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Asian perspective of capital market performance amid the COVID 19 pandemic

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Abstract

Purpose – The purpose of this research is to investigate the short-term capital markets' reactions to the public announcement first local detection of novel corona virus (COVID 19) cases in 12 major Asian capital markets.
Design/methodology/approach – Using the constant mean return model and the market model, an event study methodology has been implied to determine the cumulative abnormal returns (CARs) of 10 pre and post-event trading days. The statistical significance of the data was assessed using both parametric and nonparametric test statistics.
Findings – First discovery of local COVID 19 cases had a substantial impact on all 12 Asian markets on the event day, as shown by statistically significant negative average abnormal return (AAR) and cumulative average abnormal return (CAAR). The single factor ANOVA result has also demonstrated that there is no variability among 12 regional markets in terms of short-term market responses. Furthermore, there is little evidence that these major Asian stock market indices differ significantly from the FTSE All-World Index which might suggest possible spillover impact and co-integration among the major Asian capital markets. The study further discovers that market capitalization and liquidity did not have any significant impact on market reaction to announcement.
Research limitations/implications – The study's contribution might have been compromised by the absence of socio-demographic, technical, financial and other significant policy factors from the analysis.
Practical implications – These findings will be considerably helpful in tackling this unprecedented epidemic issue for personal and institutional investors, industrial and economic experts, government and policymakers in assessing the market in special circumstances, diversifying risk and developing financial and monetary policy proposals.
Originality/value – This paper is the first to examine the effects of local COVID 19 detection announcement on major Asian capital markets. This study will add to the literature by investigating unusual market returns generated by infectious illness outbreaks and the overall market efficiency and investors' behavioral pattern of major Asian capital markets.

Keywords COVID 19, Capital market, Event study, Asia
Paper type Research paper

1. Introduction

After the first case of the novel corona virus (COVID 19) was detected in Wuhan City, Hubei Province, China in December 2019, the quick and enormous spread of COVID 19 caused the World Health Organization (WHO) to declare COVID 19 as a global pandemic on March 11, 2020 (Gössling *et al.*, 2020). The COVID 19 pandemic catastrophe has wreaked havoc on

JEL Classification — G10, G12, G14

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several economies around the world. Travel bans, lockdowns and social distancing measures employed by several nations to limit COVID 19 contagions caused abrupt and significant interruptions in the movement of commodities and services. Because the epidemic has significantly disrupted the production and supply systems in the world's most important economies, these disruptions have resulted in economic disasters across countries (Nicola *et al.*, 2020). Demand, supply and financial shocks are the primary drivers of the socioeconomic and political repercussions of the global spread of the COVID 19 virus. Because of the governments' lockdown, shutdown and quarantine efforts to prevent the epidemic, demand-side shocks have led to a loss in people's capacity to acquire products and services (Mishra and Mishra, 2021). The stoppage of manufacturing sites, international supply chain interruption and prohibitions on internal and overseas labor movements have all contributed to the decrease in nations' economic productivity and growth (Gereffi, 2020; Caggiano *et al.*, 2020).

The stock market's reaction reflects this effect, with major fluctuations in trading volume and price indices (Ashraf, 2020). In March 2020, for example, stock trading in the US capital markets was suspended four times in 10 days owing to the circuit breaker mechanism. Since its inception in 1987, the breaker has only been used once in 1997. The S&P 500, the Dow Jones industrial average, and the Nasdaq composite have all experienced the steepest declines in a decade. The European and Asian financial markets have also collapsed as a result of the collapse of the US financial markets. The FTSE100, the UK's broadest benchmark index, plunged more than 10% to its lowest level since 1987, while Frankfurt's DAX 30 also fell dramatically due to the epidemic. The COVID 19 epidemic has wreaked havoc on Asia's major stock exchanges too, For instance, The Asia Dow Index fell by 4%, the Japanese Nikkei-225 fell by 3.6%, the Hang Seng (HIS) lost 3.6%, the Shanghai composite index (SSEC) index fell by 1.6%, Singapore's FTSE STI fell by 3.7%, Taiwan's TSEC fell by 4% and the Mumbai Sensex fell by 6.8% in a single trading day when the virus spread was declared as a "Global Pandemic" by the WHO on March 2020 (Rakshit and Neog, 2021; Topcu and Gulal, 2020). Bangladesh's two major stock exchanges DSE and CSE were suspended for trading from March 29 to April 2 (Adnan *et al.*, 2020) followed by the closure of Philippines stock exchange's trading to prevent the spread of the virus tremendously hampered the market liquidity and investors' confidence. The volatility index (VIX) has also risen dramatically due to the pandemic. When linked to prior high-risk events like 9/11 (41.75), the financial meltdown of 2008 (46.72), the US economic crisis of 2011 (48) and the most current US–China trade tensions in 2018 (36.06), the COVID 19 virus, with a VIX score of 84.57, is considered as a big source of anxiety for the markets (Nguyen, 2020). It is reasonable that the COVID 19 threat has been viewed as extraordinary, given that, although the Spanish Flu took about a year to become a global pandemic, COVID 19 took just three months to reach global, and only two months for the key centers of industrialization to be impacted (Robinson, 2021).

Many believe the 21st century will be known as the Asian Century (Park, 2013). Despite this, many financial markets in Asia, particularly emerging and frontier markets remain mostly unknown to the rest of the globe. Partly due to the worldwide success of local tech giants, the comparatively big and liquid capital markets of China, South Korea, Taiwan, Hong Kong and Singapore have become more well-known in global markets (Wang, 2014). Other regional markets, such as India, Malaysia, Bangladesh, Sri Lanka, Pakistan and Vietnam are, in terms of market behavior and features, mostly unexplored. COVID 19 has offered an unparalleled opportunity for scholars to investigate the consequences of pandemics on regional stock markets in these Asian markets as a result of an unanticipated and dreaded disease (Karabag, 2020). The purpose of this paper is to investigate the impact of COVID 19 on the regional level. It looked at how the revelation of the first local discovery of COVID 19 affected equity markets in 12 Asian nations, as indicated by their top stock market indexes. The influence of the unexpected outbreak of COVID 19 on stock market indices performance is investigated in an event study.

To the best of the researcher's knowledge, COVID 19 has been extensively studied at the industry and business levels in a particular nation in recent studies such as Xiong *et al.* (2020), Alam *et al.* (2021), He *et al.* (2020a) and In *et al.* (2002). Other studies have focused on the major capital markets in the USA and EU regions such as He *et al.* (2020c), Li *et al.* (2021) and Harjoto *et al.* (2021), however, a very negligible number of studies such as Hunjra *et al.* (2021) and Mishra and Mishra (2021) have examined the major Asian equity markets reactions to COVID 19 using an event study while considering the first local detection announcement as the event date. Most of the studies either use WHO's 11th March 2020 declaration of COVID 19 as global pandemic as event date or the 23rd of January 2020 when the Chinese government imposed lockdown in Wuhan to prevent the spread of contagion such as He *et al.* (2020a), Ramelli and Wagner (2020) and Xiong *et al.* (2020) and used the developed market context to analyze the pandemic effect (Zhang *et al.*, 2020; Zeren and Hizarci, 2020; Liu *et al.*, 2020). Using the event study method of Brown and Warner (1985), this study therefore specifically examines multiple major Asian equity markets' reactions to the first local detection of COVID 19 in both local and global timeframe. This study further tries to discover any significant difference in market reactions among the Asian markets in terms of their size and liquidity by using the single factor ANOVA model. "How may the extraordinary emergence of COVID 19 pandemic have influenced stock market movements in major Asian economies?" is the fundamental issue that this study is attempting to answer.

The empirical findings demonstrate that the initial local detection announcement of the COVID 19 pandemic has a mixed influence on the major Asian stock market indices. While, major indices in China, Hong Kong, Japan, India, Singapore and South Korea showed an insignificant reaction, the market indices of Vietnam, Indonesia, Malaysia, Bangladesh, Sri Lanka and Pakistan showed a significant negative reaction to the detection announcement. Furthermore, there is little evidence that Asian stock market indices vary significantly from the FTSE All-World Index. The findings suggest that a significant spike in market return volatility occurred during the fast spread of the coronavirus, which was predominantly prompted by weakened investor attitudes as a result of announcement effects (Papakyriakou *et al.*, 2019; Mishra and Mishra, 2021).

This study makes contributions to the literature in several aspects. Primarily, this study refers to the literature that deals with the effect of national crises or emergencies on the financial systems, such as earthquakes (Shan and Gong, 2012), the spread of Ebola (Ichev and Marinč, 2018). However, the epidemic of COVID 19 has a more significant impact than all of this. Secondly, this research is the first to employ the event study methodology to examine the effects of local COVID 19 detection announcement on major emerging Asian capital markets indices such as Bangladesh, India and Pakistan, whereas, the bulk of current research examining the effects of the COVID 19 outbreak on capital markets concentrate on developed economies such as the USA, Europe and other industrialized countries (Baker *et al.*, 2012). Overall, this research will add to the body of knowledge by investigating unusual market returns generated by infectious illness outbreaks and the overall market efficiency and investor behavioral pattern of major Asian capital markets.

The rest of this paper will go as follows. The review of the literature is presented in Section 2. The methodology is described in Section 3. The empirical findings and interpretations are presented in Section 4 while Section 5 brings the paper to a conclusion.

2. Literature review

2.1 Theoretical framework

The efficient market hypothesis (EMH) suggests that the capital market would react to any new information (Malkiel and Fama, 1970a). Therefore, the news of detection and transmission of a global epidemic is believed to create an impact in the worldwide capital markets. Apart from the EMH theory which promotes the rational investment approach, behavioral finance theories also help to understand the different "market phenomena" that complement the standard financial theory. One of these theories is the over-/under-reaction hypothesis, helps to understand why shareholders become confident as the market goes up and expect that it will continue to do so while on the other hand investors become highly negative during downturns?. A result of putting too much emphasis on recent incidents while overlooking past data is an over-or under-reaction to market volatility that results in prices dropping too much on negative news and rising too much on positive news (Bloomfield, 2010). Negative overreaction often led to panic selling. It is possible to describe panic sales as a sudden rise in sales orders for a specific investment, which drives down the stock price (Dreman and Lufkin, 2000). This can trigger a tumbling impact or "vicious loop" in which investors see a rapidly dropping price as a sign of getting out of a specific investment, which further squeezes the price and encourages more investors to sell their investments. Often this form of sale is motivated by a fear of failure rather than an understanding of the real issue at hand. Liquidity provision is the other strand of the theoretical premise. Because some traders want liquidity and enter the market to do so, the price is temporarily lower than the fundamental price to compensate for certain uneducated traders who offer liquidity (Grossman and Miller, 1988; Jegadeesh and Titman, 1995). This research examines market reactions to the news of the pandemic discovery, and so falls under the category of Market Efficiency and Overreaction.

2.2 Stock market reactions to pandemic other than COVID 19

Many earlier studies on the capital market reaction of infectious virus epidemics might be referenced as we analyze COVID 19's impact. Prior literature exhibited varied results in terms of the stock market's reaction to pandemics. One of the initial studies argued that the 2003 SARS pandemic cost as much as the Asian financial crisis, with losses estimated at $3 trillion in GDP and $2 trillion in financial market equity. Macciocchi *et al.* (2016) investigated the short-term economic effects of the Zika virus outbreak on Brazil, Argentina and Mexico, and their findings revealed that, except for Brazil, the market indexes of these three Latin Americans did not exhibit significant negative returns the day following each shock. Notable research by Nippani and Washer (2004) attempted to demonstrate the effects of the SARS pandemic on the main stock exchanges of Canada, China, Singapore, Hong Kong, Indonesia, the Philippines, Thailand and Vietnam. They attempted to examine if there was a substantial difference in stock returns between the pre-outbreak and outbreak periods, as well as with the S&P global market index. They discovered that, except for China and Vietnam, other financial markets are unaffected by the SARS outbreak. Loh (2006) considerably supplemented and expanded the findings of earlier research of Nippani and Washer (2004) on the effect of the SARS epidemic on a more particular industry data set, namely the Airline Industry of the affected nations. By using multi-level econometric testing to 12 airline stocks, the author discovered that SARS did not affect average returns of airline stocks or the major stock market index of six SARS afflicted nations.

Alternative outcomes were noticed by Chen *et al.* (2007) while analyzing the effect of the SARS outbreak on the performance of the Taiwanese tourism industry measured by the hotel stocks using an event study methodology. They found, during the SARS pandemic, seven publicly listed hotel stocks showed large negative cumulative mean abnormal returns (CARs) on and following the day of the SARS epidemic, proving that the SARS outbreak had a substantial influence on hotel stock performance. Similarly, Kim *et al.* (2020) investigated the impact of four infectious epidemic illness outbreaks in the restaurant industry in the USA from 2004 to 2016. The study validated the negative effect of epidemic illness outbreak on the restaurant business while also documenting that brand loyalty, advertising outcome and service character of the organization function as risk-mitigating factors. Chen *et al.* (2009) also conducted an event study on the Taiwanese capital market to identify the comparative impact scenario of the SARS outbreak on multiple industry segments. 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 the Taiwanese stock exchange. Additionally, Wang *et al.* (2013) significantly broaden the research setting by investigating the influence of many additional important infectious illnesses, including ENTEROVIRUS 71, DENGUE FEVER, SARS and H1N1, on the performance of the biotechnology industry listed on the Taiwanese stock market (TSE) in terms of stock value. They discovered a large increase in the market value of biotechnology stocks during the early stage of contamination, which was afterward corrected. They also claimed that a higher R&D ratio had a detrimental impact as a result of an infectious illness epidemic. Identical findings have also been demonstrated by Chong *et al.* (2010) in different market contexts, Chinese stock exchanges, where, significant anomalous gains in pharmaceutical stock prices were seen as a result of the SARS outbreak, whereas tourism stock prices fell. Similarly, Macciocchi *et al.* (2016) measured the volatility of market indices to examine the short-term economic impact of the Zika virus epidemic on Brazil, Argentina and Mexico. Except for Brazil, the results showed that the market indices of these three markets did not exhibit significant negative returns immediately after each shock.

2.3 Capital markets response to COVID 19 pandemic

As the corona pandemic continues in many areas of the world and governments continue to drastically reduce economic and financial operations, the entire and final effects of the COVID 19 pandemic are yet unknown. The majority of scholars have attempted to capture the stock market's direct impact of the deadly corona virus. In general, there is relatively little thorough research work on the consequences of the COVID 19 epidemic on regional stock markets in the literature. Nonetheless, a comprehensive analysis conducted by Ashraf (2020) of the stock markets' reaction to the COVID 19 outbreak using daily COVID 19 new cases and deaths, as well as returns on stock exchanges from 64 countries, revealed that stock markets responded more quickly and comprehensively to a surge in the percentage of cases reported than to an increase in mortality. The statistics also imply that, depending on the severity of the epidemic, this reaction may change over time. Similarly, Zeren and Hizarci (2020) discovered in their comprehensive investigation of seven highly affected countries capital markets that overall casualty and new infection numbers have long-run co-integration with stock markets return in China, South Korea and Spain, while no co-integration was found in cases of German, the UK, French and Italian capital markets. Comparable results were also seen by Liu *et al.* (2020) while examining the COVID 19 pandemic's consequences on 21 stock markets in seven different countries. Onali (2020) also looked into how the frequency of COVID 19 instances and mortality in Corona-affected countries (such as the UK, Spain, France, Italy, China and Iran) influenced the return fluctuations of the Dow Jones and S&P 500 indexes on the US stock market. The findings revealed that, except for China, new cases and death of COVID 19 had little effect on the return on the US stock market. The number of verified deaths in Italy and France, on the other hand, had a negative impact on Dow Jones returns but a positive impact on volatility, according to VAR models.

Content analysis was used by Baker *et al.* (2020) to assess the effects of daily confirmed COVID 19 cases and fatalities on the variability of Dow Jones index returns. According to the study, other viral infections like Spanish flu and Ebola have a much less impact on stock market swings than COVID 19. Infectious outbreaks in the past have had a minor impact on the stock market in the USA. In comparison to past pandemics, the analysis finds that public limits on economic activities and voluntary social distancing are the most likely drivers of the US financial markets' unprecedented dramatic response to the COVID 19 epidemic. Yilmazkuday (2022) adds to the findings of Baker *et al.* (2020) by demonstrating that a 1%

increase in median daily COVID 19 infections in the USA appears to contribute approximately 0:01% of the average fall in the S&P 500 indices on the first day and after one month, the reduction was around 0:03%. Al-Awadhi *et al.* (2020) and Liew and Puah (2020) also found evidence of a considerable negative effect on the share price of all companies listed on the Shanghai Stock Exchange and the Hang-Seng stock exchange composite index. The IT and pharmaceutical sectors, according to the data, performed better than others throughout the epidemic. Furthermore, foreign investors have a considerably higher negative impact on returns than Chinese residents. Finally, when compared to smaller enterprises, larger enterprises experience significantly greater negative effects on returns. Nguyen (2020) extends the research by demonstrating that shareholder responses to COVID 19 differ between nations and sectors. Communication, consumer goods, medical services, information technology and infrastructure are performing fairly well compared to other industries in all nations except the USA, Japan and Italy, whereas the energy sector has suffered the most in all countries. When Ru *et al.* (2021) looked at the capital market responses of 65 countries to both SARS and COVID 19, they discovered something interesting. They claimed that, while all markets reacted strongly to both epidemics, countries that had previously experienced SARS were less affected than those that had never had SARS.

Stock prices are largely controlled by the market and firm-specific factors, according to traditional economic and financial theory. Companies operating in the same industry face similar regulatory and legislative environments, as well as similar economic situations. So, the operational circumstances of firms in the same industry are strongly linked when the economic environment changes. Furthermore, according to behavioral finance theory, Aside from the intrinsic value of stocks, there are other factors to consider, such as investors' cognitive and behavioral elements will be influenced by emergencies, which will have a substantial impact on stock prices. Therefore, the COVID 19 pandemic will have an impact on the economy, altering market sentiment and causing stock price volatility. It can also be argued based on the findings of the prior empirical literature that there has been nonuniformity in the initial capital market response to pandemics between countries and industries. Therefore, this study develops the following alternative hypothesis.

H1a. The revelation of the first local identification of COVID 19 has had a significant influence on stock markets in selected Asian capital markets.

H1b. There is a significant difference in immediate reactions to the first local detection of the pandemic among the selected Asian capital market.

H1c. There has been a significant difference in market reactions among the Asian capital markets based on size and liquidity.

3. Data set and methodology

To analyze the stock market reaction of the selected Asian countries to the first official announcement of the COVID 19 case locally in 12 Asian countries, this study employed the event study methodology (ESM) by Brown and Warner (1985). Event studies, according to Fama (1991), can provide a reasonable picture of the degree to which prices change in response to information. ESM calculates firm valuations using equity indexes rather than accounting measurements such as sales and income because accounting indications can be affected if the influence of an event is not separated from market trends (McWilliams and McWilliams, 2000).

3.1 Sample formation and data source

To examine the overall market reactions on a regional basis Asian context the following 12 major Asian stock indices (see Table 1) were chosen to assess the impact of the COVID 19

Table 1. Selected stock market indexes for affected Asian countries with market classification

No	Major stock indexes	Code	Country	Market category
1	Shanghai Composite Index	SSEC	China	Emerging
2	Hang Seng Index	HIS	Hong Kong	Developed
3	FTSE Vietnam All Index	FTFVAS	Vietnam	Frontier
4	Jakarta Stock Exchange Composite Index	JKSE	Indonesia	Emerging
5	FTSE Bursa Malaysia Kuala Lumpur Composite Index	KLSE	Malaysia	Emerging
6	Nikkei 225 Index	N225	Japan	Developed
7	BSE Sensex 30 Index	BSESN	India	Emerging
8	Dhaka Stock Exchange Broad Index	DSEX	Bangladesh	Frontier
9	CSE All-Share Index	CSE	Sri Lanka	Frontier
10	Karachi All Share Index	KSI	Pakistan	Frontier
11	KOSPI Composite Index	KOSPI	South Korea	Emerging
12	FTSE Singapore	FTSE ST	Singapore	Developed

Source(s): Author's Compilation from www.investing.com and www.msci.com

epidemic since these are considered to be the major market indices in terms of equity portfolio and capitalization (Markets, 2021; Bloomberg, 2020). The selected Asian capital markets have been further classified in to three categories based on the size and liquidity (MSCI, 2021).

The market index for calculating the above-mentioned major indices' ARs is the FTSE All World Index *(a component of the FTSE Global Equity Index Series-GEIS, which represents 98% of the global equity portfolio market capitalization)*, which is a global index that measures the overall performance of stock markets throughout the world.

3.2 Event study framework

3.2.1 Event selection. In this study, the COVID 19 relevant events are identified in Table 2 where the first local detection of COVID 19 infection as per the WHO situation reports in 12 Asian countries was considered as the event date like Alam *et al.* (2021), Adnan *et al.* (2020) and Sayed and Eledum (2021) applied first detection as event day to measure capital market reaction, however these studies focuses on single market, whereas this study analyzes 12 different markets with nine different event dates which might show different dimension. Moreover, prior studies like Choudhary and Singhal (2020), Pattnaik and Gahan (2018) and Stevanius and Sukamulja(2020) examined Asian capital market co-integration found either mild or negative co-integration, therefore multiple capital market reaction with uniform event date will not reflect the actual aggregate market behavior.

Table 2. Domestic timeline of first local detection in 12 Asian countries

Country	Date of first local detection
China	December 31, 2019
Japan	January 16, 2020
South Korea	January 20, 2020
Hong Kong	January 23, 2020
Singapore	January 23, 2020
Vietnam	January 23, 2020
Malaysia	January 25, 2020
India	January 27, 2020
Sri Lanka	January 27, 2020
Pakistan	February 26, 2020
Indonesia	March 02, 2020
Bangladesh	March 08, 2020

Source(s): Authors compilation from WHO situation reports from Jan 2020 to August 2020

3.2.2 Estimation period and event windows selection. According to Peterson (1989), average estimation window durations range from 100 to 300 days. To ensure the accuracy of the predicted return estimate, this study followed Brown and Warner (1985) and Agrawal and Kamakura (1995) for selecting estimation windows of 250 trading days, 10 days before the event day respective to the different event days for the selected stock exchanges. The average abnormal return (AAR) is calculated over an 11-day timeframe surrounding a given event, including 10 days before and after the event day, as well as one day on the event day like Maneenop and Kotcharin (2020), He *et al.*, 2020c. The 21-day window prevents overlapping-window concerns since certain events are near together (Armitage, 1995). This study also investigates CAR of additional event widows such as CAR (0,−2), CAR (0,−5) and CAR (0,−10) as well as CAR (0, 2), CAR (0, 5) and CAR (0, 10) for robustness.

3.3 Measurement models

This study uses the constant mean return model and market models for producing ex-post normal returns for both the selected stock market indices and the selected industries. The market index adjusted return model has a strong relationship premise (Henderson, 1990); hence this model is not taken into account. There are certain assumptions about the returns that must be met for the two models; they are jointly multivariate normal and independently and identically distributed across time. In reality, it seldom causes issues because the assumption is empirically sound, and conclusions based on normal return models are often resistant to departures from the assumption (Peterson, 1989). Recent event studies associated with analyzing pandemic events such as those Nippani and Washer (2004), Loh (2006), Chen *et al.* (2009) and He *et al.* (2020), have widely employed the market model to assess the effect of disease outbreaks.

3.3.1 Constant mean return (CRM) model. In the estimate phase, the mean adjusted return model assumes that the *ex ante* normal return for a single stock i is equal to the simple average return of stock i's daily yield, which might differ across securities. The remainder amount upon subtracting the average return from the actual return R_{it} is equal to the abnormal return AR_{it} (eq. 1). The model aligned with the capital asset pricing model's (CAPM) theory that the stock had a constant risk exposure and expected return (Sharpe, 1963).

$$\mathrm{AR}_{it} = R_{it} - \overline{R}_i \tag{1}$$

where; AR_{it} is the abnormal return; $\overline{R}$ is the simple mean of stock i's daily return in the estimation period and R_{it} is the actual return of stock i in period t.

3.3.2 Market model and abnormal return calculation. This technique considers all market-wide characteristics as well as the systemic risk of each asset based on the single-factor return model developed by Sharpe (1963). It employs a further advanced simulation technique to stock returns in comparison to initially discussed simple approaches, forecasting linear correlations between equities and present market portfolio return (Peterson, 1989). The following regression model defines the relationship;

$$E_{it} = \alpha_i + \beta_i R_{mt} + \delta_{it} \tag{2}$$

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

On day t, the AR for stock i is defined as follows:

$$AR_{it} = R_{it} - E(R_{it}) \tag{3}$$

where: AR_{it} presents the unusual gain of stock i on day t; $E(R_{it})$ is the expected return and R_{it} is the return of security i in period t.

$$R_{it} = \ln\left(\frac{p_t}{P_{t-1}}\right) \tag{4}$$

where R_{it} denotes an individual stock return, P_t denotes the current price, and P_{t-1} denotes the previous day's price.

This study calculates the average of abnormal returns (AARs) (Eq. 5) and the cumulative value of AARs (Equations 6 and 7), which are expected to indicate the overall market reaction. CAR deviations around the event's date demonstrate that market players take into account the information relevant to the studied event, which reflects the share price (McWilliams and Siegel, 1997). Furthermore, by examining the CAARs from the day of occurrence (t_0) onwards, the market's efficiency may be judged immediately after the event (t_1).

$$\text{AAR}_t = \frac{1}{Nt}\sum_{i=1}^{N}\text{AR}_{it} \tag{5}$$

where, ARR_t denotes the estimated AAR in period t, AR_{it} is the estimated AR in period t for stock i, and n denotes the number of observations.

$$\text{CAR}_{(t1,t2)} = \sum_{t1}^{t2}\text{AR}_{it} \tag{6}$$

where CAR (T_1, T_2) denotes the total AR from period T_1 to period T_2

$$\text{CAAR}_{(t1,t2)} = \sum_{i=1}^{N}\text{CAR}_{it} \tag{7}$$

where; CAAR (T_1, T_2) is the projected CAR for time t.

3.4 Robustness checks

Both parametric and non-parametric test statistics are used in this study. The use of non-parametric testing allows the robustness of parametric test results to be verified. Such verification can be useful, as shown by Campbell and Wasley (1996). Furthermore, in a random sampling of data from Asian capital markets, such metrics are fairly well-specified and more effective (Rani *et al.*, 2015; Campbell *et al.*, 2010; Corrado and Truong, 2008). The parametric test-statistics such as Time-Series t-test (see equation 8 and 9) (Brown and Warner, 1985) and non-parametric test statistics such as the Corrado rank-test (Corrado, 1989; Corrado and Zivney, 1992) have been applied to test the significance of CARs of selected Asian markets. This study also uses single-factor ANOVA and the Kruskal–Wallis test to test the significance of the difference between selected Asian markets. Moreover, the correlation coefficient between the markets and industries is calculated to observe any potential spillover effect.

Time series t-test is defined as;

$$T_{\text{time}} = \frac{\text{CAAR}_t}{\sqrt{(t_2 - t_2 + 1)}\sigma\text{AAR}_t} \tag{8}$$

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

$$\sigma\text{AAR}_t = \frac{1}{M-d}\sum\left(\text{AAR}_t - \overline{\text{AAR}_t}\right)^2 \tag{9}$$

where M is the number of non-missing returns and d is the degree of freedom.

Under the null hypothesis, the CAAR is equivalent to zero. The statistic reflects linearly the bell curve. The variance estimator of this statistic is estimated by the sequence of unusual returns from the estimation period. The non-parametric rank test proposed by Corrado (1989) (see equations 10–12) to test the null hypothesis primarily convert ARs into ranks. The ranking is done for all ARs of both the event and the estimation period. If ranks are tied, the mid-rank is used. Corrado and Zivney (1992) suggest a standard rank adjustment to adjust for non-missing values M_i plus 1. Corrado rank test is defined as,

$$K_{i,t} = \frac{\text{rank}(\text{AR}_{i,t})}{1 + M_i + L_i} \tag{10}$$

where, L_i denotes the number of non-missing (i.e. matched) returns in the event window. The rank statistic for testing on a single day (H_0: $E(\text{AAR}) = 0$) is then given by

$$t_{\text{rank},t} = \frac{\overline{K_t} - 0.5}{S(u)} \tag{11}$$

where; where K_t denotes the number of non-missing returns across firms and

$$S(U) = \sqrt{\frac{1}{L_1 + L_2} \sum \frac{1}{\sqrt{N_t}} \left(\overline{K_t} - 0.5\right)^2} \tag{12}$$

where; N_t is the number of cross-sectional non-missing returns.

4. Results and discussion

This study first tries to observe the initial market reaction of the selected Asian stock markets to the first detection of infectious disease. Standard event study has been used to examine the daily market returns of the major indices of these selected regional markets to identify any abnormality.

Table 3 shows the AR and average abnormal return (AAR) for selected key Asian market indices for the 10 days before and after the occurrence. Using *t*-statistics, the findings were evaluated for their deviation of index returns from their average. If the incident had no impact, the return deviation would be small (Chen and Siems, 2007). The empirical result shows that the actual event day (0) generates significant (1% level) negative AAR. This proves that all the selected Asian markets except China have reacted quite uniformly to the first local detection of the pandemic on the actual event date. However, there are very inconsistent post facto market reactions have been observed. While days 1, 4, 5, 7 and 10 generate insignificant negative AAR, days 2, 3, 6, 8 and 9 generate insignificant positive AAR. The logical explanation of this mixed reaction could be the efficient market reaction which is reflected in the prompt absorption of the new market information of first local pandemic detection. The findings are quite similar to the result of Ahmed *et al.* (2021), Topcu and Gulal (2020) which demonstrated that COVID 19 has had a substantial impact on stock market performance in several Asian nations. According to Scott and Scott (2015) the market price of a security should fluctuate at random throughout time. That is, stock returns should not be serially correlated. As a result, if a firm announces positive news today, its stock price should climb to reflect the news the same day. If in the absence of new information, its price continues to grow in the following days, this is proof of inefficiency. Another possible clarification of this post facto mixed market reaction is the random walk behavior (Van Horne and Parker, 1967).

The correlation coefficient among the ARs of selected Asian markets has been shown in Table 4 to observe any possible spillover effect between the observed markets. Interestingly there has been no strong positive correlation between the Chinese market and other major Asian markets, even though a moderate negative correlation exists between SSEC and KLSE

Table 3.
Average abnormal return (AAR) analysis of Major Asian Market Indices

E.D	SSEC	FTFVAS	HIS	JKSE	KLSE	N225	BSESN	CSE	DSEX	KSI	FTSE ST	KOPSI	AAR (*t* Stat)
−10	0.012	0.014	0.016	0.001	−0.004	0.006	0.005	0.015	−0.009	0.016	0.001	−0.010	0.0051 (1.85*)
−9	−0.001	0.007	0.003	0.004	−0.002	−0.004	0.002	−0.001	−0.011	−0.002	0.002	0.009	0.0004 (0.27)
−8	0.002	0.000	0.011	0.007	0.003	−0.008	−0.003	−0.002	−0.006	−0.008	−0.001	−0.011	−0.0014 (−0.76)
−7	−0.014	0.003	−0.002	0.003	0.001	−0.020	0.000	−0.005	−0.017	0.000	0.004	0.016	−0.0026 (−0.88)
−6	−0.024	0.000	−0.004	−0.009	0.005	0.015	−0.001	−0.002	−0.016	−0.007	−0.005	0.008	−0.0031 (−1.032)
−5	0.017	0.005	0.003	−0.009	−0.004	−0.016	−0.011	−0.004	−0.013	0.010	0.008	0.010	−0.0003 (−0.115)
−4	0.005	0.002	0.005	0.000	0.000	0.022	−0.005	0.002	0.005	−0.002	0.000	0.004	0.0032 (1.641)
−3	0.004	0.001	−0.009	−0.016	−0.006	0.004	−0.006	0.005	0.010	−0.005	−0.001	−0.003	−0.0019 (−0.89)
−2	−0.010	0.009	−0.028	−0.022	−0.002	0.007	0.006	0.008	−0.013	−0.026	−0.009	0.007	−0.0061 (−1.52)
−1	0.007	0.005	0.012	−0.013	0.000	−0.005	0.005	0.002	−0.007	−0.010	0.003	0.001	0.0000 (0.012)
0	0.005	−0.032	−0.015	−0.020	−0.012	0.000	−0.010	−0.008	−0.027	−0.013	−0.005	0.005	−0.0109 (−3.22***)
1	0.019	−0.026	0.002	0.032	−0.001	0.004	−0.006	−0.009	−0.063	−0.014	0.002	−0.010	−0.0059 (−0.88)
2	0.001	−0.010	−0.027	0.021	−0.003	0.001	0.005	0.009	0.035	−0.005	0.000	0.012	0.0033 (0.74)
3	0.012	0.000	−0.027	0.001	−0.009	−0.010	−0.007	−0.001	0.011	0.032	−0.018	−0.009	−0.0022 (−0.50)
4	0.014	0.000	−0.005	−0.022	−0.005	0.006	−0.004	0.002	−0.019	−0.001	−0.001	−0.032	−0.0056 (−1.52)
5	−0.014	0.016	0.002	−0.057	0.009	−0.011	−0.025	0.000	−0.045	−0.003	−0.004	0.004	−0.0107 (−1.69)
6	0.015	0.003	0.013	0.014	0.000	0.000	0.001	0.001	−0.046	0.010	−0.006	−0.017	−0.0011 (−0.23)
7	−0.006	−0.010	0.004	−0.008	0.010	−0.022	0.021	0.000	−0.048	−0.026	−0.014	−0.014	−0.0093 (−1.80*)
8	0.012	0.003	0.025	−0.038	0.001	−0.006	0.007	−0.001	0.104	−0.032	0.011	−0.000	0.0072 (0.70)
9	−0.005	0.005	−0.004	−0.004	−0.007	0.006	0.004	−0.001	−0.005	0.014	0.013	0.018	0.0029 (1.19)
10	−0.001	0.001	−0.007	−0.032	0.006	−0.018	−0.005	−0.006	0.005	−0.005	0.008	0.003	−0.0043 (−1.32)

Note(s): E.D = Event date, the market model has been used to calculate the expected return to find the abnormal return (AR), *T* value in parentheses. * = Significant at the 10% level; ** = significant at the 5% level; *** = significant at the 1% level
Source(s): Authors calculation

Table 4. Correlation of AR among major Asian markets

Indices	SSEC	FTFVAS	HIS	JKSE	KLSE	N225	BSESN	CSE	DSEX	KSI	FTSE ST	KOPSI
SSEC	1											
FTFVAS	−0.250	1										
HIS	0.261	0.257	1									
JKSE	0.295	−0.357	−0.056	1								
KLSE	−0.493	0.281	0.366	−0.257	1							
N225	0.032	−0.040	−0.079	0.193	−0.339	1						
BSESN	−0.045	−0.034	0.146	0.306	0.126	−0.036	1					
CSE	−0.015	0.490	−0.067	0.022	−0.092	0.360	0.339	1				
DSEX	0.131	0.196	0.067	−0.223	−0.172	0.049	0.209	0.223	1			
KSI	0.223	0.292	−0.145	0.276	−0.433	0.040	−0.349	0.123	−0.139	1		
FTSE ST	0.136	0.172	0.438	−0.076	−0.044	0.020	−0.028	−0.158	0.380	−0.074	1	
KOSPI	−0.529	0.123	−0.239	−0.071	−0.029	−0.026	−0.073	−0.113	0.229	−0.030	0.402	1

Note(s): Pearson Correlation Coefficient among AR's of selected Asian capital markets
Source(s): Authors calculation

and between SSEC and KOPSI. In the case of other markets CSE and FTFVAS, as well as FTSE ST and HIS, showed some semi-strong positive correlation among them whereas KSI and KLSE showed a moderately negative association. Overall it has been observed that there is no strong linkage exists among the major Asian capital markets in terms of abnormal capital market return over the observed period. This result is quite similar to the earlier findings of Chen *et al.* (2018) who revealed that the SARS outbreak has weakened China's long-term ties with selected Asian capital markets. However, the results are different from the findings of Zeren and Hizarci (2020) that identified longer-term co-integration with stock exchange returns of highly infected countries.

Tables 5 and 6 exhibit the CARs of five different event windows (three post-event and two pre-event) of 12 major Asian stock markets. The overall findings depict diverse regional stock markets' reactions to the global pandemic. Where, the major stock indices of Vietnam, Indonesia, Malaysia and Bangladesh exhibit significant (99%) negative market reaction on event day (0, 0), stock market indices from Pakistan, Sri Lanka, India, Japan, Hong Kong, China, Singapore and South Korea showed insignificant reactions. Moreover, three markets (China, Hong Kong and Japan) out of these six markets have shown an insignificant positive return on event day, whereas, the other three markets (India, Pakistan and Sri Lanka) have shown insignificant negative returns. The HANG SENG and BSE SENSEX exhibited a late reaction while having a significant (99%) negative market reaction reflected on the negative CAR for event windows (0, 2) and (0, 5). The negative market reaction is quite prolonged for DSEX, JKSE and FTFVAS, as all these markets resulted in significant negative ARs for the event window (0, 10). It is also interesting to observe significant pre-event negative market reactions from the major market indices of Vietnam, Indonesia, Malaysia and Bangladesh. Moreover, the capital markets reaction in Vietnam, Indonesia, Malaysia, Hong Kong and Bangladesh are quite prolonged suggesting an inefficient market behavior as the market should react randomly and should not provide any arbitrage opportunity. However, in most of the cases for highly reacted markets, the markets have recovered significantly as time passes such as the CAAR of event window (0,−10) shows a significant market correction for FTSE Vietnam, HANG SENG, BSE SENSEX, DSEX and FTSE Singapore. This arose as a result of considerable financial and non-financial initiatives by local governments and other institutional entities to counteract the COVID 19 pandemic around the world during the preceding event window (Singh *et al.*, 2020). It is also worth mentioning that the Chinese stock market, which was the first to be struck by the COVID 19 epidemic, was not seriously impacted. In comparison to the selected regional markets, China's stock market demonstrates a high level of resistance with an insignificant positive AR. Moreover, it is also interesting to note that, there has been a severe difference in results between return models and test statistics.

Additionally, it is also important to identify that, markets that have experienced a substantial negative market reaction on event day and post-event periods such as DSEX, FTFVAS, JKSE and KLSE were also experiencing the significant negative ARR in the pre-event windows. This conclusion differs significantly from the recent findings of He *et al.* (2020c). This might suggest an inefficient market behavior in these markets or a spillover effect. The spillovers appear to be linked to the dissemination of COVID 19 and the shock, worry and terror felt by international investors.

Using non-parametric Mann–Whitney *u*-tests and independent *t*-tests, Table 7 analyzes the 12 Asian stock markets' event period returns to the FTSE All-World Index. The returns on these indices are compared to the returns on the FTSE All-World Index for the before (−10) and after (+10) event days. During the relevant periods, this comparison illustrates which of these indexes fared significantly below the worldwide average. Table 7 shows the overall outcome of all event periods. There is no indication that these main stock market indexes deviate considerably from the FTSE All-World Index. This can be explained by the

Table 5. Results of the impact of COVID 19 on selected Asian markets

Market	Return model	Test statistics	Event windows (−10 . . . 0)	(−5 . . . 0)	(0 . . . 0)	(0 . . . 2)	(0 . . . 5)	(0 . . . 10)
SSEC	MM	Car	0.0038	0.0287	0.0051	0.0253	0.037	0.0521
		t-test time-series	0.072 (0.9426)	0.7398 (0.4594)	0.321 (0.7482)	0.9232 (0.3559)	0.953 (0.340)	0.993 (0.321)
		Corrado rank	0.9871 (0.3236)	0.9871 (0.3236)	0.9871 (0.3236)	0.9871 (0.3236)	0.987 (0.323)	0.987 (0.324)
	CMR	Car	0.0049	0.0284	0.0056	0.0283	0.0368	0.056
		t-test time-series	0.0916 (0.927)	0.7219 (0.4703)	0.3487 (0.7273)	1.0176 (0.3089)	0.9355 (0.3495)	1.046 (0.296)
		Corrado rank	1.0308 (0.30260	1.0308 (0.30260	1.0308 (0.30260	1.0308 (0.3026)	1.0308 (0.3026)	1.031 (0.303)
FTFVAS	MM	Car	0.012	−0.0118	−0.0325	−0.0526	−0.0683	−0.051
		t-test time-series	0.4871 (0.6262)	−0.6478 (0.51710	−4.38*** (0)	−2.89*** (0.0038)	−5.32*** (0)	−2.09*** (0.037)
		Corrado rank	0.9327 (0.3510	−1.0722 (0.2836)	−1.0722 (0.2836)	−1.0722 (0.2836)	−1.0722 (0.284)	−1.072 (0.284
	CMR	Car	−0.0225	−0.0265	−0.0133	−0.0223	−0.017	−0.011
		t-test time-series	−1.3671 (0.1716)	−2.18** (0.0295)	−2.67*** (0.0076)	−1.83* (0.067)	−1.94*(0.0525)	−0.6637 (0.5069)
		Corrado rank	−1.3129 (0.1892)	−2.138** (0.032)	−1.67* (0.0949)	−1.6284 (0.1034)	−1.5459 (0.1221)	−0.5202 (0.6029)
HIS	MM	Car	−0.0081	−0.0308	−0.0151	−0.0398	−0.0702	−0.0391
		t-test time-series	−0.2494 (0.803)	−1.285 (0.1988)	−1.5373 (0.1242)	−2.34** (0.019)	−2.92*** (0.0034)	−1.2045 (0.2284)
		Corrado rank	0.2052 (0.8374)	−0.6117 (0.5407)	−1.464 (0.14320	−1.65* (0.098)	−2.09** (0.0358)	−0.9015 (0.3673)
	CMR	Car	−0.007	−0.0306	−0.0153	−0.0423	−0.0724	−0.0396
		t-test time-series	−0.2147 (0.83)	−1.276 (0.2019)	−1.5661 (0.1173)	−2.49** (0.0126)	−3.02*** (0.0025)	−1.2186 (0.223)
		Corrado rank	0.2591 (0.7956)	−0.564 (0.5727)	−1.464 (0.1432)	−1.7223* (0.085)	−2.15** (0.0312)	−0.9181 (0.3586)
JKSE	MM	Car	−0.0736	−0.0798	−0.0202	0.0321	−0.0455	−0.1132
		t-test time-series	−3.04** (0.0024)	−4.47*** (0)	−2.77*** (0.006)	2.54** (0.011)	−2.55** (0.011)	−4.68*** (0)
		Corrado rank	−1.8684 (0.0617)	−3.14*** (0.0017)	−1.6424 (0.1005)	1.0359 (0.3003)	−0.5972 (0.5503)	−1.5438 (0.1226)
	CMR	Car	−0.0856	−0.0899	−0.0165	0.0374	−0.0543	−0.141
		t-test time-series	−3.52*** (0.0004)	−5.01*** (0)	−2.25** (0.0246)	2.95*** (0.0032)	−3.02*** (0.0025)	−5.80*** (0)
		Corrado rank	−2.18** (0.0294)	−3.43*** (0.0006)	−1.5734 (0.1156)	1.0757 (0.282)	−0.7635 (0.4452)	−1.3733 (0.1697)
KLSE	MM	Car	−0.0212	−0.0241	−0.0118	−0.0157	−0.0203	−0.0109
		t-test time-series	−1.2928 (0.1961)	−1.98** (0.047)	−2.38** (0.0169)	−1.83* (0.0663)	−1.67* (0.0948)	−0.6661 (0.5053)
		Corrado rank	−1.2484 (0.2119)	−1.95* (0.0506)	−1.65* (0.0977)	−1.6335 (0.1024)	−1.6396 (0.1011)	−0.6575 (0.5109)
	CMR	Car	−0.0225	−0.0265	−0.0133	−0.0167	−0.0223	−0.0109
		t-test time-series	−1.3671 (0.1716)	−2.17** (0.0295)	−2.67*** (0.0076)	−1.9394 (0.0525)	−1.8314 (0.067)	−0.6637 (0.5069)
		Corrado rank	−1.3129 (0.1892)	−2.13** (0.0325)	−1.67* (0.0949)	−1.5459 (0.1221)	−1.6284 (0.1034)	−0.5202 (0.6029)

Note(s): *Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level, p value in (parenthesis)
MM: Market Model, CMR: Constant Mean Return
Source(s): Authors calculation

Table 6.
Results of the impact of COVID 19 on selected Asian markets – continued Table 5

Market	Return model	Date	(−10 . . . 0)	(−5 . . . 0)	(0 . . . 0)	(0 . . . 2)	(0 . . . 5)	(0 . . . 10)
N225	MM	CAAR	0.0002	0.0119	0.0002	0.0052	−0.009	−0.0478
		t-test time-series	0.0057 (0.9955)	0.5707 (0.5682)	0.0224 (0.9821)	0.3533 (0.7239)	−0.4301 (0.6671)	−1.687* (0.0917)
		Corrado rank	0.0624 (0.9502)	0.524 (0.6003)	−0.0138 (0.989)	0.5817 (0.5608)	−0.2874 (0.7738)	−1.1443 (0.2525)
	CMR	CAAR	−0.0003	0.0114	0	0.0049	−0.0091	−0.0471
		t-test time-series	−0.0118 (0.9906)	0.548 (0.5837)	0.0007 (0.9994)	0.3333 (0.7389)	−0.4343 (0.66410	−1.668* (0.0953)
		Corrado rank	0.0416 (0.9668)	0.4902 (0.624)	−0.0621 (0.9505)	0.5299 (0.5962)	−0.3127 (0.7545)	−1.1485 (0.2507)
BSESN	MM	CAAR	−0.0166	−0.0198	−0.0098	−0.0108	−0.0474	−0.0186
		t-test time-series	−0.5588 (0.5763)	−0.8998 (0.3682)	−1.0906 (0.2755)	−0.6933 (0.4881)	−2.16** (0.0311)	−0.6246 (0.5322)
		Corrado rank	−0.5077 (0.6117)	−0.9635 (0.3353)	−1.3387 (0.1807)	−0.7649 (0.4443)	−1.938* (0.0526)	−0.4952 (0.6205)
	CMR	CAAR	−0.0184	−0.023	−0.0117	−0.0121	−0.0501	−0.0186
		t-test time-series	−0.617 (0.5372)	−1.0452 (0.2959)	−1.3041 (0.1922)	−0.7744 (0.4387)	−2.27** (0.0228)	−0.6237 (0.5328)
		Corrado rank	−0.5451 (0.5857)	−1.1072 (0.2682)	−1.4768 (0.1397)	−0.7809 (0.4349)	−2.03** (0.0419)	−0.4952 (0.6205)
CSE	MM	CAAR	0.0082	0.0035	−0.0077	−0.0079	−0.0074	−0.0151
		t-test time-series	0.437 (0.6621)	0.2525 (0.8006)	−1.356 (0.1751)	−0.8062 (0.4201)	−0.5325 (0.5944)	−0.8025 (0.4223)
		Corrado rank	0.0999 (0.9204)	0.5465 (0.5847)	−1.5733 (0.1156)	−0.9721 (0.331)	−0.5409 (0.5886)	−0.8863 (0.3754)
	CMR	CAAR	0.0066	0.0006	−0.0095	−0.0091	−0.0099	−0.0152
		t-test time-series	0.3506 (0.7259)	0.0422 (0.9664)	−1.656* (0.0977)	−0.9194 (0.3579)	−0.7076 (0.4792)	−0.799 (0.4243)
		Corrado rank	−0.0229 (0.9817)	0.3634 (0.7163)	−1.6424 (0.1005)	−0.9881 (0.3231)	−0.7156 (0.4742)	−0.8136 (0.4159)
DSEX	MM	CAAR	−0.1034	−0.0443	−0.0268	−0.0543	−0.1075	−0.0974
		t-test time-series	−3.24*** (0.0012)	−1.878* (0.0605)	−2.77*** (0.0055)	−3.26*** (0.0011)	−4.56*** (0)	−3.05*** (0.0023)
		Corrado rank	−2.86*** (0.0042)	−1.2339 (0.2172)	−1.67* (0.0949)	−0.9881 (0.3231)	−1.4537 (0.146)	−1.4689 (0.1419)
	CMR	CAAR	−0.0897	−0.039	−0.0213	−0.048	−0.0906	−0.0757
		t-test time-series	−2.96*** (0.003)	−1.74* (0.0812)	−2.34** (0.0193)	−3.04*** (0.0024)	−4.05*** (0.0001)	−2.50** (0.0124)
		Corrado rank	−2.60*** (0.0092)	−1.1156 (0.2646)	−1.656* (0.0977)	−0.9801 (0.327)	−1.4199 (0.1556)	−1.2671 (0.2051)
KSI	MM	CAAR	−0.0479	−0.046	−0.0126	−0.0318	−0.0038	−0.043
		t-test time-series	−1.4013 (0.1611)	−1.823* (0.0683)	−1.2267 (0.2199)	−1.781* (0.0749)	−0.1494 (0.8813)	−1.2592 (0.208)
		Corrado rank	−1.3524 (0.1762)	−1.6171 (0.1059)	−1.3111 (0.1898)	−1.944* (0.0519)	−0.8621 (0.38870	−1.0986 (0.272)
	CMR	CAAR	−0.0416	−0.0401	−0.0122	−0.027	−0.0026	−0.0312
		t-test time-series	−1.2184 (0.2231)	−1.5901 (0.1118)	−1.185 (0.236)	−1.5141 (0.13)	−0.1032 (0.9178)	−0.9138 (0.3608)
		Corrado rank	−1.2422 (0.2142)	−1.4706 (0.1414)	−1.3112 (0.1898)	−1.780* (0.0749)	−0.7916 (0.4286)	−0.9321 (0.3513)

(*continued*)

Table 6.

Market	Return model	Date	(−10 . . . 0)	(−5 . . . 0)	(0 . . . 0)	(0 . . . 2)	(0 . . . 5)	(0 . . . 10)
FTSEST	MM	CAAR	−0.0025	−0.0032	−0.0047	0.00	−0.0239	−0.0144
		t-test time-series	−0.1281 (0.8981)	−0.2159 (0.829)	−0.7801 (0.4353)	0.0036 (0.9972)	−1.638 (0.1014)	−0.7276 (0.4669)
		Corrado rank	−0.1881 (−0.1881)	−0.2763 (−0.2763)	−1.0751 (−1.0751)	0.0307 (0.0307)	−1.1541 (−1.1541)	−0.2801 (−0.2801)
	CMR	CAAR	−0.0011	−0.0029	−0.005	−0.0033	−0.0269	−0.015
		t-test time-series	−0.0562 (0.9551)	−0.1971 (0.8437)	−0.8362 (0.403)	−0.3155 (0.7524)	−1.8264* (0.0678)	−0.7551 (0.4502)
		Corrado rank	−0.072 (0.9426)	−0.2655 (0.7906)	−1.1149 (0.2649)	−0.3525 (0.7245)	−1.4522 (0.1465)	−0.5443 (0.5863)
KOPSI	MM	CAAR	0.0363	0.0237	0.0052	0.0069	−0.03	−0.0399
		t-test time-series	1.3999 (0.1615)	1.2384 (0.2156)	0.6591 (0.5098)	0.5072 (0.612)	−1.5672 (0.1171)	−1.5377 (0.1241)
		Corrado rank	1.5207 (0.1283)	1.4196 (0.1557)	0.9158 (0.3598)	0.6207 (0.5348)	−0.5148 (0.6067)	−0.7043 (0.4812)
	CMR	CAAR	0.0367	0.024	0.0052	0.0068	−0.0306	−0.0406
		t-test time-series	1.4121 (0.1579)	1.2512 (0.2109)	0.6581 (0.5105)	0.5009 (0.6164)	−1.5974 (0.1102)	−1.5658 (0.1174)
		Corrado rank	1.5287 (0.1263)	1.4305 (0.1526)	0.9291 (0.4641)	0.6284 (0.5298)	−0.5364 (0.5917)	−0.7323 (0.464)

Note(s): *Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level, p value in (parenthesis)
Source(s): Authors calculation

Table 7.
Abnormal return difference between global index and local index in local timeframe

Test value	SSEC	FTFVAS	HIS	JKSE	KLSE	N225	BSESN	CSE	DSEX	KSI	FTSEST	KOSPI
Δ AR of	0.012	0.007	0.010	0.000	−0.009	−0.001	0.002	0.009	0.000	0.011	0.005	−0.010
global and	0.001	0.008	0.004	0.009	−0.003	0.001	0.002	−0.006	0.021	0.000	−0.004	0.010
domestic	0.002	−0.005	0.007	0.003	0.002	−0.008	−0.003	−0.002	0.018	−0.009	0.005	−0.012
market	−0.015	0.003	−0.002	0.007	−0.004	−0.020	−0.004	−0.010	−0.011	0.000	−0.004	0.009
index (−10	−0.024	−0.001	−0.005	−0.003	0.001	0.017	−0.004	−0.006	0.020	−0.002	0.005	0.009
to	0.018	−0.001	−0.002	0.018	−0.004	−0.017	−0.010	−0.005	0.020	0.005	−0.002	0.005
+10 Days)	0.006	−0.003	0.002	0.021	0.003	0.017	−0.001	0.005	−0.026	0.003	0.004	0.004
	0.003	0.001	−0.009	−0.012	−0.007	0.006	−0.006	0.003	0.021	0.003	0.001	−0.004
	−0.011	0.013	−0.024	0.008	0.000	0.007	0.009	0.009	−0.041	0.008	0.005	0.002
	0.011	0.003	0.012	0.001	0.003	−0.005	0.010	0.005	0.015	0.016	−0.003	−0.003
	0.005	−0.030	−0.013	−0.048	0.003	−0.005	0.006	0.007	0.051	−0.008	0.003	0.005
	0.013	−0.022	0.006	0.044	−0.001	0.000	−0.012	−0.015	0.008	0.024	−0.006	−0.006
	0.010	0.008	−0.028	−0.005	−0.001	0.002	0.006	0.009	0.011	0.012	−0.017	0.011
	0.010	−0.008	−0.024	0.019	0.003	−0.005	−0.005	0.001	0.056	−0.002	0.025	−0.007
	0.016	0.000	0.007	−0.004	−0.009	0.006	0.008	0.013	0.076	0.014	0.000	−0.027
	−0.015	0.019	−0.002	0.007	−0.005	−0.008	0.000	−0.003	−0.093	−0.033	0.002	0.020
	0.009	0.016	−0.002	−0.010	−0.009	0.006	0.009	−0.008	0.048	0.032	−0.007	−0.024
	−0.001	−0.013	−0.005	0.025	0.005	−0.004	−0.001	−0.004	0.007	−0.003	0.017	−0.013
	0.008	−0.012	0.021	0.050	0.007	−0.012	−0.001	0.005	0.100	0.047	0.002	0.002
	−0.002	−0.005	0.002	−0.052	−0.011	0.007	0.002	−0.005	0.027	−0.014	−0.003	0.030
	−0.001	−0.005	−0.009	0.053	0.002	−0.015	−0.007	−0.010	0.037	0.035	−0.003	0.000
Mean	0.003	−0.001	−0.003	0.004	−0.002	−0.001	0.00	0.00	0.017	0.007	0.001	0.0002
T value	−1.053 (0.29)	−0.757 (0.47))	0.783 (0.44)	−0.636 (0.53)	0.83 (0.41)	0.54 (0.59)	−0.036 (0.97)	0.19 (0.85)	−1.49 (0.14)	0.061 (0.95)	−0.55 (0.58)	0.053 (0.958)
Z value	−1.58 (0.112)	−1.274 (0.204)	0.503 (0.617)	−0.654 (0.516)	1.21 (0.23)	0.18 (0.86)	0.352 (0.73)	0.68 (0.49)	−1.46 (0.14)	−0.15 (0.88)	−0.754 (0.45)	0.704 (0.48)

Note(s): *T* value derived from the independent *t*-test and *Z* value derived from Mann-Whitney U Test. *p*-value in (parenthesis). *Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.
Source(s): Authors calculation

fact that selected all Asian major market indices are co-moving with the global market indices (He *et al.*, 2020c). The data also show that COVID 19 has a very consistent influence on Asian stock markets (Khanthavit, 2020).

Table 8 is exhibiting the difference of CAR between major Asian capital market indexes and global market index in local time frame also supporting the same fact as found in Table 7 that there is no dissimilar reaction observed among major Asian capital markets. Four different event windows (*two pre-event and two post-event*) have been analyzed and no statistically significant difference was observed among the CARs. Therefore it can be argued that alternative hypothesis (H1a) is proved.

This study further tries to identify the potential difference in reaction between the selected Asian capital markets. The single factor ANOVA has been applied to identify any difference between these markets. The p-value corresponding to the F-statistic of one-way ANOVA is higher than 0.05, as shown by the results. Since p-value > α, H0 cannot be rejected. The mean ranks of all groups (markets) assume to be equal. In other words, the difference between the mean ranks of all groups is not big enough to be statistically significant. Other multiple comparison tests, such as Scheffe or Bonferroni, may not be able to determine which of the pairs of treatments are substantially different. Therefore it could be said that the market reactions were uniform between selected Asian markets to the first local detection of COVID 19, so the null hypothesis ($H0_b$) cannot be rejected, which might suggest that there has been a strong co-integration between these markets or possible regional or global spillover effect (see Table 9).

The study further extends the analysis to identify the classified market reaction in terms of market capitalization and liquidity. Selected 12 Asian markets are segregated among Developed, Emerging and Frontier markets according to their size and liquidity (MSCI, 2021). Table 10 depicts the CAARs of two pre-event and three post-event windows around local detection announcements. It is interesting to observe that all three markets had statistically insignificant negative CAARS in pre-event windows (0 . . . −5 and −10). Additionally, apart from the Frontier market characterized as lowest size and liquidity, Emerging markets and Developed markets did not generate any significant post-event CAARs. Only frontier markets have generated significant CAAR at event day and post-event period of (0 . . . 2) and (0 . . . 10) that might suggest an inefficient market behavior and higher risk and volatility among these low tier markets (Ngene *et al.*, 2018; Economou *et al.*, 2015).

Table 11 exhibits the variance analysis of the AAR of three market classes around the 21 days event periods. The result shows that the p-value corresponding to the F-statistic is higher than 0.05. Since p-value > α, H0 cannot be rejected. The mean ranks of all groups (markets) assume to be equal. So the second hypothesis of the study that there has been a significant difference in market reactions between three types of stock markets cannot be established.

5. Conclusion

COVID 19 is a classic black swan event, with no knowledge of its emergence, evolution, or even extinction, as well as the extent, and degree of its influence. The impact of the corona virus epidemic on Asian capital markets was investigated in this paper. An event study approach with two different return models, the constant mean return model and market model is used to identify the AAR and CAAR in the regional market context in both domestic and international timelines. Both parametric and non-parametric statistical text such as time series T-test, Corrado rank tests has been consecutively used to measure the statistical significance of the market response. Additionally, the single factor ANOVA test has been conducted to measure the significance of the difference in reaction between regional markets and market classes. Moreover, this study also tries to analyze the announcement effect based on market size and liquidity.

Event window	CAR (local Market index)	CAR (FTSE all world)	Δ CAR	Independent *t*-test	Mann–Whitney *U* test
SSEC					
0, −10	0.017	0.009	0.008	0.203 (0.841)	1.182 (0.238)
0, −5	0.035	0.003	0.032	1.494 (0.166)	1.841* (0.065)
0, 5	0.043	0.004	0.039	1.309 (0.220)	1.521 (0.129)
0, 10	0.068	0.016	0.052	1.494 (0.150)	1.182 (0.238)
FTFVAS					
0, −10	0.0106	0.016	−0.005	0.141 (0.888)	0.984 (0.327)
0, −5	−0.0122	0.005	−0.017	0.454 (0.659)	0.720 (0.471)
0, 5	−0.0511	−0.018	−0.032	0.680 (0.511)	0.240 (0.810)
0, 10	−0.0514	0.001	−0.052	0.951 (0.352)	0.525 (0.596)
HIS					
0, −10	−0.0055	0.016	−0.021	0.483 (0.633)	0.131 (0.896)
0, −5	−0.0298	0.005	−0.035	0.908 (0.385)	0.240 (0.810)
0, 5	−0.0716	−0.018	−0.053	1.524 (0.158)	1.040 (0.298)
0, 10	−0.0381	0.008	−0.046	0.803 (0.431)	0.853 (0.395)
JKSE					
0, −10	−0.0892	−0.093	0.004	0.061(0.951)	0.262 (0.794)
0, −5	−0.0919	−0.080	−0.011	0.178 (0.861)	0.400 (0.689)
0, 5	−0.0563	−0.069	0.013	0.104(0.918)	0.080 (0.936)
0, 10	−0.1446	−0.223	0.079	0.389 (0.701)	0.131 (0.896)
KLSE					
0, −10	−0.0251	−0.010	−0.015	0.578 (0.569)	0.984 (0.327)
0, −5	−0.0279	−0.025	−0.002	0.127 (0.901)	0.560 (0.575)
0, 5	−0.0237	−0.014	−0.009	0.284 (0.782)	0.400 (0.689)
0, 10	−0.0135	0.0024	−0.015	0.407 (0.687)	0.525 (0.596)
N225					
0, −10	0.0073	0.014	−0.0075	0.172 (0.864)	0.131 (0.896)
0, −5	0.0156	0.013	0.0022	0.067 (0.947)	0.080 (0.936)
0, 5	−0.0049	0.005	−0.010	0.515 (0.617)	0.080 (0.936)
0, 10	−0.0395	−0.011	−0.028	0.746 (0.464)	0.197 (0.841)
BSESN					
0, −10	−0.0105	−0.010	−0.000	0.017 (0.987)	0.065 (0.944)
0, −5	−0.0187	−0.025	0.0067	0.278 (0.786)	0.240 (0.810)
0, 5	−0.0181	−0.021	0.0030	0.112(0.913)	0.080 (0.936)
0, 10	0.0097	0.0054	0.0043	0.098 (0.922)	0.131 (0.896)
CSE					
0, −10	0.0063	−0.004	0.010	0.352 (0.728)	0.065 (0.944)
0, −5	0.0004	−0.025	0.025	1.191 (0.261)	1.040 (0.298)
0, 5	−0.0101	−0.021	0.011	0.399 (0.698)	0.400 (0.689)
0, 10	−0.0155	−0.004	−0.011	0.349 (0.730)	0.787 (0.429)
DSEX					
0, −10	−0.098	−0.186	0.088	0.865 (0.397)	1.116 (0.262)
0, −5	−0.0435	−0.083	0.040	0.398 (0.698)	0.400 (0.689)
0, 5	−0.0951	−0.203	0.108	1.126 (0.286)	0.880 (0.378)
0, 10	−0.084	−0.411	0.327	1.435 (0.166)	0.880 (0.378)

(*continued*)

Table 8.
CAR difference between global index and local indexes of different event windows

Event window	CAR (local Market index)	CAR (FTSE all world)	Δ CAR	Independent *t*-test	Mann–Whitney *U* test
KSI					
0, −10	−0.0427	−0.069	0.027	0.527 (0.603)	0 (1)
0, −5	−0.0407	−0.068	0.027	0.643 (0.534)	0.560 (0.575)
0, 5	−0.0032	−0.010	0.007	0.101 (0.921)	0.560 (0.575)
0, 10	−0.0323	−0.137	0.104	0.884 (0.387)	1.050 (0.293)
FTSEST					
0, −10	0.001444	0.016	−0.014	0.785 (0.441)	0.722 (0.471)
0, −5	−0.0015	0.005	−0.006	0.392 (0.703)	0.400 (0.689)
0, 5	−0.02548	−0.018	−0.006	0.267 (0.794)	0.080 (0.936)
0, 10	−0.01248	0.001	−0.013	0.307 (0.761)	0.393 (0.696)
KOSPI					
0, −10	0.038833	0.021	0.016	0.562 (0.580)	1.113 (0.262)
0, −5	0.025175	0.015	0.009	0.714 (0.491)	0.880 (0 0.378)
0, 5	−0.02944	−0.025	−0.004	0.097 (0.924)	0.240 (0.810)
0, 10	−0.03847	−0.030	−0.008	0.160 (0.874)	0.197 (0.841)

Note(s): *T* value derived from the independent *t*-test and *Z* value derived from Mann–Whitney *U* Test. *p*-value in (parenthesis). *Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level
Source(s): Authors calculation

Table 8.

ANOVA: Single factor
Summary

Groups	Count	Sum	Average	Variance
SSEC	21	0.050801	0.002419	0.000131
FTVAS	21	−0.00683	−0.00033	0.00013
HIS	21	−0.03217	−0.00153	0.000198
JKSE	21	−0.16657	−0.00793	0.000402
KLSE	21	−0.02035	−0.00097	3.01E−05
N225	21	−0.04779	−0.00228	0.000131
BSESN	21	−0.02542	−0.00121	8.31E−05
CSE	21	0.00082	3.9E−05	3.07E−05
DSEX	21	−0.1741	−0.00829	0.001174
KSI	21	−0.07823	−0.00373	0.000221
FTSEST	21	−0.00624	−0.0003	5.78E−05
KOSPI	21	−0.00499	−0.00024	0.000152

ANOVA

Source of variation	SS	Df	MS	*F*	*p*-value	*F* Crit
Between groups	0.002356	11	0.000214	0.937678	0.504787	1.828695
Within groups	0.054827	240	0.000228			
Total	0.057184	251				

Source(s): Authors Calculation
Note(s): Result derived from the single factor ANOVA test

Table 9. Variance analysis of returns between selected Asian markets

Table 10.
CAAR in event window for major Asian indices in terms of size and liquidity

Emerging markets Event windows	JKSE	KLSE	SSEC	BSESN	KOSPI	CAAR	*T* value	*p*-value
(−10 . . . 0)	−0.074	−0.021	0.004	−0.017	0.036	−0.014	−0.710	0.516
(−5 . . . 0)	−0.080	−0.024	0.029	−0.020	0.024	−0.014	−0.650	0.551
(0 . . . 0)	−0.020	−0.012	0.005	−0.010	0.005	−0.006	−1.129	0.322
(0 . . . 2)	0.032	−0.016	0.025	−0.011	0.007	0.008	0.714	0.514
(0 . . . 5)	−0.046	−0.020	0.037	−0.047	−0.03	−0.021	−1.234	0.284
(0 . . . 10)	−0.113	−0.011	0.052	−0.019	−0.040	−0.026	−0.877	0.430

Frontier markets Event windows	CSE	DSEX	KSI	FTFVAS	CAAR	*T* value	*p*-value
(−10 . . . 0)	0.008	−0.103	−0.048	0.012	−0.033	−1.042	0.373
(−5 . . . 0)	0.004	−0.044	−0.046	−0.012	−0.025	−1.743	0.179
(0 . . . 0)	−0.008	−0.027	−0.013	−0.033	−0.020	−2.954*	0.059
(0 . . . 2)	−0.008	−0.054	−0.032	−0.053	−0.037	−2.922*	0.061
(0 . . . 5)	−0.007	−0.108	−0.004	−0.068	−0.047	−1.614	0.205
(0 . . . 10)	−0.015	−0.097	−0.043	−0.051	−0.052	−2.620*	0.079

Developed markets Event windows	HIS	N225	FTSEST	CAAR	*T* value	*p*-value
(−10 . . . 0)	−0.008	0.000	−0.001	−0.003	−0.961	0.437
(−5 . . . 0)	−0.031	0.012	−0.003	−0.007	−0.473	0.682
(0 . . . 0)	−0.015	0.000	−0.005	−0.007	−1.210	0.349
(0 . . . 2)	−0.040	0.005	−0.003	−0.013	−0.746	0.533
(0 . . . 5)	−0.070	−0.009	−0.027	−0.035	−1.589	0.253
(0 . . . 10)	−0.039	−0.048	−0.015	−0.034	−2.834	0.105

Note(s): *T* value derived from the single sample *t*-test
*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level
Source(s): Authors calculation

Table 11.
Variance analysis of AAR between Asian markets segments

ANOVA: Single factor Summary Groups	Count	Sum	Average	Variance
AAR (Developed)	21	−0.030	−0.001	0.000
AAR (Emerging)	21	−0.034	−0.002	0.000
AAR (Frontier)	21	−0.065	−0.003	0.000

ANOVA Source of Variation	SS	Df	MS	*F*	*p*-value	*F* crit
Between Groups	3.35E−05	2	1.68E−05	0.258411722	0.773132	3.150411
Within Groups	0.003893	60	6.49E−05			
Total	0.003926	62				

Note(s): Result derived from the single factor ANOVA test
Source(s): Authors calculation

Findings reveal that all selected twelve Asian markets have significantly reacted to the first detection of local COVID 19 cases. The market reactions have been uniform on the event day as represented by statistically significant negative AAR and CAAR. The single factor

ANOVA result also proved that there is no heterogeneity in terms of short-term market reactions between 12 regional markets. Moreover, there is no indication that these major Asian stock market indexes deviate considerably from the FTSE All-World Index. The classified market-level analysis however exhibits that Frontier markets have generated significant post-event negative CAAR whereas both the emerging and developed markets have insignificant post Event negative CAAR. However, single-factor variance analysis shows that there has been no difference in daily AAR between frontier, emerging and developed markets. Overall the findings show that the pandemic has altered investors' feelings, making them panicked and worried about their assets. Market uncertainty has arisen as a result of the epidemic, which has undermined investor confidence and resulted in market volatility of varying degrees, depending on the intensity of the pandemic on the region.

The findings of this study have significant consequences for policymakers. Given the finding's empirical value, it is reasonable to suppose that they will be incredibly useful for personal and institutional investors in creating efficient global portfolio to diversify investment risk and for industrial and economic specialists to research the market behavior and capital market theoretical implication and stock market regulators and for governments in formulating investment and trading policy to enhance investors' confidence and market liquidity in combating this unprecedented epidemic. However, the article's contribution might have been compromised by the absence of socio-demographic, technical, financial and other significant policy factors from the analysis. Furthermore, the analysis is limited by the fact that it ignores the effects of the pandemic on individual stock performance in selected Asian markets. As a result, the study has room for further improvement. For example, using behavioral finance theory, it would be useful to analyze the pandemic's consequence at an industry level for the afflicted nations, since the pandemic's influence is unevenly distributed (both favorably and adversely) across industries. Moreover, other socioeconomic-political, demographic, technical and policy variables that are important in forecasting anomalous stock returns might be identified as part of a study project.

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