widely used and have superior predictive power (Sharpe, 1963). This method takes into consideration all market-wide variables and each security's systemic risk (Brenner, 1979). Compared to previously mention simpler approaches, it uses a more advanced modelling approach to equity returns by forecasting linear correlations between securities and existing market portfolio returns (Ahlgren & Antell, 2012) (see Equation 4).

$$E_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{4}$$

where E_{it} is the expected return of stock i on day t; R_{mt} is the market return at period t; α_i and β_i are the model parameters and $\mathcal{E}_{it}$ is the error term.

The abnormal return (AR) for stock i on day t is defined as:

$$AR_{it} - R_{it} - E(R_{it}) \tag{5}$$

where AR_{it} is the abnormal return of stock *i* on day *t*; $E(R_{it})$ is expected return.

This paper also measures the Average of Abnormal Returns (AARs) (Equation 6) and cumulative value of AARs (CAARs) (Equations 7 and 8), which is predicted to reflect the aggregate market response.

$$AAR_t = \frac{1}{N_t}\sum_{i=1}^{N} AR_{it} \tag{6}$$

where ARR_t is the estimated AAR in period *t*, AR_{it} is stock *i*'s estimated AR at period *t* and *N* is the number of observations.

$$CAR_{T1,T2} = \sum_{T1}^{T2} AR_{it} \tag{7}$$

where $CAR_{\text{T1, T2}}$ is the cumulative abnormal return from period T1 to T2.

$$CAAR_{(T1,T2)} = \frac{1}{N}\sum_{i=1}^{N} CAR_{it} \tag{8}$$

Statistical Significance Measures

This study used numerous test statistics that include both parametric and non-parametric test statistics, instead of relying on single statistical test statics, to ensure that the experiments are robust. The three parametric test-statistics, namely, time-series t-test (shown in Equation 9), cross-sectional t-test or crude dependence test (shown in Equation 10) (Brown & Warner, 1980; 1985) and standardised cross-sectional test (shown in Equation 11) (Boehmer et al., 1991) have been implied to test for the significance of CAAR over the three event windows. To test the importance of CAARs, the two non-parametric test statistics, namely generalised sign-test (shown in Equation 13) (Cowan, 1992), Corrado rank-test (see Equation 12) (Corrado, 1989; Corrado & Zivney, 1992), were carried out.

$$T_{time} = \frac{CAAR_t}{\sqrt{(t_2 - t_2 + 1) - \sigma AAR_t}} \tag{9}$$

where σAAR_t is the standard deviation across firms at time *t*.

$$T_{cross} = \frac{CAAR_{(t1,t2)}}{\sigma CAAR_{t1,t2}} \tag{10}$$

$$T_{Boehmer\ et\ al.} = \frac{\overline{CSAR}_{(t1,t2)}}{S(\overline{CSAR})} \tag{11}$$

where CSAR is the average cumulative standardised abnormal returns.

$$T_{Corrado} = \frac{1}{\sqrt{N}} \sum \frac{(U_{i,t} - 0.5)}{S(U)} \tag{12}$$

$$t_{gs} = \frac{P_0^+ - P_{est}^+}{\sqrt{P_{est}^+ (1 - P_{est}^+)/N}} \tag{13}$$

where P_{est}^+ is the ratio of positive CAR over the estimation window.

This research further aims to determine whether there is a major gap between the price reactions of companies in the industrial and utility sectors and between firms in the financial and non-financial sectors. This research uses the parametric t-test of two samples (also known as the Welch t-test) (see Equation 14) and the non-parametric Mann-Whitney U test (Bowman, 1983) (shown in Equation 15) to check whether there is a substantial difference between the groups.

Test statics for two sample t-test (also known as Welch's t-test) is:

$$t = \frac{\overline{x_1} - \overline{x_2} - d}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \tag{14}$$

where $\bar{x}_1$ = sample average of group 1; S_1 = sample standard deviation of group 1; n_1 = sample size of group 1.

$$Z = \frac{U - E(U)}{\sigma_u} \tag{15}$$

RESULTS AND DISCUSSION

Average abnormal return (AAR) is seen in Table 1 for all listed companies in two separate return models for 10 days pre- and post-event windows. The empirical findings indicate that, both models produced substantially negative abnormal returns on event day 0, while statistically significant (99%) overall positive abnormal returns were generated on days –1, –3 and –4. However, the return became substantially negative on day –2 in MAR and statistically irrelevant in MM. The post facto market response was also statistically significant (99%) with negative AAR at day 1 in MAR. However, the market reversed sharply on day 2 with a noteworthy strong AAR at 99% significance level, notable in both models. Nevertheless, in all return models, the market again significantly produced negative ARR on day 4, 5, 6, 7 and 9, which could be represented as the persistent impact of COVID-19 on the capital market.

Table 1
Market reaction to COVID-19 exhibiting on overall stock return

Model	Date	AAR	Pos: Neg test	t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
MM	(–10 … –10)	–0.0139	83:231	–8.62***	–8.59***	–1.01	–1.13	–7.78***
MAR		–0.0134	86:228	–8.32***	–8.30***	–0.98	–1.11	–7.77***
	(–9 … –9)	–0.0043	118:196	–2.66***	–2.93***	–0.44	–0.52	–3.83***
		–0.0036	126:188	–2.23**	–2.48**	–0.40	–0.47	–3.26***
	(–8 … –8)	0.0075	201:113	4.67***	5.48***	0.49	0.60	5.54***
		0.0079	205:109	4.91***	5.72***	0.51	0.63	5.66***
	(–7 … –7)	–0.0081	99:215	–5.04***	–5.71***	–0.77	–0.72	–5.98***
		–0.007	109:205	–4.37***	–4.92***	–0.694	–0.643	–5.176***
	(–6 … –6)	–0.0127	64:250	–7.86***	–9.86***	–1.25	–1.18	–9.93***
		–0.012	78:236	–7.204***	–9.09***	–1.175	–1.124	–8.676***
	(–5 … –5)	–0.0231	55:259	–14.32***	–15.49***	–1.80	–1.72	–10.95***
		–0.022	59:255	–13.62***	–15.19***	–1.768	–1.697	–10.820***
	(–4 … –4)	0.0134	250:64	8.31***	8.57***	1.08	1.25	11.07***
		0.013	252:62	8.02***	8.30***	1.061	1.221	10.965***
	(–3 … –3)	0.0160	230:84	9.92***	9.20***	1.14	1.25	8.82***
		0.015	232:82	9.56***	8.92***	1.114	1.237	8.708***
	(–2 … –2)	–0.0133	86:228	–8.25***	–8.39***	–1.15	–1.10	–7.45***
		–0.012	93:221	–7.71***	–7.83***	–1.097	–1.058	–6.982***
	(–1… –1)	–0.0022	123:191	–1.39	–1.32	–0.27	–0.38	–3.27***
		–0.002	124:190	–1.171	–1.099	–0.252	–0.371	–3.483***
	(0 … 0)	–0.0317	35:279	–19.70***	–18.75***	–2.24	–2.17	–13.20***
		–0.031	45:266	–18.69***	–17.81***	–18.11	–2.263	–12.097***
	(1 … 1)	–0.0822	05:309	–51.03***	–41.86***	–5.22	–3.25	–16.59***
		–0.078	17:297	–48.07***	–49.16***	–5.442	–3.288	–16.916***
	(2 … 2)	0.0491	298:16	30.51***	29.94***	3.62	2.78	16.50***
		0.046	300:14	28.78***	30.13***	3.512	2.738	16.383***
	(3 … 3)	0.0221	270:44	13.71***	15.39***	1.85	1.78	13.33***
		0.021	273:41	12.85***	14.45***	1.746	1.701	13.336***
	(4 … 4)	–0.0300	47:267	–18.61***	–16.56***	–1.91**	–2.04**	–11.85***
		–0.028	53:261	–17.54***	–16.004***	–1.864**	–1.99**	–11.498***
	(5 … 5)	–0.0563	15:299	–34.94***	–31.46***	–3.97***	–2.93***	–15.46***
		–0.054	22:292	–33.19***	–32.15***	–3.91***	–2.95***	–15.900***

(*continued on next page*)

Table 1: (*continued*)

Model	Date	AAR	Pos: Neg test	t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
	(6 … 6)	–0.0609	17:297	–37.82***	–29.92***	–3.49***	–2.85***	–15.24***
		–0.057	23:290	–35.58***	–31.49***	–3.50***	–2.88***	–15.561***
	(7 … 7)	–0.0565	23:291	–35.11***	–13.28***	–2.00***	–2.79***	–14.79***
		–0.053	38:276	–33.09***	–12.75***	–1.94**	–2.82***	–14.997***
	(8 … 8)	0.1365	305:09	84.73***	32.90***	4.16***	3.22***	17.29***
		0.129	310:04	79.97***	35.29***	4.23***	3.264***	17.512***
	(9 … 9)	–0.0069	123:191	–4.31***	–2.91***	–0.45	–0.49	–3.27***
		–0.007	124:190	–4.17***	–2.82***	–0.441	–0.481	–3.483***
	(10 … 10)	0.0057	244:70	3.56***	5.08***	0.62	0.80	10.40***
		0.005	252:62	3.24***	4.62***	0.581	0.729	10.965***

Note: Number of samples is 314 listed firms in Dhaka stock exchange (DSE), Bangladesh. 10%, 5% and 1% significant level = *, ** and ***, consecutively.

In this analysis, multiple event windows were used to see the market reactions by measuring Cumulative Average Abnormal Returns (CAARs) to the arrival of the COVID-19 event at the stock price of 314 DSE listed companies. The event windows are pre (–1, –1), post (0, +1) and event day (0, 0). The reactions of CAARs to the arrival of the COVID-19 are presented in Table 2. The initial response to the first announcement was substantially negative. The first case of COVID-19 tends to dramatically shift investor sentiment and trigger negative CAARs on the first day after its release. The findings exhibits that the COVID-19 has a significant effect on stock return which is in the line with efficient market hypothesis (EMH), which suggests that capital market would react to any new information (Fama, 1970), therefore the news of detection and transmission of the pandemic believed to create impact in the global as well as local capital markets. This result is quite consistent with the earlier findings by Chen et al. (2009), Al-Awadhi et al. (2020), and Rahman et al. (2020) with different market context.

Table 2
CAAR of overall market

Model		MAR			MM			MRM	
Windows	–1…–1	0…0	0…+1	–1…–1	0…0	0…1	–1…–1	0…0	0…+1
CAAR	–0.22	–3.06	–10.88	0.35	–0.59	–0.79	0.26	–0.91	–2.09
Test statistics									
t-test time-series	–1.33	$–18.7^{***}$	$–46.9^{***}$	2.30^{**}	$–3.8^{***}$	$–3.7^{***}$	1.70^{*}	$–5.95^{***}$	$–9.62^{***}$
t-test cross-sectional	–1.25	$–17.8^{***}$	$–44.7^{***}$	2.04^{**}	$–3.5^{***}$	$–3.1^{***}$	1.5	$–5.30^{***}$	$–8.59^{***}$
Boehmer test	$–2.22^{**}$	$–18.1^{***}$	$–43.2^{***}$	1.3	$–3.3^{***}$	$–2.8^{***}$	0.82	$–4.68^{***}$	$–6.78^{***}$
Corrado rank test	–0.43	$–2.26^{**}$	$–4.09^{***}$	0.09	–1.24	–1.14	0.03	$–1.65^{*}$	$–3.04^{***}$
Sign test	$–3.48^{***}$	$–12.1^{***}$	$–6.86^{***}$	–0.2	$–2.93^{***}$	–1	0.19	$–3.45^{***}$	$–5.27^{***}$

Note: Number of samples is 314 listed firms in Dhaka stock exchange (DSE), Bangladesh. 10%, 5% and 1% significant level = *, ** and ***, consecutively.

In order to test the robustness of the results, this study has further divided the total sample into four major sub samples: financial vs. non-financial firms and manufacturing vs. services industries. Table 3 presents the CAAR for financial vs. non-financial firms display that in pre event window (–1, –1), Financial industry's stock return were negative and statistically significant in all return models. However, variability in return as well as statistical significance has been observed in the post event phase (0, 1), where, MAR and MRM showed statistically significant pessimistic return, the MM however exhibited insignificant negative return. In terms of test statics, parametric test statics are showing more unified results. Overall, it is observed that the announcement event window (–1, –1) has negatively affected the financial stocks in DSE quite significantly which is well verified in all return and statistics.

When evaluating the effect of the announcement on the aggregate return of non-financial stocks, the pre-event span revealed a totally different scenario. For all return models except MAR, the overall pre-event (0, 0) CAAR was positive and statistically significant. A substantial overall negative market return has been produced by the actual event window (0, 0). Moreover, unlike financial companies, non-financial firms in all measurement models have experienced a statistically significant negative return. In aggregate, it can reasonably be said that the non-financial sector was more exposed to the first COVID-19 detection announcement.

Table 3
CAAR for financial versus non-financial firms

Industry	Model	Windows	CAARs (%)	Test statistics				
				t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
FI	MAR	(–1…–1)	–1.11	–3.84***	–5.24***	–5.29***	–0.94	–5.24***
		(0...0)	–3.12	–10.81***	–14.02***	–15.50***	–2.40**	–8.89***
		(0...1)	–9.97	–24.39***	–24.18***	–26.25***	–3.91***	–9.71***
	MM	(–1...–1)	–0.57	–2.10**	–2.77***	–2.50**	–0.70	–2.50**
		(0...0)	–0.76	–2.83***	–3.40***	–3.48***	–0.87	–2.09**
		(0...1)	–0.35	–0.93	–0.76	–0.10	–0.24	–0.26
	MRM	(–1…–1)	–0.60	–2.20**	–2.79***	–2.58**	–0.74	–2.44**
		(0...0)	–0.94	–3.46***	–4.22***	–4.14***	–1.11	–2.23**
		(0...1)	–1.10	–2.87***	–2.73***	–1.34	–0.98	–1.62
NFI	MAR	(–1...–1)	0.23	1.14	1.00	0.00	–0.13	–0.53
		(0...0)	–3.01	–15.08***	–13.08***	–13.02***	–1.94*	–8.51***
		(0...1)	–11.26	–39.92***	–37.77***	–34.96***	–3.72***	–13.73***
	MM	(–1...–1)	0.81	4.38***	3.57***	2.69***	0.50	1.58
		(0...0)	–0.47	–2.54**	–2.12**	–1.93*	–0.78	–2.00**
		(0...1)	–0.91	–3.49***	–2.93***	–3.05***	–0.97	–0.90
	MRM	(–1...–1)	0.69	3.70***	3.01***	2.21***	0.44	2.02**
		(0...0)	–0.88	–4.71***	–3.81***	–3.27***	–1.11	–2.53**
		(0...1)	–2.50	–9.48***	–8.37***	–7.06***	–2.59**	–5.15***

Note: Financial industry comprises of 99 listed firms in banking, insurance and non-banking financial institutions and non-financial firms comprises of 215 listed firms. 10%, 5% and 1% significant level = *, ** and ***, consecutively.

Table 4 displays the aggregate market reaction of manufacturing firms and service firms to the first COVID-19 announcement expressed in CAAR in three separate event windows. For each section, the results are very close. Due to the COVID announcement on the event day (0, 0), which extends to the next event phase (0, 1), both manufacturing and non-manufacturing firms have encountered a substantially negative market return. However, the pre event (–1, –1) returns are different for each segment, where manufacturing firms showed positive average return before announcement, negative average returns were experienced by services firms. Overall, both the industry segments have experienced statistically significant abnormal negative return due to first COVID-19 identification.

Table 4
CAAR for manufacturing firms (MNF) versus services firms (SER)

Industry	Model	Windows	CAAR (%)	Statistics				
				t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
MNF	MAR	(–1…–1)	0.24	1.15	1.04	0.20	–0.08	0.02
		(0…0)	–2.91***	–14.00***	12.12***	–12.03***	–1.92*	–8.15***
		(0…1)	–11.22***	–38.11***	–36.15***	–33.05***	–3.71***	–13.17***
	MM	(–1…–1)	0.70	3.60***	3.02***	2.34***	0.52	2.33**
		(0…0)	–0.78	–4.02***	–3.25***	–2.83***	–1.02	–2.27**
		(0…1)	–2.46***	–8.93***	–7.91***	–6.71***	–2.57***	–5.00***
	MRM	(–1…–1)	0.82	4.23***	3.55***	2.80***	0.57	1.89*
		(0…0)	–0.40	–2.05**	–1.69*	–1.59	–0.71	–1.70*
		(0…1)	–0.96	–3.50***	–2.96***	–3.10***	–0.97	–1.12
SER	MAR	(–1…–1)	–0.93	–3.49***	–3.91***	–4.70***	–0.92	–5.58***
		(0…0)	–3.27	–12.25***	–14.76***	–16.31***	–2.45***	–9.14***
		(0…1)	–10.23	–27.11***	–26.26***	–28.54***	–4.01***	–10.45***
	MM	(–1…–1)	–0.38	–1.51	–1.61	–2.03**	–0.74	–2.63**
		(0…0)	–0.85	–3.41***	–3.98***	–3.86***	–1.11	–2.44**
		(0…1)	–0.36	–1.03	–0.84	–0.20	–0.39	0.00
	MRM	(–1…–1)	–0.43	–1.71*	–1.78*	–2.19**	–0.79	–2.54**
		(0…0)	–1.09	–4.37***	–4.91***	–4.58***	–1.41	–2.54**
		(0…1)	–1.38	–3.89***	–3.59***	–2.13**	–1.38s	–1.98*

Note: Manufacturing industry comprises of 194 listed firms and Service firms comprises of 120 listed firms. 10%, 5% and 1% significant level = *, ** and *** consecutively.

The significance of the CAAR variations between industry segments is provided in Tables 5 and 6 (i.e., financial versus non-financial firms and manufacturing versus non-manufacturing firms). The difference is marginal in the actual event window (0, 0), but there was a substantial statistical difference between industry segments in the pre-event and post-event windows, suggesting that the negative effect of the first COVID detection announcement was primarily restricted to the financial and non-financial sectors as well as to the manufacturing and service sectors. In addition, it was observed that the returns of non-financial firms and manufacturing firms were more negatively affected by the announcement in the event and post-event period, taking into account the positive CAARs prior to the event.

Table 5
Difference of CAARs between financial firms and non-financial firms

Model		MAR			MM			MRM		
Windows		–1…–1	0…0	0…1	–1…–1	0…0	0…1	–1…–1	0…0	0…1
CAAR	FI	–0.011	–0.031	–0.099	–0.005	–0.007	–0	–0.006	–0.009	–0.011
	NFI	0.002	–0.03	–0.112	0.008	–0.004	–0.01	0.006	–0.008	–0.025
Difference of CAARs		–0.013	–0.001	0.012	–0.013	–0.002	0.005	–0.012	0	0.014
Test statistics										
Welch's t-test		–3.7***	–0.31	2.48**	–3.8***	–0.81	1.03	–3.49***	–0.17	2.69**
p-value		0	0.75	0.01	0	0.42	0.3	0.000	0.86	0.01
Wilcoxon rank sum test		–3.1***	0.18	2.37**	–3.3***	–0.17	1.18	–2.97***	0.35	2.58***
p-value		0	0.85	0.01	0	0.85	0.23	0	0.72	0.01

Note: 10%, 5% and 1% significant level = *, ** and *** consecutively. FI = Financial Firms, NFI = Non-Financial firms

Table 6
Difference of CAARs between manufacturing firms and service firms

Model		MAR			MM			MRM		
Windows		–1…–1	0…0	0…1	–1…–1	0…0	0…1	–1…–1	0…0	0…1
CAAR	MI	0.002	–0.03	–0.11	0.008	–0.004	–0.01	0.007	–0.007	–0.024
	NMI	–0.009	–0.03	–0.10	–0.003	–0.01	–0.00	–0.004	–0.011	–0.014
Difference of CAARs		0.011	0.003	–0.009	0.012	0.004	–0.01	0.011	0.003	–0.01
Welch's t-test		3.52***	1.07	–1.99**	3.63***	1.42	–1.1	3.37***	0.94	4.63***
p-value		0	0.28	0.04	0	0.15	0.27	0	0.34	0
Wilcoxon rank sum test		3.18***	0.51	–1.92*	3.27***	0.74	–1.08	3.01***	0.31	4.43***
p-value		0	0.6	0.05	0	0.45	0.27	0	0.75	0

Note: 10%, 5% and 1% significant level = *, ** and ***, consecutively. MNF = manufacturing, SER = service firms.

Table 7 represents the CAAR of pharmaceuticals firms and other non-pharmaceuticals manufacturing firms listed in the DSE. Apart from the MRM, other two models MAR and MM generate significant negative abnormal return for pharmaceuticals firms which are indifferent with non-pharmaceuticals firms. However, it was expected that pharmaceutical firms would perform better than that of other non-pharmaceuticals industry as found by earlier studies represented by

Al-Awadhi et al. (2020) and Liew and Puah (2020) but quite similar to the findings of Aravind and Manojkrishnan (2020) which was carried on similar market context (i.e., India); which also suggests that sectoral reactions are different in diverse market context as suggested by Nguyen (2020).

Table 7
CAAR for pharmaceutical firms versus all other manufacturing firms (non-pharmaceuticals)

Industry	Model	Windows	CAAR	Test statistics				
				t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
Pharmaceuticals (PH)	MAR	(–1…–1)	0.004	0.809	0.615	0.037	–0.147	–0.302
		(0...0)	–0.027	–5.137***	–3.811***	–1.355	–1.344	–2.706***
		(0...1)	–0.111	–15.15***	–11.42***	–3.99***	–3.09***	–4.710*
	MRM	(–1…–1)	–0.006	–0.999	–0.791	–0.251	–0.006	0.886
		(0...0)	0.009	1.605	1.295	0.305	0.220	0.486
		(0...1)	–0.026	–3.288***	–2.647**	–0.782	–0.932	–1.117
	MM	(–1…–1)	0.004	0.731	0.561	0.022	–0.166	–0.292
		(0...0)	–0.028	–5.494***	–4.29***	–1.511	–1.512	–3.098***
		(0...1)	–0.118	–16.167***	–12.89***	–4.91***	–3.21***	–4.701***
Non-pharmaceuticals (NPH)	MAR	(–1…–1)	0.002	0.925	0.849	0.005	–0.089	–0.535
		(0...0)	–0.029	–12.833***	–11.095***	–1.581	–1.81***	–7.812
		(0...1)	–0.112	–34.448***	–33.38***	–4.37***	–3.47***	–12.30***
	MRM	(–1…–1)	0.006	2.634**	2.541**	0.299	0.238	1.709
		(0...0)	–0.009	–3.657***	–3.329***	–0.405	–0.569	–3.254***
		(0...1)	–0.028	–8.062***	–8.209***	–0.988	–1.317	–5.891***
	MM	(–1…–1)	0.002	–0.054	1.032	0.961	0.032	0.101
		(0...0)	–0.028	–12.36***	–10.854***	–1.529	–1.799*	–8.108***
		(0...1)	–0.108	–33.09***	–29.553***	–4.241**	–3.44***	–11.98***

Note: Pharmaceuticals industry comprises of 25 listed firms and non-pharmaceuticals firms comprises of 167 listed firms. 10%, 5% and 1% significant level = *, ** and ***, consecutively.

The study also examined if there is any difference of CAARs between pharmaceuticals firms and non-pharmaceuticals manufacturing firms in Table 8 to check the robustness of the results. Interestingly, it is found that there is no significance difference between CAAR. Therefore, it can be argued that there has been no sectoral abnormal return difference to the detection of COVID-19.

Table 8
Difference in CAAR pharmaceuticals versus non-pharmaceuticals manufacturing firms

Model		MAR			MM			MRM		
Windows		–1…–1	0...0	0...1	–1...–1	0...0	0...1	–1…–1	0...0	0...1
CAAR	PH	0.004	–0.03	–0.11	0.004	–0.03	–0.12	–0.01	0.01	–0.03
	NPH	0.002	–0.03	–0.11	0.006	–0.01	–0.03	0.002	–0.03	–0.11
Difference of CAAR		0.002	0.003	0.001	–0.003	–0.02	–0.09	–0.01	0.04	0.08
Welch's t-test		–0.66	0.38	0.19	–0.61	0.63	0.85	–0.76	0.28	0.05
p-value		0.51	0.71	0.84	0.54	0.53	0.39	0.45	0.78	0.96
Wilcoxon rank sum test		–0.55	–0.19	–0.19	–0.52	0.11	1.03	–0.57	–0.21	–0.31
p-value		0.58	0.85	0.84	0.6	0.92	0.3	0.57	0.83	0.76

Note: 10%, 5% and 1% significant level = *, ** and ***, consecutively. PH = pharmaceuticals, NPH = non-pharmaceuticals.

Earlier literatures (such as Baek et al., 2020; Haroon & Rizvi, 2020; He et al., 2020; Xiong et al., 2020) analysed the specific industry response in capital market to the COVID-19 pandemic, largely found that, the ICT and telecommunication sector performed better during pandemic. However, this study exhibited in Table 9 that the IT and telecommunications sector created substantial negative CAAR on the event day (0) and post event window (0, 1) which is statistically significant in all return models although the sector had positive return in pre event window (–1).

Table 9
CAAR for IT and telecommunication versus other non-manufacturing (non-IT and telecom)

Industry	Model	Windows	CAAR	Statistics				
				t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
IT and Telecom (ITT)	MAR	(–1…–1)	0.001	0.143	0.112	–0.269	–0.481	–0.951
		(0…0)	–0.041	$–4.739^{***}$	$–6.171^{***}$	$–2.676^{**}$	$–2.07^{**}$	$–2.22^{**}$
		(0...1)	–0.118	$–9.643^{***}$	$–9.475^{***}$	$–4.65^{***}$	$–3.34^{***}$	$–2.86^{***}$
	MRM	(–1…–1)	0.006	0.621	0.534	0.030	–0.149	–1.031
		(0…0)	–0.020	$–2.191^{**}$	$–2.962^{***}$	–1.154	–1.284	$–2.299^{**}$
		(0...1)	–0.034	$–2.579^{**}$	$–2.633^{**}$	–1.026	–1.422	–1.665
	MM	(–1…–1)	0.001	0.054	0.042	–0.311	–0.527	–0.928
		(0…0)	–0.045	$–5.137^{***}$	$–5.945^{***}$	$–2.68^{**}$	$–2.08^{**}$	$–2.20^{**}$
		(0...1)	–0.132	$–10.766^{***}$	$–7.971^{***}$	$–4.25^{***}$	$–3.34^{***}$	$–2.836^{**}$

(*continued on next page*)

Table 9: (*continued*)

Industry	Model	Windows	CAAR	Statistics				
				t-test time-series	t-test cross-sectional	Boehmer test	Corrado rank test	Sign test
Non-IT and Telecom (NITT)	MAR	(–1…–1)	–0.011	–4.094***	–4.798***	–0.942	–0.849	–5.08***
		(0…0)	–0.031	–11.875***	–14.241***	–2.89***	–2.29**	–9.02***
		(0...1)	–0.101	–26.941***	–24.879***	–5.11***	–3.79***	–10.00***
	MRM	(–1…–1)	–0.007	–2.179**	–2.653**	–0.462	–0.335	–2.26**
		(0…0)	–0.010	–3.662***	–4.582***	–0.719	–0.561	–2.66***
		(0...1)	–0.015	–3.856***	–3.766***	–0.368	–0.653	–2.263
	MM	(–1…–1)	–0.011	–4.135***	–4.874***	–0.941	–0.809	–4.782
		(0…0)	–0.032	–12.041***	–14.429***	–2.98***	–2.31**	–9.117
		(0...1)	–0.102	–27.404***	–21.270***	–4.62***	–3.75***	–9.708

Note: IT and telecom industry comprises of 12 listed firms and other non-IT and telecom service firms comprises of 103 listed firms. ITT = IT & Telecom, NITT = Non-IT and Telecom. 10%, 5% and 1% significant level = *, ** and ***, consecutively.

Table 10 shows any potential difference in CAAR between IT and telecommunication firms and other service firms. The result shows that in MAR and MRM model the difference of CAAR in event day (0) were statistically significant at 95% level. However, in market model the difference was insignificant. The difference suggest that investors perceive that IT and telecommunication sector would perform better than other service firms such as banks in pandemic situation due to the limited physical movements (Leventsov et al., 2020).

Table 10

Difference in CAAR between IT and telecom versus other service firms (non-IT and telecom)

Model		MAR			MM			MRM		
Windows		–1…–1	0…0	0…1	–1…–1	0…0	0…1	–1…–1	0…0	0…1
CAARs	ITT	0.004	–0.03	–0.11	–0.01	0.009	–0.026	0.004	–0.03	–0.12
	NITT	0.002	–0.03	–0.11	0.01	–0.009	–0.028	0.002	–0.03	–0.11
Difference of CAARs		0.002	0.003	0.001	–0.01	0.018	0.002	0.001	0	–0.01
Welch's t-test		–1.59	–1.30	1.453	–1.16	0.805	0.22	1.53	1.34	1.53
p-value		0.116	0.195	0.149	0.27	0.423	0.826	0.13	0.18	0.13
Wilcoxon rank sum test		–0.526	1.964***	1.497	–0.79	1.355	0.18	–0.47	1.94**	1.54
p-value		0.596	0.049	0.133	0.43	0.173	0.857	0.64	0.05	0.12

Note: 10%, 5% and 1% significant level = *, ** and ***, consecutively. ITT = IT and Telecoms, NITT = Non- IT and Telecoms.

CONCLUSIONS

A basic and original empirical analysis of the stock market reaction of the capital market of Bangladesh to the COVID-19 pandemic is given in this paper. This research analyses how the stock market in Bangladesh reacted to the uncertainties generated by COVID-19. An overall negative stock market response to the pandemic announcement is found in this research. An event study methodology with three different return models such as constant mean return model, market return model and market model are used to find abnormal return and tested for statistical significance by both parametric and non-parametric test statistics. In addition, this study enquiry market-level developments, so this study split the overall industry into six industry groups, such as financial versus non-financial, service versus manufacturing, pharmaceuticals versus non-pharmaceutical manufacturing and IT and telecommunications versus Non-IT and telecommunications service firms. In order to compare sector specific returns, this study also use the cross-sectional t-test and Mann-Whitney test.

The results of the research showed that the announcement of the first detection of COVID-19 in Bangladesh had a substantial negative impact on stock market returns across all companies and industries. All firms produced statistically significant negative returns for both the event period (0, 0) CAAR and the post-event period (0, 1) CAAR. Moreover, as measured by the statistically significant negative CAAR for the event and post-event era, the non-financial industry was more exposed to the announcement of the first COVID-19 detection. Additionally, no significant statistical variations between industry segments were seen both in the pre-event and post-event windows, suggesting that the negative effect of the first COVID-19 detection announcement was generally restricted to all sectors. The overall findings of the paper indicate that the outbreak of COVID-19 badly affects the output of the emerging and developed economies' stock markets. Because of global instability and aggravated investor panic, the crash of financial markets can partly be due to a pause in economic growth and partly to price pressure. The rapid crash confirms the investor overreaction hypothesis which exhibited the deviation from the basic value of asset prices; thus, this means an obstacle to the equal distribution and disciplinary roles of stock markets (Bondt & Thaler, 1987). Nevertheless, businesses are revising their earnings prospects downwards because of suppressed customer spending. As a result, this leads to a market reassessment of the values of businesses and a significant decrease in equity prices, as seen in this report.

This study results have important implications for decision makers. Taking into account the empirical value of the findings, it can be concluded that these finding will also be very effective in addressing this pandemic issue efficiently for retail and personal investors, investment managers, industrial and financial analysts. There is considerable space for more research into the reactions of investors within and between domestic and regional markets, and attention should be given to investors' confidence and volatility.

REFERENCES

Adnan, A. T. M., Hasan, M. M., & Ahmed, E. (2020). Capital market reactions to the arrival of COVID-19: A developing market perspective. *Economic Research Guardian, 10*(2), 97–121.

Ahern, K. R. (2009). Sample selection and event study estimation. *Journal of Empirical Finance, 16*(3), 466–482. https://doi.org/10.1016/j.jempfin.2009.01.003

Ahlgren, N., & Antell, J. (2012). *Tests for abnormal returns under weak cross-sectional dependence* (Hanken School of Economics Working Paper No. 561). https://doi.org/10.2139/ssrn.1785485

Al-Awadhi, A. M., Al-Saifi, K., Al-Awadhi, A., & Alhamadi, S. (2020). Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance*, *27*, 100326. https://doi.org/10.1016/j.jbef.2020.100326

Alfaro, L., Chari, A., Greenland, A. N., & Schott, P. K. (2020). Aggregate and firm-level stock returns during pandemics, in real time (NBER Working Paper No. 26950). https://doi.org/10.3386/w26950

Aravind, M., & Manojkrishnan, C. (2020). COVID 19: Effect on leading pharmaceutical stocks listed with NSE. *International Journal of Research in Pharmaceutical Sciences, 11*(SPL1), 31–36. https://doi.org/10.26452/ijrps.v11iSPL1.2014

Ashraf, B. N. (2020). Stock markets' reaction to COVID-19: cases or fatalities? *Research in International Business and Finance*, *54*, 101249. https://doi.org/10.1016/j.ribaf.2020.101249

Baek, S., Mohanty, S. K., & Glambosky, M. (2020). COVID-19 and stock market volatility: An industry level analysis. *Finance Research Letters, 37*, 101748. https://doi.org/10.1016/j.frl.2020.101748

Baker, S. R., Bloom, N., Davis, S. J., Kost, K., Sammon, M., & Viratyosin, T. (2020a). The unprecedented stock market reaction to COVID-19. *The Review of Asset Pricing Studies, 10*(4), 742–758. https://doi.org/10.1093/rapstu/raaa008

Baker, S. R., Bloom, N., Davis, S. J., Kost, K. J., Sammon, M. C., & Viratyosin, T. (2020b). The unprecedented stock market impact of COVID-19 (NBER Working Paper No. 26945). Retrieved from https://www.nber.org/papers/w26945

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics, 9*(1), 3–18. https://doi.org/10.1016/0304-405X(81)90018-0

Boehmer, E., Musumeci, J., & Poulsen, A. (1991). On the use of the multivariate regression model in event studies. *Journal of Financial Economics, 30*(2), 253–272. https://doi.org/10.1016/0304-405X(91)90032-F

Bondt, D. W. F., & Thaler, R. H. (1987). Further evidence on investor overreaction and stock market seasonality. *The Journal of Finance, 42*(3), 557–581. https://doi.org/10.1111/j.1540-6261.1987.tb04569.x

Bowman, R. G. (1983). Understanding and conducting event studies. *Journal of Business Finance & Accounting, 10*(4), 561–584. https://doi.org/10.1111/j.1468-5957.1983.tb00453.x

Brenner, M. (1979). The sensitivity of the efficient market hypothesis to alternative specifications of the market model. *The Journal of Finance, 34*(4), 915–929. https://doi.org/10.1111/j.1540-6261.1979.tb03444.x

Brown, S. J., & Warner, J. B. (1980). Measuring security price performance. *Journal of Financial Economics, 8*(3), 205–258. https://doi.org/10.1016/0304-405X(80)90002-1

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics, 14*(1), 3–31. https://doi.org/10.1016/0304-405X(85)90042-X

Cable, J., & Holland, K. (1999). Modelling normal returns in event studies: A model-selection approach and pilot study. *The European Journal of Finance, 5*(4), 331–341. https://doi.org/10.1080/135184799336993

Chen, C. D., Chen, C. C., Tang, W. W., & Huang, B.-Y. (2009). The positive and negative impacts of the SARS outbreak: A case of the Taiwan industries. *The Journal of Developing Areas*, *43*(1), 281–293. https://doi.org/10.1353/jda.0.0041

Chen, M. H., Jang, S. S., & Kim, W. G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: An event-study approach. *International Journal of Hospitality Management, 26*(1), 200–212. https://doi.org/10.1016/j.ijhm.2005.11.004

Chong, T. T. L., Lu, S., & Wong, W. K. (2010). *Portfolio management during epidemics: The case of SARS in China*, SSRN. https://doi.org/10.2139/ssrn.1673671

Corrado, C. J. (1989). A nonparametric test for abnormal security-price performance in event studies. *Journal of Financial Economics, 23*(2), 385–395. https://doi.org/10.1016/0304-405X(89)90064-0

Corrado, C. J., & Zivney, T. L. (1992). The specification and power of the sign test in event study hypothesis tests using daily stock returns. *Journal of Financial and Quantitative Analysis*, *27*(3), 465–478. https://doi.org/10.2307/2331331

Cowan, A. R. (1992). Nonparametric event study tests. *Review of Quantitative Finance and Accounting, 2*(4), 343–358. https://doi.org/10.1007/BF00939016

Dunford, D., Dale, B., Stylianou, N., Lowther, E., Ahmed, M., & De la Torres Arenas, I. (2020, 6 April). Coronavirus: The world in lockdown in maps and charts. *BBC News*. Retrieved from https://www.bbc.com/news/world-52103747

Dyckman, T., Philbrick, D., & Stephan, J. (1984). A comparison of event study methodologies using daily stock returns: A simulation approach. *Journal of Accounting Research*, *22*, 1–30. https://doi.org/10.2307/2490855

Fama, E. F. (1970). Efficient market hypothesis: A review of theory and empirical work. *Journal of Finance, 25*(2), 28–30. https://doi.org/10.2307/2325486

Fama, E. F., Fisher, L., Jensen, M. C., & Roll, R. (1969). The adjustment of stock prices to new information. *International Economic Review, 10*(1), 1–21. https://doi.org/10.2307/2525569

Funck, M., & Gutierrez, J. A. (2018). Has Ebola infected the market: A contagious reaction to a (media) health care crisis? *Journal of Business Strategies*, *22*(8), e21360. Retrieved from https://www.jmir.org/2020/8/e21360/

Goodell, J. W. (2020). COVID-19 and finance: Agendas for future research. *Finance Research Letters*, *35*, 101512. https://doi.org/10.1016/j.frl.2020.101512

Habib, A. (2019, November 08, 2019). China bourse to launch index at DSE: Bid to attract Chinese investors to the secondary market, *The Daily Star*. https://www.thedailystar.net/business/news/china-bourse-launch-index-dse-1824571

Haroon, O., & Rizvi, S. A. R. (2020). COVID-19: Media coverage and financial markets behavior –A sectoral inquiry. *Journal of Behavioral and Experimental Finance*, *27*, 100343. https://doi.org/10.1016/j.jbef.2020.100343

Hasan, M. M., Ibrahim, Y., Olajide, R. J., Minai, M. S., & Uddin, M. M. (2017). Malaysian acquiring firms' shareholders' wealth effect following cross-border acquisition. *Journal of Accounting and Finance in Emerging Economies, 3*(2), 147–158. https://doi.org/10.26710/jafee.v3i2.95

He, P., Sun, Y., Zhang, Y., & Li, T. (2020). COVID-19's impact on stock prices across different sectors: An event study based on the Chinese stock market. *Emerging Markets Finance and Trade, 56*(10), 2198–2212. https://doi.org/10.1080/1540496X.2020.1785865

He, Q., Liu, J., Wang, S., & Yu, J. (2020). The impact of COVID-19 on stock markets. *Economic and Political Studies*, *8*(3), 275–288. https://doi.org/10.1080/20954816.2020.1757570

Huo, X., & Qiu, Z. (2020). How does China's stock market react to the announcement of the COVID-19 pandemic lockdown? *Economic and Political Studies*, *8*(4), 436–461. https://doi.org/10.1080/20954816.2020.1780695

Ibrahim, Y., Minai, M. S., Hasan, M. M., & Raji, J. O. (2019). Agency costs and post cross border acquisition performance of Malaysian acquirers. *International Journal of Business and Society, 20*(3), 870–887.

Ichev, R., & Marinč, M. (2018). Stock prices and geographic proximity of information: Evidence from the Ebola outbreak. *International Review of Financial Analysis, 56*(c), 153–166. https://doi.org/10.1016/j.irfa.2017.12.004

Jiang, Y., Zhang, Y., Ma, C., Wang, Q., Xu, C., Donovan, C., Sun, W. (2017). H7N9 not only endanger human health but also hit stock marketing. *Advances in Disease Control and Prevention, 2*(1), 1–7. https://doi.org/10.25196/adcp201711

Klein, A., & Rosenfeld, J. (1987). The influence of market conditions on event-study residuals. *Journal of Financial and Quantitative Analysis*, *22*(3), 345–351. https://doi.org/10.2307/2330968

Kliger, D., & Gurevich, G. (2014). *Event studies for financial research: A comprehensive guide*. Springer. https://doi.org/10.1057/9781137368799

Kothari, S. P., & Warner, J. B. (2007). Econometrics of event studies. In B. E. Eckbo (Ed.), *Handbook of empirical corporate finance* (pp. 3–36). Elsevier. https://doi.org/10.1016/B978-0-444-53265-7.50015-9

Leventsov, V., Gluhov, V., & Leventcov, A. (2020). Investment attractiveness of the telecommunications economic sector during the coronavirus pandemic. In O. Galinina, S. Andreev, S. Balandin, & Y. Koucheryavy (Eds.), *Internet of things, smart spaces, and next generation networks and systems* (pp. 285–296). Springer. https://doi.org/10.1007/978-3-030-65729-1_24

Liew, V. K. S., & Puah, C. H. (2020). Chinese stock market performance in the time of novel coronavirus pandemic (MPRA working Paper: 100414), University Library of Munich. https://doi.org/10.21203/rs.3.rs-29363/v1

Loh, E. (2006). The impact of SARS on the performance and risk profile of airline stocks. *International Journal of Transport Economics/Rivista Internazionale di Economia dei Trasporti*, *33*(3), 401–422.

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature, 35*(1), 13–39.

Malkiel, B. G., & Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25*(2), 383–417. https://doi.org/10.1111/j.1540-6261.1970.tb00518.x

Masulis, R. W. (1980). The effects of capital structure change on security prices: A study of exchange offers. *Journal of Financial Economics, 8*(2), 139–178. https://doi.org/10.1016/0304-405X(80)90015-X

Mobarek, A., & Keasey, K. (2000). *Weak-form market efficiency of an emerging market: Evidence from Dhaka Stock Market of Bangladesh.* Paper presented at the ENBS Conference, Oslo, Norway, May 2000.

Nguyen, K. (2020). *A coronavirus outbreak and sector stock returns: the tale from the first ten weeks of year 2020*, SSRN. https://doi.org/10.2139/ssrn.3559907

Nippani, S., & Washer, K. M. (2004). SARS: A non-event for affected countries' stock markets? *Applied Financial Economics, 14*(15), 1105–1110. https://doi.org/10.1080/0960310042000310579

Onali, E. (2020). *Covid-19 and stock market volatility*, SSRN. https://doi.org/10.2139/ssrn.3571453

Ortmann, R., Pelster, M., & Wengerek, S. T. (2020). *COVID-19 and investor behavior*, SSRN. https://doi.org/10.2139/ssrn.3589443

Ovi, I. H., & Mahmud, N. (2018). DSE signs strategic partnership agreement with Chinese consortium, *Dhaka Tribune*. Retrieved from https://www.dhakatribune.com/business/stock/2018/05/14/dse-signs-strategic-partnership-agreement-with-chinese-consortium

Pendell, D. L., & Cho, C. (2013). Stock market reactions to contagious animal disease outbreaks: An event study in Korean foot-and-mouth disease outbreaks. *Agribusiness, 29*(4), 455–468. https://doi.org/10.1002/agr.21346

Peterson, P. P. (1989). Event studies: A review of issues and methodology. *Quarterly Journal of Business and Economics*, *28*(3), 36–66.

Phan, D. H. B., & Narayan, P. K. (2020). Country responses and the reaction of the stock market to COVID-19: A preliminary exposition. *Emerging Markets Finance and Trade, 56*(10), 2138–2150. https://doi.org/10.1080/1540496X.2020.1784719

Rahman, M. L., Amin, A., & Al Mamun, M. A. (2020). The COVID-19 outbreak and stock market reactions: Evidence from Australia. *Finance Research Letters*, 38, 101832. https://doi.org/10.1016/j.frl.2020.101832

Ramelli, S., & Wagner, A. (2020). What the stock market tells us about the consequences of COVID-19. Retrieved from https://voxeu.org/article/what-stock-market-tells-us-about-consequences-covid-19

Ru, H., Yang, E., & Zou, K. (2020). What do we learn from SARS-CoV-1 to SARS-CoV-2: Evidence from global stock markets. (BOFIT Discussion Paper No. 15/2020), The Bank of Finland Institute for Emerging Economies. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3641827

Shan, L., & Gong, S. X. (2012). Investor sentiment and stock returns: Wenchuan earthquake. *Finance Research Letters, 9*(1), 36–47. https://doi.org/10.1016/j.frl.2011.07.002

Sharpe, W. F. (1963). A simplified model for portfolio analysis. *Management Science, 9*(2), 277–293. https://doi.org/10.1287/mnsc.9.2.277

Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020). The impact of the COVID-19 pandemic on firm performance. *Emerging Markets Finance and Trade, 56*(10), 2213–2230. https://doi.org/10.1080/1540496X.2020.1785863

Singh, B., Dhall, R., Narang, S., & Rawat, S. (2020). The outbreak of COVID-19 and stock market responses: An event study and panel data analysis for G-20 countries. *Global Business Review*, 1–26. Retrieved from https://doi.org/10.1177/0972150920957274

Strong, N. (1992). Modelling abnormal returns: A review article. *Journal of Business Finance & Accounting, 19*(4), 533–553. https://doi.org/10.1111/j.1468-5957.1992.tb00643.x

Subhani, M. I., Hasan, S. A., Mehar, D., & Osman, M. (2011). Are the major South Asian equity markets co-integrated? (MPRA Working Paper No. 34737), University Library of Munich. Retrieved from https://ideas.repec.org/p/pra/mprapa/34737

The Daily Star. (2020, March 10). Stocks crater on coronavirus fears. Retrieved from https://www.thedailystar.net/business/news/stocks-crater-coronavirus-fears-1878649

The Daily Star. (2019, 8 January). Bangladesh 2nd largest economy in South Asia; To become 24th largest economy in world by 2033: UK think tank. Retrieved from https://www.thedailystar.net/bangladesh/bangladesh-ranked-41st-largest-economy-in-2019-all-over-the-world-study-1684078

The Independent. (2020, 10 March). Dhaka stocks nosedive on coronavirus shock: DSEX sheds 279.32 points, biggest one day loss. Retrieved from http://www.theindependentbd.com/post/240319

Topcu, M., & Gulal, O. S. (2020). The impact of COVID-19 on emerging stock markets. *Finance Research Letters, 36*, 101691. https://doi.org/10.1016/j.frl.2020.101691

Trading Economics. (2019). Bangladesh GDP annual growth rate. Retrieved 8 June 2020, from https://tradingeconomics.com/bangladesh/gdp-growth-annual

Vukkadala, N., Qian, Z. J., Holsinger, F. C., Patel, Z. M., & Rosenthal, E. (2020). COVID-19 and the otolaryngologist: Preliminary evidence-based review. *The Laryngoscope, 130*(11), 2537–2543. https://doi.org/10.1002/lary.28672

Wang, Y. H., Yang, F. J., & Chen, L. J. (2013). An investor's perspective on infectious diseases and their influence on market behavior. *Journal of Business Economics and Management, 14*(2013), S112–S127. https://doi.org/10.3846/16111699.2012.711360

World Health Organisation. (2020). Coronavirus disease (COVID-19) outbreak situation. Retrieved 8 June 2020, from https://covid19.who.int/

World Bank. (2019). GDP growth (annual %). Retrieved 8 June 2020, from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

Xiong, H., Wu, Z., Hou, F., & Zhang, J. (2020). Which firm-specific characteristics affect the market reaction of Chinese listed companies to the COVID-19 pandemic? *Emerging Markets Finance and Trade, 56*(10), 2231–2242. https://doi.org/10.1080/1540496X.2020.1787151

Ye, Z., & Florescu, I. (2020). *COVID-19 and the equity market: A March 2020 tale*, SSRN. https://doi.org/10.2139/ssrn.3566281

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. *Finance Research Letters*, *36,* 101528. https://doi.org/10.1016/j.frl.2020.101528