COVID-19 Pandemic and Firm-Level Dynamics in the USA, UK, Europe, and Japan

Abstract

This paper examines the impact of the coronavirus pandemic during its first and second waves for the USA, UK, Europe, and Japan. We explore the firm-level dynamics and exhibit the impact of coronavirus events on large and small firms and firms' idiosyncratic risk. We find that the intensity of the impact of the coronavirus pandemic events is not uniform for firms. The Black Swan events in March 2020 exhibit a substantial effect than the second wave till April 2021. The second wave analysis reveals the sign of recovery and receding effect of the pandemic. The idiosyncratic analysis shows the positive impact of the coronavirus and stringency measures on the idiosyncratic risk.

Keywords: Stock Returns; Event Study; COVID-19; Structural Break, Idiosyncratic risk

JEL Code: G14, G12, G13, C34

1. Introduction

The coronavirus pandemic has reversed the global business cycle with an unprecedented loss of lives and livelihood. The subsequent waves have become a global cause of concern as new regions are trapped by the virus. The coronavirus pandemic has sought the attention of researchers with numerous studies covering macro and micro dimensions. The first version focussed on the macro dimension, followed by the micro dimension with firm-level analysis. There is a need to incorporate the impact of the second wave and analyse the learnings from the first wave across countries. This study is a significant contribution in this direction as it examines the first and second waves of the coronavirus pandemic and provides a micro (firm) perspective to the analysis. The study focuses on the developed markets as these economies are major drivers of the global economy.[1] We examine the firms in two stages. At the first stage, we confirm the first and second waves of coronavirus pandemic on the stock market performance using the event-study approach. The result of the first wave shows significant impact than the second wave in the case of developed markets comprising the USA, UK, Europe, and Japan. We, then, shortlist the firms based on their size and number of employees to confirm whether the impact of the coronavirus pandemic has been uniform across firms (large and small). Employability implies the number of employees in a firm to ensure that we

[1] Numerous studies have examined the impact of coronavirus at the macro and financial markets levels in the literature. For instance, Haroon and Rizvi (2020) for the US and world markets. Goodell and Huynh, (2020) examined the trading behaviour of US legislators during the coronavirus outbreak. Hernandez et al. (2020) analysed the impact on developing and emerging America. Sharif, Aloui, and Yarovaya (2020) on the effects of coronavirus outbreak on the US economy. Corbet et al. (2020) repuation-based contagion of the coronavirus pandemic. Ali, Alam, and Rizvi (2020) examine reactions and channels of COVID-19 spread. Haroon and Rizvi (2020) investigated the relationship between pandemic news and stock market volatility. Corbet, Larkin, and Lucey (2020) on Chinese stock markets and bitcoin during the pandemic's peak. Hartley and Rebucci (2020) showcase the significant effect of quantitative easing on emerging and developed markets. Maneenop and Kotcharin (2020) examine the impact of coronavirus pandemic on the global airline stock performance. Chen and Yeh (2021) examine the reactions of US industries to both the global financial crisis of 2008 and COVID-19 pandemic. Heyden and Heyden (2021) showcase the impact of short-term market reactions to COVID-19 during the first phase. At sector level, Ahmad, Kutan and Gupta (2021) examine the US, UK, European sectors and conclude the devastating effect of the coronavirus outbreak during the second week of March 2020. Ahmad et al. (2021) confirm the network synchronicity with the implied volatility of US stock market with sectoral returns. Szczygielski et al. (2021) find the significant impact of COVID-19 uncertainty in the global industry returns.

do not miss analysing the impact of the pandemic on firms' employment strength. One of the commonly pursued objectives is to find whether the rescue measures should have the components of first come and first serve or oriented to impacted firms. In the literature, we see a gap in this respect, and studies have conducted the performance of firms uniformly in the case of China, Japan, Netherlands, and the USA. Some of the relevant studies are Morikawa (2021), Kanno (2021), Groenewegen et al. (2021), Ke (2021), Ren et al. (2021), Yong and Laing (2021), Krammer (2021), Jin et al. (2021), and Huynh, Foglia, Doukas (2021).

At the second stage, we examine the firm-level behaviour of firms in two steps. In the first step, we calculate the idiosyncratic volatility of sample firms and confirm whether COVID-19 and subsequent stringency measures and firm-specific factors impacted the firms' idiosyncratic volatility. We also confirm this analysis with the cross-sectional regression of Fama and Macbeth (1973). This analysis is essential as it makes the event-study analysis robust and comprehensive from a policy point of view. To summarize, the objectives of this study are as follows: *First*, to examine the impact of coronavirus outbreak events during the first and second waves on the stock prices of firms in the USA, UK, Europe, and Japan. *Second*, to investigate the impact of coronavirus outbreak and stringency measures and balance sheet indicators on the idiosyncratic volatility of firms. To our knowledge, this is the first study that provides a detailed account of the first and second waves for developed markets.

The stock market crash has always fascinated the researchers with a host of studies examining the single-day fall in stock prices due to extreme events (Zhang and Shinki, 2007; Herrera and Schipp, 2014; Piccoli et al., 2017; Braun, Ammar, and Eling, 2019; Bash and Alsaifi, 2019; Kemper and Mortenson, 2020). We find similar analysis for the coronavirus outbreak events in the literature duo unforgettable second week of March during which the

US stock market nosedived. According to Adrian and Natalucci (2020), the major equities markets have observed a decline of 30 percent in a week. Mazur, Dang, and Vega (2021) also suggest that the coronavirus outbreak triggered the March 2020 stock market crash as Dow-Jones Industrial Average (DJIA) fell by 26%. It is noteworthy that in the second week of March 2020, the US Securities and Exchange Commission (SEC) had to apply circuit breakers four times to avoid the Black Swan events similar to the *1987 Black Friday*.

As the developed markets have experienced the first wave, the second and subsequent waves have created panic among policymakers regarding the delay in recovery. Although the vaccine invention provides a timely respite, its uneven distribution and vaccine hesitance started the debate on poor economic recovery. Apart from emerging markets, the second wave has been harmful to the UK and Japan, where the regulatory structure faced enormous challenges to keep moving the economy. In this context, the firm-level analysis may provide an immediate direction to whether the intensity of the second wave has been the same as the first wave.

We find that the first wave of COVID-19, particularly during the Black Swan events of March, had a severe impact on firms' and the impact across large and small firms has been uniform for the USA and to some extent in Europe. But we do not observe such behaviour for the UK and Japan. The event-study analysis suggests that the impact of the first wave had a strong impact on Europe and the US markets. However, we do not observe a similar impact intensity during the second wave in these countries. The event-study analysis till April 2021 reveals the recovery and better performance in the stock markets of these economies. There is also a visible impact of vaccination drive and hope for a quicker recovery. The idiosyncratic analysis shows a significant and positive impact of COVID-19 and stringency measures on firms' idiosyncratic risk. The analysis of large and small firms also conveys the same. Time-series and cross-sectional analysis further confirms the negative impact of cash flow, return

on equity, market capitalization (size) on the idiosyncratic risk of the firms during the sample period that significantly covers the coronavirus outbreak period.

2. Literature Review

Some studies have conducted firm-level analysis to understand the propagation mechanism in the literature on the coronavirus pandemic impact. Morikawa (2021) analyses the productivity of Japanese firms during the initial phase of the COVID-19 outbreak. Kanno (2021) develops a susceptible-infected-recovered-dead model to study the risk contagion of COVID-19 in Japanese firms. Groenewegen et al. (2021) show the impact of state aid in the case of the Netherlands during the first wave of 2020. Ke (2021) finds that the COVID-19 has increased the cost of equity capital of US firms by 172 basis points. In the case of China, Ren et al. (2021) analyse the performance of firms until the first quarter of 2020 and the COVID-19 outbreak. Yong and Laing (2021) analyze the impact of COVID-19 on US firms' international exposure. Krammer (2021) provides a theoretical perspective to the adaptation strategies of firms to cope-up the COVID-19 pandemic. Jin et al. (2021) examine the impact of COVID-19 on firm innovation by examining the Chinese firms. They find the state-owned enterprises have a clear advantage over non-state-owned enterprises. During the coronavirus pandemic, Huang, Yang, and Zhu (2021) focus on firm performance and brand value. They find that the top brands have efficiently mitigated the stock market crash in the US economy. Using multi-country data, Hu and Zhang (2021) show the impact of COVID-19 on firm performance and conclude that COVID-19 has deteriorated the financial performance of firms. The COVID-19 disruptions also increased the volatility of Chinese stocks, and it showed a positive relationship with different measures of economic policy uncertainty, as reported by Yang and Yang (2021). A similar inference was drawn by Jie et al. (2021). They conclude that COVID-19 uncertainty had a significant impact on the firms' investment in China. For the US stocks, Chebbi, Ammer, and Hameed (2021) showcase the negative effects

of COVID-19 on stock liquidity. The environmental impact of COVID-19 is examined by Guérin and Suntheim (2021). They find that the COVID-19 shock has negatively impacted the firms' environmental performance. The COVID-19 disruptions on the stock also impacted the performance of efficient and inefficient firms, as examined by Neukirchen et al. (2021). They find that the highly efficient firms recorded a higher jump in their stock returns than the crisis-period returns. Whether operating flexibility contributed significantly to the firm's performance during the first wave of coronavirus outbreaks has been examined by Liu, Yi, and Yin (2021). They find that the operating flexibility indeed helped the firm, especially in those provinces which were badly hit by the pandemic in China. For Europe, Huynh, Foglia, Doukas (2021) confirm the strong interconnectedness in the early phase of COVID-19 for the 46 large companies. Didier (2021) highlights the relevant issues in firms' financing and how difficult it has become for firms to remain in the hibernation model due to unprecedented uncertainty. Ahmad, Chahal, and Rais (2021) also studied the impact of coronavirus outbreaks at the firm level for the ASEAN countries. They found that the first wave and the subsequent stringency measures had a significant effect on the economic integration of these countries.

Overall, it is apparent that most studies cover the first wave of the coronavirus pandemic and have limitations regarding the firm selection and choice of variables. We still find our study different than the above-discussed studies and contribute extensively to the literature. The rest of the study is organized as follows: Section 3 outlines the data and methodology. Section 4 focuses on analyzing results. Section 5 concludes the study.

3. Data and Methodology

We consider the daily data for the event study analysis from May 1, 2019, till April 30, 2021. For Europe, we consider S&P (Standard and Poor's) for Europe, which has 186 constituents. For Japan and the UK, Nikkei-225 and FTSE-350 (Financial Times Stock

Exchange), respectively. For the US market, we consider 503 stocks of S&P-500. All the sample data have been sourced from Thomson DataStream (Refinitiv). We calculate the abnormal returns from Fama and French (1992), three-factor model. We download the factors series from the Fama and French's webpage.[2]

We identify significant events related to the coronavirus pandemic and financial markets. In the first step, we adopt linear and nonlinear endogenous structural break models. As a linear model, we use the Bai and Perron (2003, hereafter BP) model which is based on the general-to-specific procedure. The key characteristic of this test is that it allows us to identify the unknown dates endogenously. It uses the *sup* F_T (k, n) test that has the null hypothesis of no structural break (n = 0) against the alternative of a structural break (n = k). The null hypothesis remains the same for the double maximum and sequential test criteria, adding a methodological dimension to structural breaks. In the second step, we adopt the nonlinear framework of the Markov-switching Model (MSM) coined by Hamilton (1989). We use the MS-DR (Dynamic Regression) framework of Doornik (2013) due to the adoption of high-frequency data. The MS-DR has the same number of regimes and states, making it suitable for daily and monthly data. We specify the MS-DR model with switching intercept (means) and the variance[3]:

$$r_t = \alpha_i(S_t) r_{t-i} + \mu(S_t) + \varepsilon_t \qquad (1)$$

$$\varepsilon_t \sim iid[0, \sigma^2(S_t)], s_t = 1, 2$$

where we assume that a market return r_t is generated as an autoregression of order k with regime-switching in intercept (mean) μ and variance (σ^2). α_i is the model parameter & ε_t is a residual term. Following the chronology of the coronavirus pandemic, we apply the BP

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International (Accessed on 10th May 2020).

[3] We follow following criteria to decide about the appropriate number of regimes. At the first step, we estimate the model with two and three regimes and based on likelihood and residuals diagnostics criteria, we select the appropriate regime. We have considered two regime MS-DR model for our analysis.

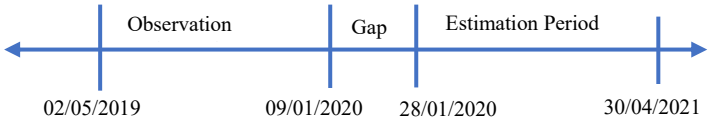
test on the stock market returns of China, Italy, the UK, and the USA. We calculate the growth of total coronavirus cases and deaths and then apply the endogenous structural break tests.

Next, we map the identified dates to the timelines of the coronavirus pandemic reported by well-known new agencies. The list includes the New York Times, The Economist, CNBC, Bloomberg, Forbes, and The Guardian. After this, we consider unknown dates as events and apply the Event Study Methodology (ESM). ESM is a widely popular tool to assess the impacts of news announcements and extreme events. Even for the pandemic, Kim et al. (2020) have applied to understand the impact on firms and financial markets. To calculate abnormal returns, we choose the Fama French 3-Factor model to capture the state of the market before the occurrence of the events (i.e., during the estimation period). The market model is as follows

$$ExR_{it} = \alpha_{it} + \beta(R_{mt} - R_{ft}) + \gamma SMB_t + \delta HML_t + \varepsilon_{it} \quad (2)$$

where ExR_{it} is the excess return of stock i at time t, R_{mt} is market index return, R_{ft} is the risk-free return at time t, SMB_t is the size premium at time t, HML_t is the value premium at time t and $\epsilon_{i,t}$ is the error term. α, β, γ, and δ are estimated parameters.

The estimated market model is then used as a reference to calculate the expected returns ER_{it} during the event window. Generally, in ESM studies, the evaluation period is chosen to be a few days apart from the event window to prevent information leakage on the estimated market model. More specifically, in this study, we have chosen the evaluation period of 329 trading days with a 12-trading day gap from the observation period.



Event Timeline

Utilising the estimated market model, we calculate the AR and the CAR values as below:

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

$$CAR_i = \sum_{t=t_0}^{t_1} AR_{it} \tag{4}$$

where, R_{it} is the actual return of firm *i* at time *t*, $E(R_{it})$ is the estimated return using the computed market model of Eq. (2). The CAR_i is then computed by taking the sum of the *ARs* over the chosen event window. We select three windows for the AR and CAR are [-1, +1], [-3, +3], and [-5, +5] were considered.[4] We use [-5, +5] for the analysis. However, the results of [-1, +1] and, [-3, +3] are available upon request. To establish the significance of the evaluated AR, and CAR values, we conduct the t-tests as follows: $t_{AR_{i,t}} = AR_{i,t} / S_{AR,i}$; where $S_{AR,i}$ is the standard deviation of the AR values calculated in the estimation window. $t_{CAR_{i,t}} = CAR_{i,t} / S_{CAR,i}$,

4. Results

4.1. Event-study Analysis

The event dates identified through the endogenous structural break test are listed in Table 1.[5] It appears that the event dates identified by the structural break models seem valid. According to Mazur, Dang, and Vega (2021), the coronavirus outbreak impacted the global market in March 2020. Our structural break test also reports the same and identifies three break dates: March 12, 18, and March 23. We observe that the highly significant event occurs during the

[4] We are thankful to the anonymous referee for the suggestion to calculate the AR and CAR for a relatively longer period.

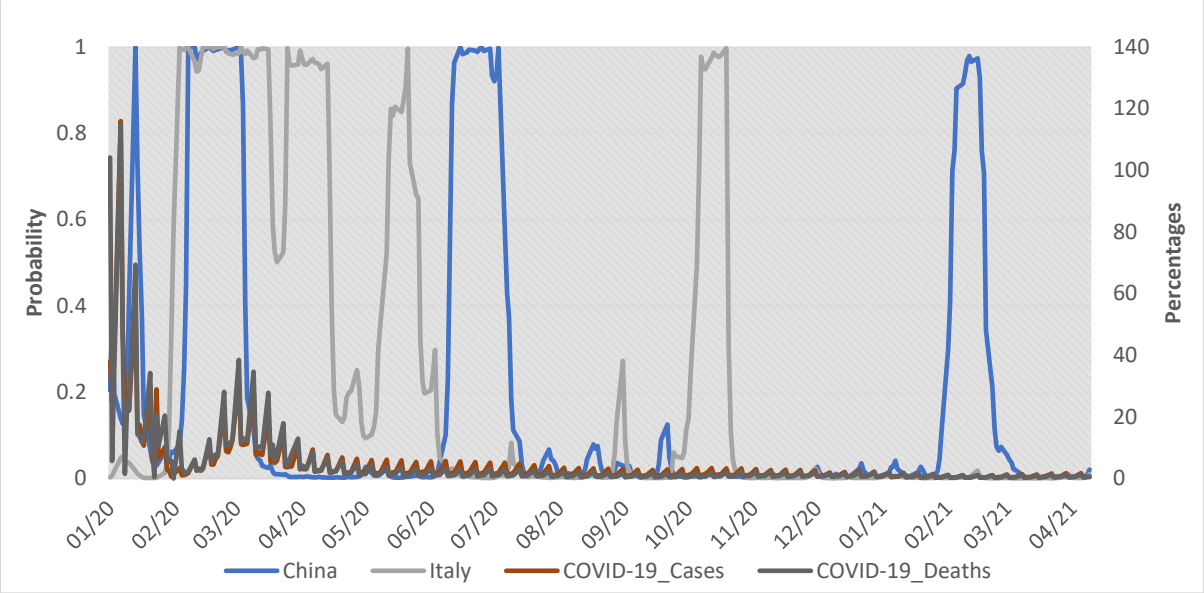
[5] Specific to structural break analysis, we consider the stock index returns of China (Shanghai Stock Exchange A-Share) and Italy (FTSE- MIB), in addition to the USA and the UK.

first and second weeks of March 2020. According to WEF (2020), SEC had to use circuit breakers to the S&P 500 on March 9, 12, 16, and 18. In February, the BP test appropriately captured the coronavirus outbreak in South Korea and Italy. The MSM model further confirms the BP results. Figure 1 (Panels A & B) exhibits the plots of the smoothed probabilities of the MSM model. We observe that during January and February, the stock markets of China and Italy experienced spikes and a bearish phase. For instance, the smoothed probability of China reached its peak from the third week of January, and with a slight moderation, it again showed a rise during the third and fourth weeks of February. This observation allows us to conclude why we have major events starting from the first week of February 2020. According to Farrer (2020), the coronavirus fear had a catastrophic impact on the Chinese stock market as the Shanghai Composite Index fell by more than 8%, the highest since the 2015 slowdown. As a result, Chinese authorities had to announce a rate cut and stimulus package. We observe significant upheavals towards the end of February and the first half of March (CNBC, 2020). The dates considered by Al-Awadhi et al. (2020) and Corbet, Larkin, and Lucey (2020) are different than our study because they select the dates based on the news coverage only.

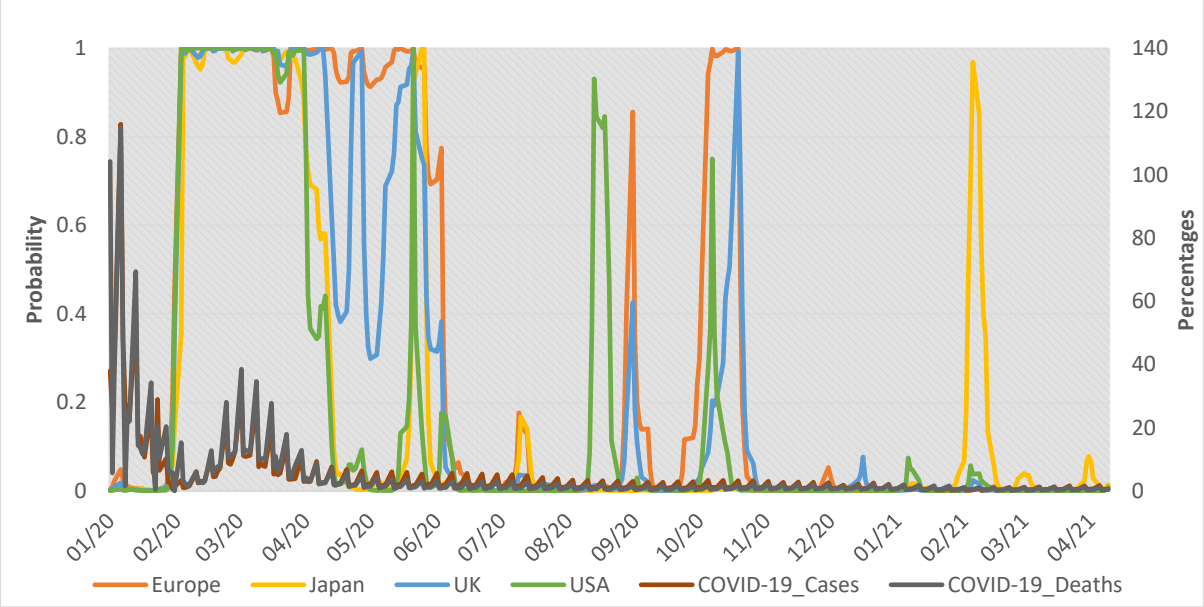
We also cover 2021 till April when most countries experienced either the first wave or second wave and take into account the effect of vaccination derives in the sample countries and how the markets' reacted at the beginning of 2021. The results suggest that during 2021, we identify two breaks, i.e., February 16 and March 4. On both dates, we observed that the stock markets had positive reactions.

Figure 1: Growth in Coronavirus Cases and Deaths and Bearish Stock Markets of China, Italy, USA, and the UK

Panel A: China and Italy



Panel B: USA, UK, Europe, and Japan



Note: the secondary axis shows the smoothed probabilities of the bear market for the period January 23, 2020, till April 30, 2021. COVID-19 (Deaths) and COVID-19 (Cases) exhibit the global growth of Coronavirus cases and deaths. China, Italy, the USA, UK, and Europe represent the daily stock returns of representative stock market indices.

Table 1: List of events identified using multiple structural break model

Even Date	Events	Source
28-01-2020	The first coronavirus death was reported outside China. Chinese stock market fell by more than 9% due to coronavirus outbreak	New York Times and Bloomberg, and The Guardian
18-02-2020	Hundreds left the quarantined Diamond Princess cruise. Seventy-nine people were reported positive.	New York Times
21-02-2020	A secret church group in South Korea was linked to the surge in infections.	WEF and The Guardian

05-03-2020	The US approved widespread testing and called for an interest rate cut. The first death of coronavirus in the UK.	New York Times and CNBC
12-03-2020	Pandemic crashes the global stock markets with disruptions across sectors and industries. Down Jones experienced the circuit breaker, and FTSE recorded its worse performance since Black Monday in October 1987.	BBC
18-03-2020	The global coronavirus infection crosses 200,000. Iran and France reported a spike in coronavirus cases by 15% each. The EU barred most travelers from outside.	New York Times and The Guardian
23-03-2020	Dow Jones sinks 580 points in the wake of Senate failing to pass the fiscal stimulus and COVID concerns	CNBC
09-04-2020	Global COVID-19 cases neared 1.5 million. The Dow Jones experienced the jumps as Federal Reserve unveiled the Main Street lending program. IMF acknowledges the COVID-19 pandemic as the worst economic crisis since the 1930s.	CNBC & BBC
15-05-2020	The stock market in the US performs well amid election uncertainty. The Dow closes up more than 8% due to a surge in the volume of healthcare stocks.	BBC
19-05-2020	Dow Jones recorded the highest jump due to a surge in the trading of tech firms. NASDAQ Composite, S&P 500, and Down Jones Industrial Average (DJIA) recorded a significant leap.	CNBC
08-06-2020	DJIA and S&P 500 surged on account of COVID vaccine news shared by Pfizer and BioNTech with an efficacy rate of more than 90%. Information about the spread of the virus to other regions in the Middle East, Latin America, and South Asia.	CNBC New York Times
18-06-2020	Coronavirus outbreak in Beijing impacted the markets. The 1.51 million Americans applied for unemployment benefits.	CNBC
06-07-2020	Amid the rise in COVID-19 cases in 23 states in the US, the US stock market rallied because of a surge in technology stocks.	CNBC
16-02-2021	The stock market performed well on the expectation of the second tranche of fiscal stimulus and a downward trend in COVID-19 infections. Major indices in the US went up due to technology stocks.	NASDAQ
04-03-2021	The stock market performed well on account of visible green shoots in the US economy in terms of nonfarm payrolls and a better sectoral growth outlook. DJIA reported a jump of 570 points	CNBC

WEF: World Economic Forum.

It is apparent that the coronavirus outbreak has generated the Black Swan events, and most of these events occurred in March 2020. The structural breaks during the 2021 period exhibit a sign of recovery and green shoots in these economies. We provide a detailed analysis of four dates viz., March 12, 18 in 2020, and February 16 and March 4 in 2021, analyze their impacts on different classifications of firms. We first classify the constituents of stock indices of the USA, UK, Europe, and Japan into large and small using two criteria. *First*, based on the number of employees, and *second,* based on the size. Table 2 (Panels A-D) shows large and small firms' AR and CAR values based on the number of employees. The impact of coronavirus events is significantly visible in the US stock market as both (large and small)

firms are impacted strongly by the March 12 stock market crash than the other events. For the UK, March 18 is more visible on smaller firms than the large firms.

Similarly for Europe, the events on March 12 and 18 are significant, with negative AR and CAR values across large and small firms based on their employment strength. For Japan, March 12 and 18 are sparingly effective with negative and positive AR and CAR values. Focussing on 2021, February 16, and March 04 are statistically significant for the USA though the values are smaller than the March 2020 dates. For Europe, UK and Japan, the event dates are not as statistically significant as we find in the US. Sector-wise distribution of firms suggests that consumer discretionary, consumer staple, and real estate firms are adversely impacted compared to other sectors. For the UK, Europe, and Japan, the firms in consumer staples, financials, consumer discretionary, and real estate firms. These results agree with the analysis of Kumar and Haydon (2020), Goodell and Huynh (2020) and Hartley and Rebucci (2020), and Haroon and Rizvi (2020). The finding implies that the coronavirus outbreak may decrease the possibilities of employment opportunities in the firms. However, during 2021 events, industries, information technology, and financials as leading sectors across sample countries.

Overall, the classification of the top ten firms based on the number of employees suggests that the Black Swan event dates had a significant impact, small and large, on the US and European markets. The Japanese stocks (firms) exhibit a mixed effect on all event dates. Based on this result, we conclude that the above result provided sufficient insights about the design of policy stimulus and recovery plans. It will be essential to track the performance of affected firms, and if the negative effect persists for a more extended period, a proper stimulus package may give a new life. For instance, in the case of the US and Europe, policymakers should emphasize reviving the smaller firms to generate more employment than the larger firms. Although one may argue that the stock market fall is often linked to short-

term gains or losses, it is also critical to monitor these firms' financial and operating performances. From the investors' perspective, the result suggests investment in large and small firms until March 31, 2020. However, the 2021 event dates significantly explain the impact of COVID-19 vaccine and vaccination plans in these economies.

We also classify the firms based on their size (market capitalization) to confirm the above results. Table 3 (Panels A – D) shows the top ten small and large stocks (companies) based on their size. The results clearly distinguish the significant impact of March 12 and March 18 events on the large and small-sized firms in the USA. For the UK and Japan, the significance is observed for large and small-sized firms. For both (the US and Europe), the AR and CAR values of March 12 are frequently significant than the rest of the countries. The AR and CAR values are negative for healthcare, consumer discretionary, energy, real estate, and industries for the UK and Japan. In contrast, the rest of the sector had favourable green shoots. The 2021 event dates reflect the upward shifts in the mood of the large and small firms analysed across markets, as most AR and CAR values are positive and statistically significant.

The results of Table 3 seemed aligned with the Table 2 results of employees. Overall, the analysis reflects the intensity of the coronavirus outbreak across large and small firms. The research also navigates us through the impact difference of COVID-19 shocks of 2020 and 2021 (till April).

Table 2: Top 10 large and small companies based on their employees [Window Size: ±5)

Panel A: USA

		March 12		March 18		February 16		March 04	
Large (Employees)	**Sector**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**
WALMART INC	CS	**-0.129**	**0.010**	**0.019**	**-0.144**	0.012	**-0.082**	-0.008	**-0.036**
AMAZON.COM INC	CD	**-0.087**	**-0.064**	0.008	**-0.015**	-0.007	**-0.036**	-0.007	**-0.013**
UNITED PARCEL SVCS	INDUS	**-0.040**	**-0.041**	0.013	**-0.029**	-0.020	**-0.019**	-0.002	**0.034**
ACCENTURE PLC	IT	**-0.084**	**-0.175**	**-0.043**	**-0.149**	0.001	**-0.012**	**-0.032**	**0.015**

HOME DEPOT, INC.	CS	**-0.120**	**-0.418**	**-0.117**	**-0.248**	-0.008	**-0.045**	**-0.032**	**0.012**
KROGER CO	CD	**-0.058**	**-0.077**	**0.023**	**-0.124**	**-0.022**	**-0.104**	**-0.032**	**-0.054**
TARGET CORP	CS	**-0.106**	**-0.110**	-0.011	**-0.182**	-0.014	**-0.053**	-0.022	**-0.064**
INT'L BUSINESS MACHS	IT	**-0.153**	**-0.299**	**-0.035**	**-0.188**	-0.006	**-0.022**	**-0.020**	**0.025**
BERKSHIRE HATHAWAY	FIN	**-0.166**	**-0.456**	**-0.201**	**-0.262**	-0.015	**0.031**	-0.012	**0.040**
STARBUCKS CORP	CD	**-0.102**	**-0.302**	**-0.054**	**-0.158**	-0.002	**-0.052**	-0.007	**0.023**
Small (Employees)									
PINNACLE WEST CAPTL	CD	**-0.194**	**-0.454**	**-0.154**	**-0.279**	-0.004	**0.049**	-0.015	**0.043**
HOST HOTELS	RE	**-0.048**	**-0.220**	-0.010	**-0.086**	**-0.036**	**-0.049**	-0.007	**0.073**
REALTY INCOME CORP	RE	**-0.132**	**-0.742**	**-0.232**	**-0.480**	0.017	**0.024**	**-0.031**	**0.051**
HEALTHPEA PROPERTIES	RE	**-0.110**	**-0.352**	**-0.033**	**-0.163**	**0.036**	**0.116**	-0.018	**-0.053**
FEDERAL REALTY INVST	RE	**-0.142**	**-0.325**	**0.028**	**-0.204**	-0.016	**0.073**	-0.026	**0.059**
DUKE REALTY CORP	RE	**-0.074**	**-0.222**	**0.045**	**-0.247**	0.006	**0.079**	-0.014	**0.016**
WELLTOWER INC	RE	**-0.191**	**-0.570**	**-0.272**	**-0.196**	0.007	**0.071**	0.012	0.001
REGENCY CENTERS CORP	RE	**-0.087**	**-0.381**	**-0.091**	**-0.372**	-0.003	**0.056**	-0.010	-0.003
VENTAS, INC.	RE	**-0.103**	**-0.429**	**-0.202**	**-0.282**	**-0.018**	**0.071**	**-0.026**	**-0.026**
ALEXANDRIA REAL ESTA	RE	**-0.092**	**-0.274**	-0.005	**-0.271**	0.005	**-0.033**	-0.018	**-0.046**

Panel B: UK

			March 12		**March 18**		**February 16**		**March 04**
Large (Employees)	**Sector**	AR	CAR	AR	CAR	AR	CAR	AR	CAR
COMPASS GROUP	CS	**0.041**	-0.050	**0.002**	**-0.125**	-0.016	0.001	0.020	**0.032**
G4S DEAD	Misc.	**0.065**	**-0.200**	**0.069**	0.072	0.003	**0.005**	0.013	0.023
TESCO	CS	**-0.038**	**0.067**	**0.034**	-0.065	-0.007	-0.080	-0.007	-0.036
HSBC HOLDINGS	FIN	0.009	**0.159**	**0.030**	0.034	**0.041**	**0.031**	**-0.030**	-0.015
SAINSBURY J	CD	**-0.050**	0.068	0.134	0.012	-0.016	**-0.040**	-0.003	0.012
ROYAL MAIL	INDUS	-0.023	-0.056	**0.115**	**0.067**	0.023	0.028	-0.013	**-0.030**
UNILEVER (UK)	CD	-0.009	**-0.042**	0.015	-0.119	0.009	0.002	0.012	0.036
GLENCORE	MATE	-0.008	0.009	0.009	**-0.013**	0.021	0.079	**-0.045**	**-0.083**
ASSOCIATED BRIT.FOODS	CS	**0.043**	0.058	**-0.042**	0.018	-0.016	0.050	0.003	**-0.043**
MORRISON(WM)SPMKTS.	CS	**-0.036**	**0.074**	**0.112**	-0.044	-0.009	-0.013	0.008	0.019
Small (Employees)		AR	CAR	AR	CAR	AR	CAR	AR	CAR
BBGI GLOBAL INFR.SA	FIN	**0.037**	**-0.088**	**-0.123**	**0.022**	0.013	0.004	-0.003	**-0.035**
RIT CAPITAL PARTNERS	FIN	**0.043**	**-0.043**	**-0.037**	**0.048**	0.006	-0.017	0.011	**0.054**
PURETECH HEALTH	CD	**0.057**	**0.064**	**0.048**	0.016	0.024	**0.023**	0.018	0.005
CAPITAL & CNTS.PROPS.	RE	**0.035**	**0.063**	**-0.039**	-0.005	-0.009	**0.032**	-0.001	-0.019
ASSURA	RE	-0.016	**0.035**	**0.048**	0.058	0.006	0.014	0.003	-0.008
IP GROUP	FIN	**0.048**	**0.112**	**-0.065**	0.032	0.038	**0.076**	-0.011	-0.017
GREAT PORTLAND ESTATES	RE	-0.017	**-0.010**	-0.016	**-0.115**	-0.010	-0.006	0.015	**-0.003**
CLS HOLDINGS	RE	0.025	**0.018**	**-0.079**	**-0.045**	0.006	0.005	0.007	**-0.003**
DERWENT LONDON	RE	-0.017	**-0.011**	**0.033**	**-0.045**	-0.003	0.007	0.017	**0.013**
LAW DEBENTURE	RE	**0.102**	**-0.016**	**-0.066**	**0.006**	0.002	0.015	0.018	**-0.032**

Panel C: Europe

		March 12		**March 18**		**February 16**		**March 04**	
Large	Sector	AR	CAR	AR	CAR	AR	CAR	AR	CAR
VOLKSWAGEN AG	CD	**0.020**	**0.117**	**-0.062**	**0.039**	0.003	**-0.029**	0.017	**0.124**
VOLKSWAGEN AG	INDUS	**0.030**	**-0.086**	**-0.076**	**-0.045**	-0.001	**-0.039**	0.010	**0.051**
DEUTSCHE POST AG	CD	**0.017**	**0.107**	**-0.052**	**0.044**	0.008	**-0.063**	-0.018	**0.028**
SODEXO	INDUS	**-0.089**	**-0.395**	**0.031**	**-0.226**	0.004	**0.075**	0.014	**0.018**
KONINKLIJKE AHOLD	CS	0.000	**0.052**	**0.053**	**0.038**	0.004	**-0.074**	**0.022**	**0.024**
TELEPERFORMANCE SE	IT	**-0.071**	**-0.258**	**0.052**	**-0.335**	-0.003	**0.012**	0.010	**0.115**
CARREFOUR S.A.	CS	**-0.035**	**0.158**	**0.049**	**0.097**	-0.005	**-0.017**	0.001	**-0.040**
FRESENIUS SE	CD	**0.040**	**-0.077**	-0.006	**0.015**	-0.006	**0.016**	0.014	0.000
SIEMENS AG	HE	**0.026**	**0.019**	**-0.050**	**0.040**	-0.012	**-0.073**	-0.013	0.002
DAIMLER AG	FIN	0.009	**-0.021**	**-0.019**	**0.089**	0.000	**-0.078**	0.006	**0.032**
Small									

GROEP BRUSSEL LAM	UTL	**-0.107**	-0.002	**0.050**	**-0.035**	0.000	**-0.054**	**0.011**	**0.026**
DEUTSCHE WOHNEN SE	IT	-0.017	**-0.177**	**-0.042**	**0.022**	-0.014	**-0.012**	0.015	0.003
GECINA	EN	**-0.098**	**-0.517**	**-0.088**	**-0.225**	-0.012	**-0.047**	**0.019**	**0.027**
AROUNDTOWN SA	FIN	**-0.142**	**-0.547**	**-0.108**	**-0.401**	0.001	**0.029**	0.004	**0.045**
PORSCHE AUTOMOBIL	FIN	0.003	**-0.191**	**-0.096**	**-0.083**	0.003	0.002	0.003	**0.100**
KLEPIERRE SA	RE	**-0.115**	**-0.164**	**0.037**	**0.079**	**-0.029**	**-0.017**	**0.051**	**0.105**
LEG IMMOBILIEN SE	RE	**-0.110**	**-0.457**	**-0.086**	**-0.155**	-0.008	**-0.055**	0.002	**-0.013**
ENAGAS SA	CD	**-0.094**	**-0.094**	**0.079**	**-0.012**	-0.013	**0.011**	**0.031**	**0.031**
GALAPAGOS	UTL	**-0.100**	**-0.427**	**-0.045**	**-0.175**	**0.039**	**-0.236**	**0.047**	**-0.026**
ADYEN NV	EN	**0.067**	**0.122**	-0.006	**0.033**	**0.033**	**0.084**	0.001	**0.015**

Panel D: Japan

		March 12		**March 18**		**February 16**		**March 04**	
Large	**Sector**	AR	CAR	AR	CAR	AR	CAR	AR	CAR
TOYOTA MOTOR CORP	CD	-0.002	0.050	-0.003	0.066	**-0.020**	**-0.011**	0.008	**0.012**
HITACHI, LTD.	TEL	**-0.032**	**-0.034**	**-0.045**	**-0.117**	0.011	**0.007**	0.013	**0.039**
NIPPON TELEG/TELEPH.	CD	0.011	**0.037**	**-0.025**	**0.063**	**0.014**	**0.022**	-0.004	0.001
SUMITOMO ELECTRIC	CD	**0.005**	**-0.029**	**0.021**	**0.008**	0.001	-0.018	-0.001	0.024
PANASONIC CORP	CD	-0.019	**-0.033**	-0.011	**-0.035**	-0.001	0.008	0.001	0.015
JAPAN POST	FIN	-0.011	**-0.039**	0.004	0.031	0.002	0.012	0.002	0.017
YAMATO HOLDINGS CO	INDUS	-0.008	-0.018	0.008	-0.014	0.001	-0.004	0.013	0.015
HONDA MOTOR CO., LTD	CD	**0.016**	**0.009**	**0.035**	**0.041**	0.005	0.008	-0.006	**0.015**
DENSO CORP	CD	0.008	**0.033**	**-0.028**	**-0.032**	-0.004	-0.048	**0.021**	**0.009**
CANON INC.	IT	**-0.022**	**-0.029**	**0.031**	**0.106**	0.002	-0.008	-0.006	**-0.026**
Small		AR	CAR	AR	CAR	AR	CAR	AR	CAR
MATSUI SECURITIES	FIN	**-0.046**	**-0.080**	**0.037**	**0.158**	**0.015**	**0.021**	**-0.004**	-0.029
PACIFIC METALS CO.	INDUS	**-0.040**	**-0.046**	0.002	0.059	**0.019**	0.076	**-0.041**	**-0.093**
SKY PERFECT JSAT	INDUS	**-0.047**	**-0.044**	**-0.048**	**-0.065**	0.004	-0.017	-0.004	-0.009
TOHO ZINC CO., LTD.	INDUS	0.021	**0.067**	0.011	**0.054**	**0.030**	**-0.005**	**-0.012**	**-0.023**
JAPAN EXCHANGE	FIN	-0.001	0.052	**0.058**	**0.155**	**0.025**	**0.018**	**0.026**	**0.024**
DENA CO LTD	INDUS	-0.007	**-0.094**	**-0.057**	**-0.030**	0.004	-0.014	0.007	-0.015
AOZORA BANK LTD	FIN	**-0.043**	-0.074	**0.034**	**0.046**	**0.023**	0.048	0.004	**0.012**
NISSAN CHEMICAL CORP	INDUS.	0.001	-0.032	-0.064	**-0.188**	-0.006	-0.004	**-0.013**	-0.015
SUMITOMO OSAKA CEM.	MATE	0.003	**0.002**	**0.019**	**0.038**	-0.007	-0.027	**0.006**	**-0.026**
UNITIKA, LTD.	INDUS	0.011	**0.003**	0.090	**0.282**	**0.002**	-0.004	**-0.012**	-0.025

Note: the bold values show the level of significance at 5% and better. The number of employees is downloaded from Thomson DataStream. CD = Consumer Discretionary, TEL= Telecommunications, FIN = Financials, INDUS = Industrials, IT = Information Technology, CS = Consumer Staples, RE = real Estate, UTL = Utilities, EN = Energy.

5. Table 3: Top 10 large and small companies based on their size [Window Size: ±5)

Panel A: USA

Large		**March 12**		**March 18**		**February 16**		**March 04**	
	Sector	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**
APPLE	IT	**-0.124**	**-0.269**	**-0.036**	**-0.207**	**-0.026**	**-0.106**	-0.013	**-0.051**
MICROSOFT	IT	**-0.106**	**-0.203**	**-0.050**	**-0.123**	-0.008	**-0.046**	-0.007	**-0.011**
AMAZON.COM	CD	**-0.087**	**-0.064**	0.008	**-0.015**	-0.007	**-0.036**	-0.007	**-0.013**
FACEBOOK CLASS A	IT	**-0.104**	**-0.242**	**-0.021**	**-0.152**	0.010	**-0.008**	0.009	**0.026**
ALPHABET 'C'	IT	**-0.114**	**-0.306**	**-0.167**	**-0.296**	**-0.022**	**0.065**	-0.008	**0.043**
ALPHABET A	FIN	**-0.079**	**-0.231**	**-0.023**	**-0.143**	0.004	**-0.024**	0.015	**0.008**

JOHNSON & JOHNSON	HE	**-0.057**	**-0.133**	**-0.015**	**-0.184**	-0.011	**-0.029**	**-0.019**	-0.023
JP MORGAN CHASE & CO.	FIN	**-0.114**	**-0.369**	**-0.121**	**-0.147**	**0.022**	**0.060**	**-0.018**	**-0.016**
VISA 'A'	FIN	**-0.090**	**-0.257**	**-0.066**	**-0.149**	-0.010	**0.015**	**-0.019**	**0.012**
PROCTER & GAMBLE	HE	**-0.094**	**-0.136**	**-0.011**	**-0.198**	-0.001	**-0.017**	**-0.009**	**-0.019**
Small									
UNDER ARMOUR A	CD	**-0.106**	**-0.402**	**-0.036**	**-0.277**	0.021	**0.109**	0.001	0.007
GAP	CD	**-0.078**	**-0.155**	-0.006	**-0.030**	-0.009	**-0.040**	**-0.025**	**0.064**
UNUM GROUP	FIN	**-0.095**	**-0.334**	**-0.108**	**-0.227**	**-0.024**	**0.037**	-0.011	**0.184**
RALPH LAUREN CL. A	CD	**-0.117**	**-0.519**	**-0.127**	**-0.381**	**-0.022**	**0.116**	-0.015	**0.074**
DISCOVERY SERIES A	TEL	**-0.157**	**-0.284**	**0.059**	**-0.228**	-0.005	**0.096**	-0.019	**-0.015**
HOLLYFRONTIER	EN	**-0.109**	**-0.349**	**-0.134**	**-0.221**	**-0.029**	**-0.044**	**-0.031**	**0.045**
PVH	CD	**-0.110**	**-0.455**	**-0.174**	**-0.312**	-0.012	-0.007	0.012	**-0.029**
NEWS 'A'	CD	**-0.137**	**-0.368**	**-0.066**	**-0.208**	**-0.050**	**-0.102**	-0.002	**0.103**
NOV	INDUS	**-0.080**	**-0.233**	-0.019	**-0.147**	0.004	**-0.024**	0.016	**0.010**
HANESBRANDS	CD	**-0.201**	**-0.670**	**-0.119**	**-0.130**	0.024	**0.104**	0.039	**0.056**

Panel B: UK

		March 12		**March 18**		**February 16**		**March 04**	
Large	**Sector**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**
ASTRAZENECA	HE	**-0.049**	**-0.115**	0.008	-0.111	-0.008	0.002	0.016	**0.013**
HSBC HOLDINGS	FIN	0.009	**0.159**	**0.030**	0.034	**0.041**	**0.031**	**-0.030**	-0.015
GLAXOSMITHKLINE	HE	**-0.021**	-0.105	**-0.026**	**-0.091**	-0.007	-0.015	0.016	**0.041**
UNILEVER (UK)	CD	-0.009	**-0.042**	0.015	-0.119	0.009	0.002	0.012	0.036
DIAGEO	CD	**0.023**	**-0.017**	**-0.027**	-0.062	-0.003	-0.014	**0.023**	0.018
BP	EN	0.021	-0.119	**-0.036**	**0.122**	-0.003	0.010	0.014	**0.023**
BRITISH AMERICAN TOBACCO	CD	**-0.028**	-0.084	0.021	**-0.159**	-0.013	-0.053	0.011	**0.006**
ROYAL DUTCH SHELL A	EN	-0.007	**-0.051**	**-0.039**	0.003	-0.005	**0.029**	0.010	0.008
RIO TINTO	MATE	-0.009	**0.078**	0.006	0.142	0.013	**0.059**	**-0.042**	-0.072
ROYAL DUTCH SHELL B	EN	-0.004	**-0.124**	**-0.040**	0.155	-0.008	**-0.013**	0.016	0.011
Small		AR	CAR	AR	CAR	AR	CAR	AR	CAR
BAKKAVOR GROUP	CS	0.027	0.052	0.002	**0.284**	0.011	0.001	0.020	**0.039**
CONTOURGLOBAL	EN	-0.024	**0.031**	**0.084**	**0.247**	-0.001	0.000	-0.001	**-0.027**
PPHE HOTEL GROUP	RE	**-0.132**	**-0.153**	**-0.123**	0.008	0.008	-0.001	0.011	**0.019**
RANK GROUP	INDUS	0.015	**-0.022**	0.004	-0.014	**0.077**	**0.107**	**0.072**	**0.051**
HYVE GROUP	INDUS	0.044	-0.007	**0.125**	**-0.128**	**0.113**	0.107	0.017	**0.003**
STAGECOACH GROUP	INDUS	**0.051**	0.017	-0.007	0.020	-0.044	0.070	0.024	**-0.022**
SENIOR	INDUS	**0.082**	0.128	**-0.164**	**-0.211**	-0.008	-0.007	0.018	**0.055**
CLS HOLDINGS	RE	0.025	0.018	**-0.079**	**-0.045**	0.006	0.005	0.007	**-0.003**
PAYPOINT	FIN	0.018	-0.031	**-0.133**	**-0.179**	-0.002	0.001	0.022	**0.040**
EQUINITI GROUP	IT	**0.106**	0.083	0.003	**-0.068**	-0.009	**-0.013**	0.021	**-0.011**

Panel C: Europe

Large		**March 12**		**March 18**		**February 16**		**March 04**	
	Sector	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**
NORDEA BANK ABP	FIN	0.009	**0.138**	**0.068**	**0.006**	**0.034**	**-0.017**	-0.003	**0.032**
LVMH MOET HENNESSY	CD	**0.099**	**0.157**	**-0.058**	**0.112**	0.007	**-0.024**	**-0.053**	**-0.074**
L'OREAL SA	CD	**0.075**	**0.132**	-0.001	**0.041**	0.000	**-0.070**	-0.004	**0.011**
SAP SE	IT	**0.080**	**0.123**	-0.010	**0.156**	0.013	**0.023**	0.000	**0.044**
ANHEUSER BUSCH IN	CS	-0.010	**-0.136**	-0.009	**-0.118**	-0.004	**-0.060**	**0.019**	**0.036**
UNILEVER	CS	**-0.028**	**-0.245**	**-0.089**	**0.086**	-0.005	**0.014**	**0.020**	0.028
TOTAL SA	EN	**0.026**	**0.019**	**-0.050**	**0.040**	-0.012	**-0.073**	-0.013	**0.002**
SANOFI	HE	**-0.022**	**-0.188**	**-0.067**	**-0.074**	0.000	**-0.027**	0.001	**0.035**

ASML HOLDING NV	INDUS	**-0.058**	**-0.157**	0.007	**-0.142**	0.004	**0.041**	0.009	**0.023**
AIRBUS SE	INDUS	-0.004	**-0.118**	**0.029**	**-0.022**	0.001	**0.037**	**0.018**	**0.055**
Small									
LANXESS AG	INDUS	**0.082**	**0.184**	-0.008	**-0.021**	-0.003	**-0.148**	-0.014	**0.033**
BANK OF IRELAND GROUP	FIN	0.013	**0.216**	**0.110**	**0.038**	**0.046**	**0.160**	0.002	**-0.054**
METSO	INDUS	**0.037**	**0.332**	**0.003**	**0.078**	0.002	**-0.078**	-0.025	**0.047**
GEA GROUP AG	INDUS	**-0.073**	**-0.016**	0.053	**0.055**	-0.013	**-0.047**	0.003	**0.022**
UNITED INTERNET AG	IT	0.015	**0.156**	**-0.014**	**0.186**	-0.019	**-0.105**	**-0.029**	0.002
PRYSMIAN SPA	INDUS	**-0.078**	**-0.129**	**0.092**	**-0.025**	0.007	**0.055**	**0.026**	**-0.068**
SES FDR (PAR)	IT	**-0.092**	**-0.266**	-0.038	**-0.235**	0.004	**0.024**	0.001	**0.036**
WARTSILA OYJ	INDUS	0.002	**-0.121**	-0.029	0.001	-0.012	0.005	0.014	-0.017
BANCO DE SABADELL	FIN	0.001	**0.112**	-0.016	**0.076**	0.003	**-0.067**	0.005	**0.073**
ENAGAS SA	EN	**0.091**	**0.071**	0.028	**0.148**	0.023	**0.021**	**-0.039**	-0.009

Panel D: Japan

		March 12		**March 18**		**February 16**		**March 04**	
Large	**Sector**	AR	CAR	AR	CAR	AR	CAR	AR	CAR
TOYOTA MOTOR	CD	-0.002	0.050	-0.003	0.066	**-0.020**	**-0.011**	0.008	**0.012**
SONY GROUP	CD	-0.003	0.034	0.014	**0.046**	0.019	**0.028**	0.003	0.028
SOFTBANK GROUP	FIN	-0.006	0.022	**-0.112**	**-0.300**	**0.044**	**0.062**	-0.024	**-0.001**
RECRUIT HOLDINGS	INDUS	-0.038	**-0.058**	**0.033**	**-0.108**	**0.021**	**0.033**	0.012	**-0.045**
NIPPON TELG. & TEL.	TEL	0.011	**0.037**	**-0.025**	0.063	0.014	**0.022**	-0.004	0.001
MITSUBISHI UFJ FINL.GP.	INDUS	**-0.021**	**-0.010**	-0.002	**-0.017**	**0.040**	**0.057**	0.005	**-0.012**
TAKEDA PHARMACEUTICAL	HE	**-0.049**	**-0.085**	**-0.037**	-0.030	-0.001	0.000	0.011	**0.025**
DAIICHI SANKYO	CD	**-0.011**	**-0.011**	0.002	0.108	-0.013	**0.018**	0.014	**0.052**
DAIKIN INDUSTRIES	CD	0.015	**0.021**	**0.031**	**0.132**	0.008	**0.006**	**0.021**	**0.059**
KDDI	TEL	0.000	-0.104	**-0.049**	**0.025**	0.006	**0.003**	0.001	0.010
Small									
UNITIKA	CD	0.011	**0.003**	**0.090**	**0.282**	0.002	-0.004	-0.012	**-0.025**
TOHO ZINC	INDUS	0.021	**0.067**	0.011	**0.054**	**0.030**	**-0.005**	-0.012	**-0.023**
PACIFIC METALS	MATE	**-0.040**	**-0.046**	0.002	0.059	0.019	**0.076**	**-0.041**	**-0.093**
NIPPON SHEET GLASS	MATE	**0.017**	**-0.025**	**-0.033**	**-0.112**	**0.027**	**0.041**	-0.007	0.060
MITSUI E&S HOLDINGS	INDUS	**-0.050**	**-0.103**	**-0.060**	**-0.286**	**0.032**	**0.079**	-0.018	**0.042**
KAWASAKI KISEN KAISHA	INDUS	**-0.054**	**-0.020**	**-0.028**	**-0.061**	0.054	**0.073**	**0.070**	0.045
SKY PERFECT JSAT HDG.	TEL	-0.047	**-0.044**	**-0.048**	**-0.065**	0.004	-0.017	-0.004	-0.009
HITACHI ZOSEN	INDUS	-0.014	**-0.035**	**0.044**	**0.094**	0.007	0.006	**0.176**	**0.157**
OKI ELECTRIC IND.	INDUS	-0.014	**-0.012**	**-0.024**	**0.005**	0.002	-0.027	-0.008	**0.016**
CITIZEN WATCH	INDUS	-0.009	**0.016**	**0.066**	**0.170**	-0.017	0.015	-0.001	0.075

6. Note: the bold values show the level of significance at 5% and better. The number of employees is downloaded from Thomson DataStream. CD = Consumer Discretionary, TEL= Telecommunications, FIN = Financials, INDUS = Industrials, IT = Information Technology, CS = Consumer Staples, RE = real Estate, UTL = Utilities, EN = Energy.

4.1. Idiosyncratic risk analysis

It is apparent from the above analysis that the coronavirus pandemic has impacted the performance of firms, and it would be wise to analyse these firms from systematic and non-

systematic risks perspectives. As size and employment strengths do matter for the micro-analysis, we undertake an idiosyncratic volatility analysis to find the extent of the impact of coronavirus outbreak on the idiosyncratic risk of firms. We adopt the following procedure: *First*, we calculate the idiosyncratic risk using the three-factor model using Equation (2). *Second*, we decompose the total risk into systematic and firm-specific risk, also known as the idiosyncratic risk. Following Fu (2009), the realized idiosyncratic risk (volatility) series is obtained using the standard deviation of the residuals from equations (2).

$$IVOL_i = \sigma_{\varepsilon t} \tag{5}$$

We have used a time-varying regression of equations (2), with a period of at least 20 daily observations in a month, to generate an idiosyncratic monthly series. Then the standard deviation of the residuals is used as the idiosyncratic risk component. *Third*, we specify the following regression to estimate the impact of firm-specific factors and controls.

$$IVOL_{it} = \alpha_0 + \beta_i X_{it} + Controls_t + \varepsilon_{it} \tag{6}$$

where $IVOL_{it}$ is the idiosyncratic monthly volatility of sample firms, X_{it} shows the firm-specific factors, which include cash flow/sales (*Cash*) as a measure of profitability; free-float market capitalization *(MC)* to measure the daily variations in the market value of the firms (size), turnover by volume (*Volume*) to show the number of shares traded for a stock on a particular day. For $Controls_t$, we select the number of Coronavirus cases (*COVID*) in the respective countries. CBOE Crude Oil Volatility Index (*OVX*) to measure the implied volatility of the crude oil market. COVID-19 Government Response Stringency Index (*Stringency*) to showcase the effect of lockdown and other measures. ε_{it} is the error term. α, β are the parameters. δ_i and δ_t are individual and time effects.

Table 4 shows the results of panel fixed-effect regression Equation (6). We find that firm-specific factors such as cash flow (*Cash*) and market capitalization (*MC*) negatively correlate

with idiosyncratic risk. The results seem valid though the statistical significance varies across markets. Economically, the negative relationship implies that a 1% increase in the market capitalization in the case of the US leads to a 10.8% decrease in the idiosyncratic risk for all countries. The result implies that idiosyncratic risk declines as the firm's profitability increases and is much stronger during the crisis period. However, the trading volume's (Volume) coefficient picks a positive sign that implies that the increase in trading volume leads to an increase in idiosyncratic risk. During the crisis period, the sample period of monthly analysis covers the coronavirus outbreak period.

The coefficients of controls such as COVID-19 (*COVID*) cases and *Stringency* measures positively explain firms' idiosyncratic risk, implying coronavirus cases increased, which led to an increase in the idiosyncratic risk of firms. However, there is a caveat in the case of the USA. The coefficient of stringency exhibits a negative sign, suggesting an inverse relationship between idiosyncratic risk and COVID-19 related stringency index. According to Huang, Yang, and Zhu (2021), top brands in the USA experienced higher stock returns, lower systematic risk and lower idiosyncratic risk as the COVID-19 restrictions increased during the COVID-19 outbreak period. Our result seems to be valid in this respect.

The coefficient of OVX shows a positive relationship, and it also suggests that the idiosyncratic risk of firms positively explains it. The impact of COVID-19 has been significant across sectors in the USA, as reported by Ahmad, Hernandez, Saini, and Mishra (2021). This result is a new finding at the firm level for these countries.

However, we also estimate the Fama and Macbeth (1973) cross-sectional regression for all firms. Table 5 shows the results. We find that the signs of the coefficients are commensurate with the results of Table 4 discussed above.

We also estimate the results for large and small firms based on their size and number of employees, as we have done for the event-study analysis. This analysis is a robustness

exercise to confirm the results of the event-study analysis and the results reported at the aggregate level in Tables 4 & 5. We find that large firms based on market capitalization and number of employees are reported in Tables 6-7 and Tables 10-11. The cash flow shows a significant and negative relationship with idiosyncratic risk for firms in the UK and Japan, whereas the coefficients are insignificant for the USA and Europe. We also draw a similar statistical inference for the cross-sectional analysis. At the cross-section level, we find the results are more pronounced and statistically significant. This inference signifies the importance of cross-sectional analysis for the firm-level analysis.

Similarly, for large firms based on employees, we find that the cash and market capitalization negatively correlate with firms' idiosyncratic risk. However, the coefficients are not significant for all the countries. The cross-sectional analysis confirms the above findings.

Coming to COVID-19 and stringency index variables, we find that the number of COVID-19 cases and Stringency measures positively associate with idiosyncratic risk. The results are statistically significant for positive coefficients for large firms based on their size and number of employees. We also do a similar exercise for small firms based on the market capitalization (size) and the number of employees. The results are reported in Tables 8-9 (size) and Tables 12-13 (employees). The firm-specific factors do not enforce enough for these firms, as we find in the previous analysis. However, some of the coefficients are significant and consistent with previous analysis for the Europe and Japan.

The COVID-19 cases and Stringency measures positively correlate with idiosyncratic risk for the USA, UK, and Japan. However, Europe seems an exception for the COVID-19 cases and the USA for the stringency index as the coefficients of both countries imply a negative and significant relationship with idiosyncratic risk.

Overall, the micro-analysis reveals the differential impact of the COVID-19 cases and stringency measures on firms' idiosyncratic risk, consistent with the event-study analysis

reported above. In event-study analysis, we observed similar differences concerning the impact of events during the first and second waves. The general hypothesis that the coronavirus outbreak has impacted the firms uniformly is incorrect, and the intensity of the impact has varied across the types of firms.

Table 4: Determinants of Idiosyncratic risk of firms

Variables	USA	UK	Europe	Japan
Cash	-0.0193	-0.0168*	-0.0419	-0.0009
	(0.0275)	(0.0090)	(0.0299)	(0.0007)
MC (Size)	-0.108***	-0.263***	-0.0425	-0.0789***
	(0.0196)	(0.041)	(0.0279)	(0.0151)
Volume	4.03e-07**	0.0857**	0.0071	0.0306*
	(1.58e-07)	(0.038)	(0.0071)	(0.0171)
COVID	0.0245***	0.0138**	0.0202***	1.22e-05
	(0.00176)	(0.0056)	(0.0063)	(4.39e-05)
OVX	1.994***	1.162***	0.736***	0.541***
	(0.0379)	(0.0549)	(0.0302)	(0.0185)
Stringency	-0.0342***	0.0011	0.0910***	0.0325***
	(0.0063)	(0.0099)	(0.0175)	(0.0058)
Constant	-4.519***	-1.497***	-1.279***	-0.0064
	(0.242)	(0.252)	(0.192)	(0.246)
Observations	11,784	6,044	4,174	5,352
Number of Groups	491	252	174	223

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The variables under consideration are *Cash*: cash flows/sales, *MC* – free float market capitalization, *Volume* – turnover by volume, *ROE* – return on equity, COVID – COVID-19 cases reported in respective sample countries. OVX – CBOE crude oil volatility index, Stringency – Stringency Index.

Table 5. The determinants of Idiosyncratic risk: Fama and Macbeth cross-section regressions

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0337***	-0.0166***	-0.0508***	-0.0003
	(0.0100)	(0.0036)	(0.0152)	(0.0011)
MC	-0.190***	-0.262***	-0.293***	-0.122***
	(0.0227)	(0.0305)	(0.0233)	(0.0085)
Volume	5.87e-07***	0.0857***	0.0102**	0.0633***
	(5.43e-08)	(0.0147)	(0.0048)	(0.0101)
Constant	4.073***	3.007***	2.792***	2.381***

	(0.474)	(0.270)	(0.190)	(0.132)
Observations	11,784	6,044	4,174	5,352
Number of groups	24	24	24	24
R-squared	0.063	0.108	0.080	0.074

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R-squared are average values. For variables' definition, please refer to note of table 4.

Table 6: Determinants of Idiosyncratic risk of large firms (size)

VARIABLES	USA	UK	Europe	Japan
Cash	0.0227	-0.0298***	0.0138	-0.0016***
	(0.0420)	(0.0045)	(0.0414)	(0.0005)
MC (Size)	-0.0595*	-0.187**	0.0783*	-0.0175
	(0.0307)	(0.0781)	(0.0426)	(0.0347)
Volume	3.78e-07***	0.0405	0.0034	-0.0123
	(1.44e-07)	(0.0788)	(0.0111)	(0.0278)
COVID	0.0208***	0.0131	0.0063	7.56e-05
	(0.0024)	(0.008)	(0.0100)	(6.36e-05)
OVX	0.0181***	0.0109***	0.668***	0.534***
	(0.0004)	(0.0009)	(0.0467)	(0.0300)
Stringency	0.0210**	0.0343**	0.0589**	0.0329***
	(0.0088)	(0.0138)	(0.0249)	(0.0091)
Constant	1.157***	2.114***	-1.961***	-0.480
	(0.354)	(0.539)	(0.300)	(0.658)
Observations	4,008	2,564	1,464	2,064
Number of groups	167	107	61	86

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For variables' definition, please refer to note of table 4.

Table 7. The determinants of Idiosyncratic risk of large firms (size): Fama and Macbeth cross-section regressions

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0146	-0.0302***	9.63e-05	-0.0008
	(0.0157)	(0.0047)	(0.0140)	(0.0009)
MC (Size)	-0.124***	-0.188***	-0.0806**	-0.0803***
	(0.0198)	(0.0350)	(0.0382)	(0.0123)
Volume	4.60e-07***	0.0407**	0.00551	0.0206*
	(3.40e-08)	(0.0167)	(0.0044)	(0.0101)
Constant	3.223***	2.877***	1.531***	2.222***
	(0.442)	(0.397)	(0.157)	(0.163)

Observations	4,008	2,564	1,464	2,064
Number of groups	24	24	24	24
R-squared	0.058	0.129	0.051	0.042

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R-squared are average values. For variables' definition, please refer to note of table 4.

Table 8: Determinants of Idiosyncratic risk of small firms (size)

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0622	-0.0158	-0.0076	-0.0476***
	(0.0541)	(0.0492)	(0.0522)	(0.0178)
MC (Size)	-0.0390	-0.483***	0.0446	-0.0773*
	(0.0520)	(0.155)	(0.0811)	(0.0415)
Volume	-0.0139	0.113***	0.0135	0.123***
	(0.0357)	(0.0411)	(0.0144)	(0.025)
COVID	0.0128***	0.0251**	0.0371***	7.45e-05
	(0.0031)	(0.0127)	(0.0136)	(0.0001)
OVX	0.0218***	0.0146***	0.0080***	0.534***
	(0.0007)	(0.0013)	(0.0007)	(0.0359)
Stringency	0.0953***	0.0171	0.174***	0.0404***
	(0.0130)	(0.0252)	(0.0400)	(0.0119)
Constant	1.398**	3.273***	0.676**	-0.819
	(0.595)	(0.975)	(0.342)	(0.565)
Observations	4,224	1,488	1,200	1,464
Number of groups	176	62	50	61

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For variables' definition, please refer to note of table 4.

Table 9. The determinants of Idiosyncratic risk of small firms (size): Fama and Macbeth cross-section regressions

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0769***	-0.0111	-0.0372	-0.0383***
	(0.0246)	(0.0124)	(0.0229)	(0.0099)
MC (Size)	-0.0995***	-0.483***	-0.115	-0.138***
	(0.0322)	(0.0684)	(0.0742)	(0.0232)
Volume	-0.0502***	0.112***	0.0174**	0.130***
	(0.0079)	(0.0226)	(0.0080)	(0.0178)
Constant	3.935***	4.247***	2.038***	1.991***
	(0.506)	(0.427)	(0.335)	(0.255)

Observations	4,224	1,488	1,200	1,464
Number of groups	24	24	24	24
R-squared	0.020	0.102	0.064	0.133

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R-squared are average values. For variables' definition, please refer to note of table 4.

Table 10: Determinants of Idiosyncratic risk of large firms (employees)

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0439	-0.0261***	-0.136***	-0.0191
	(0.0363)	(0.00360)	(0.0366)	(0.0402)
MC (Size)	-0.124***	-0.359***	-0.0581	-0.0843***
	(0.0330)	(0.0428)	(0.0493)	(0.0241)
Volume	4.85e-07**	0.106***	0.00640	-0.0169
	(2.03e-07)	(0.0366)	(0.0130)	(0.0270)
COVID	0.0286***	0.0194*	-0.0165	4.56e-05
	(0.0034)	(0.0111)	(0.0109)	(7.72e-05)
OVX	1.906***	1.198***	0.639***	0.538***
	(0.0558)	(0.112)	(0.0460)	(0.0343)
Stringency	-0.0552***	0.0213	0.0970***	0.0573***
	(0.0112)	(0.0162)	(0.0285)	(0.0099)
Constant	-3.980***	-0.928**	-0.632*	0.581
	(0.384)	(0.438)	(0.362)	(0.546)
Observations	3,984	2,136	1,462	1,752
Number of groups	166	89	61	73

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For variables' definition, please refer to note of table 4.

Table 11. The determinants of Idiosyncratic risk of large firms (employees): Fama and Macbeth cross-section regressions

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0176	-0.0257***	-0.177***	-0.0196
	(0.0167)	(0.00442)	(0.0271)	(0.0190)
MC (Size)	-0.203***	-0.359***	-0.212***	-0.142***
	(0.0247)	(0.0522)	(0.0333)	(0.0191)
Volume	6.13e-07***	0.106***	0.0136**	0.00103
	(5.46e-08)	(0.0162)	(0.00632)	(0.00927)
Constant	4.148***	3.804***	2.738***	3.430***
	(0.460)	(0.475)	(0.206)	(0.303)

Observations	3,984	2,136	1,464	1,752
Number of groups	24	24	24	24
R-squared	0.106	0.265	0.156	0.117

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R-squared are average values. For variables' definition, please refer to note of table 4.

Table 12: Determinants of Idiosyncratic risk of small firms (employees)

VARIABLES	USA	UK	Europe	Japan
Cash	0.0181	0.0006	-0.0204	-0.0384**
	(0.0511)	(0.0180)	(0.0505)	(0.0164)
MC (Size)	-0.0400	-0.211	-0.0947*	-0.0313
	(0.0430)	(0.171)	(0.0531)	(0.0288)
Volume	3.39e-07	0.0182	-0.00412	0.0713***
	(2.92e-07)	(0.105)	(0.0121)	(0.0242)
COVID	0.0229***	0.0028	-0.0262**	4.23e-05
	(0.0031)	(0.0081)	(0.0130)	(7.17e-05)
OVX	2.027***	1.179***	0.817***	0.588***
	(0.0671)	(0.104)	(0.0649)	(0.0326)
Stringency	-0.0281**	-0.0042	0.0860**	0.0073
	(0.0112)	(0.0160)	(0.0381)	(0.0099)
Constant	-5.443***	-1.362*	-1.218***	-1.021***
	(0.515)	(0.705)	(0.372)	(0.381)
Observations	4,008	1,944	1,296	1,848
Number of groups	167	81	54	77

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For variables' definition, please refer to note of table 4.

Table 13. The determinants of Idiosyncratic risk of small firms (employees): Fama and Macbeth cross-section regressions

VARIABLES	USA	UK	Europe	Japan
Cash	-0.0345	0.0008	0.0012	-0.0393***
	(0.0223)	(0.0039)	(0.0195)	(0.0075)
MC (Size)	-0.138***	-0.211***	-0.273***	-0.0620***
	(0.0299)	(0.0366)	(0.0611)	(0.0141)
Volume	4.47e-07***	0.0182	-0.0052	0.103***
	(1.53e-07)	(0.0148)	(0.0068)	(0.0145)
Constant	3.568***	3.137***	2.664***	1.330***
	(0.466)	(0.279)	(0.310)	(0.205)

Observations	4,008	1,944	1,296	1,848
Number of groups	24	24	24	24
R-squared	0.043	0.062	0.074	0.086

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R-squared are average values. For variables' definition, please refer to note of table 4.

5. Conclusion and Policy Implications

Overall, the stock (firm) level analysis reveals exciting patterns as far as the impact of the coronavirus pandemic is concerned. Our empirical setup contributes to the literature in the following manner. *First*, the applications of linear and nonlinear structural break models help identify the major events related to the coronavirus pandemic, including the Black Swan events reported during the first and second weeks of March and also the recovery phase of 2021. *Second*, the analysis of the event-study approach confirms the significant impact of coronavirus pandemic events on the stock markets of sample countries. However, the analysis became interesting when we classified the firms into two categories, large and small, using the number of employees and the size. The results suggest notable differences with regards to the different phases of coronavirus shocks beginning February 2020. The differences between large and small firms are negligible for the US and Europe, implying that the coronavirus outbreak uniformly impacted the firms and stocks on March 12 and 18.

Further studies can examine these issues. We observed an almost similar impact on small and large stocks for the UK, but large firms seemed more responsive than small stocks. For Japan, we observe the symmetric effect of the coronavirus pandemic across large and small firms. The incorporation of 2021 till April makes a difference to our analysis as AR and CAR values are not as significant as we found in 2020.

Overall, the above-discussed results provide enormous opportunities for policy experts to trace the financial performance of small and large firms. A suitable remedy could be suggested to reduce the financial vulnerabilities of these firms. As aforementioned, the

classification of firms' analysis seems useful from a policy perspective. The findings of our study can be linked to Kumar and Haydon (2020), Goodell and Huynh (2020) and Hartley and Rebucci (2020), and Haroon and Rizvi (2020), Huang, Yang and Zhu (2021) and Chebbi, Ammer and Hameed (2021). Some results also differ with multi-country studies by Hu and Zhang (2021).

However, the idiosyncratic analysis further substantiates the above findings as firm-specific factors negatively correlate with sample firms' idiosyncratic risk. The control variables such as COVID-19 cases and stringency measures positively explain firms' idiosyncratic risk, which is a significant finding. The analysis of large and small firms also confirms the differential impact of the coronavirus pandemic events based on their sizes.

Based on these results, we can say that the stock level analysis at the micro-level gives better clarity than the country and sectoral analysis, and the study can be extended to cover more countries and even emerging markets.

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