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COVID-19 Pandemic and firm-level dynamics in the USA, UK, Europe, and Japan

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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 Blank Swan events in March 2020 exhibit stronger impact 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.

1. Introduction

The coronavirus pandemic has reversed the global business cycle with 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 at a later stage. There is a need to incorporate the impact of the second wave and analyze 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) level perspective. The study focuses on the developed markets as these economies are major drivers of the global economy. We examine the firms in two stages. At the first stage, we confirm the shock of coronavirus first and second waves on their 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 employability to confirm whether the impact of coronavirus outbreak has been uniform across firms (large and small). Employability implies the number of employees in a firm to ensure that we do not miss analyzing the impact of the pandemic on their employment strength. One of the commonly pursued

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objectives is to find whether the rescue measures should have the components of first come and first serve or oriented to firms that are impacted. 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, Hardeman, and Stam (2021), Ke (2021), Ren, Zhang, and Zhang (2021), Yong and Laing (2021), Krammer (2021), Jin, Zhang, Sun, and Cui (2021), and Huynh, Foglia, and 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 (Bash & Alsaiﬁ, 2019; Braun, Ammar, & Eling, 2019; Herrera & Schipp, 2014; Kemper & Mortensen, 2020; Piccoli, Chaudhury, Souza, & da Silva, 2017; Zhang & Shinlki, 2007). We find similar analysis for the coronavirus outbreak events in the literature due 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% in a week. Mazur, Dang, and Vega (2021) also suggest that the March 2020 stock market crash was triggered by the coronavirus outbreak 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 and have delayed the economic 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 2020, 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 of post-COVID performance in the stock markets of these economies. There is also a visible impact of vaccination drive and hope for a quicker recovery in our analysis. The idiosyncratic analysis shows a significant and positive impact of COVID-19, and stringency measures, on the idiosyncratic risk of firms. 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

In the literature on the coronavirus impact, some studies have conducted firm-level analysis to understand the propagation mechanism. Morikawa (2021) analyses the productivity of Japanese firms during the initial phase of COVID-19 outbreak. Kanno (2021) develops 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. Ren et al. (2021) in case of China, analyse the performance of firms till the first quarter of 2020 and the COVID-19 outbreak. Yong and Laing (2021) examine 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 coronavirus outbreaks, 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. Hu and Zhang (2021), using multi-country data, show the impact of COVID-19 on firm performance and conclude that the firm’s financial performance during 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, Yang, and Hu (2021). A similar inference was drawn by Jin 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 Hamed (2021) showcase the negative effects of COVID-19 on stock liquidity. The environmental impact of COVID-19 is examined by Gutrin and Sunheim (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, Engelhardt, Krause, and Posch (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 et al. (2021) conﬁrm the strong interconnectedness in the early phase of COVID-19 for the 46 large companies. Didier, Huneeuc, Larrain, and Schmukler (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 Pandemic and have limitations regarding the ﬁrm selection and choice of variables. We still ﬁnd our study different than the above discussed 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 from May 1, 2019, till April 30, 2021, for the event study analysis. For Europe, we consider S&P (Standard and Poor’s), 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.\footnote{\url{http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#international} (Accessed on 10th May 2020).}

We identify significant events related to the coronavirus outbreak 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 $F_0(k,n)$ 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, which also add 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, which makes it suitable for daily and monthly data. We specify the MS-DR model with switching intercept (means) and the variance\footnote{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.}:

$$r_t = \alpha(S_t) r_{it} + \mu(S_t) + \epsilon_t \quad (1)$$

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

where, we assume that a market return $r_t$ is generated as an autoregression of order $k$ with regime-switching in intercept (mean) $\mu$ and variance ($\sigma^2$). $\alpha_t$ is the model parameter & $\epsilon_t$ is a residual term. Following the chronology of coronavirus outbreak, we apply the BP 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 coronavirus outbreak 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 in case of pandemic, Kim, Kim, Lee, and Tang (2020) have applied to understand the impact on firms and financial markets. To calculate abnormal returns, we choose the Fama French 3-Factor model (Fama and French, 1993) 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

$$E[R_t] = \alpha + \beta(R_m - \alpha) + \gamma SMB_t + \delta HML_t + \epsilon_t \quad (2)$$

where $E[R_t]$ is the excess return of stock $i$ at time $t$, $R_m$ is market index return, $R_f$ 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 $\epsilon_t$ is the error term. $\alpha$, $\beta$, $\gamma$, and $\delta$ are estimated parameters.

The estimated market model is then used as a reference to calculate the expected returns $E[R_t]$ 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 the effect of information leakage on the estimated market model. More specifically, in this study, we have chosen the evaluation period to be of 329 trading days with a 12-trading day gap from the observation period.

### Table 1

| 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 calls 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. Dow Jones experienced the circuit breaker, and FTSE recorded its worst 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 |
| 02-04-2020 | Dow Jones sinks 860 points in the wake of Senate failing to pass the fiscal stimulus and COVID concerns. 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 most severe economic crisis since 1930s. | CNBC |
| 09-04-2020 | 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. Dow Jones recorded the highest jump due to a surge in the trading of tech firms. Dow Jones Industrial Average (Dow) recorded a significant leap. 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 |
| 15-05-2020 | Coronavirus outbreak in Beijing impacted the markets. The 1.51 million Americans applied for unemployment benefits. 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. 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. The stock market performed well on account of a visible green shoots in the US economy in terms of nonfarm payrolls and better sectoral growth outlook. DJIA reported a jump of 570 points | NBC |

**WEF**: World Economic Forum.

#### 3.1. Event Timeline

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

$$AR_t = R_t - E[R_t] \quad (3)$$
### 4. Results

#### 4.1. Event-study analysis

The event-dates identified through the endogenous structural break test are listed in Table 1. It appears that the event dates identified by the structural break models seem valid. According to Mazur et al. (2021), coronavirus outbreak impacted the most to the global market in the month of March 2020. Our structural break test also reports the same and identifies three break dates viz., March 12, 18 and March 23. We observe that the highly significant event occurred during the 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 captures the coronavirus outbreak in South Korea and Italy. The MSM model further confirms the BP results. Fig. 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 peak 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, 2020 (CNBC, 2020). The dates considered by Al-Awadhi, Al-Saifi, Al-Awadhi, and Alhamadi (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 drive in the sample countries. The results suggest that during 2021, we identify two breaks, i.e., February 16 and March 4. On both dates, we observe that the stock markets had positive reactions.

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 markets. We provide a detailed analysis of four dates viz., March 12, 18 in 2020, and February 16 and March 4 in 2021.

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*Fig. 1. Growth in coronavirus cases and deaths and bearish stock markets of China, Italy, USA, and the UK.*

*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 2

Top 10 large and small companies based on their employees [Window Size: ±5].

#### Panel A: USA

| Large (Employees)                        | March 12 | March 18 | February 16 | March 04 |
|-----------------------------------------|----------|----------|--------------|----------|
|                                         | Sector   | AR       | CAR          |          |
| WALT MART INC                           | CS       | −0.129   | 0.010       | 0.019    |
| AMAZON.COM INC                          | CD       | −0.087   | −0.064      | 0.008    |
| UNITED PARCEL SVCS                     | INDUS    | −0.040   | −0.041      | 0.013    |
| ACCENTURE PLC                           | IT       | −0.084   | −0.175      | −0.043   |
| HOME DEPT, INC                          | CS       | −0.120   | −0.418      | −0.117   |
| KROGER CO                               | CD       | −0.058   | −0.077      | 0.023    |
| TARGET CORP                             | CS       | −0.106   | −0.110      | −0.011   |
| INTL BUSINESS MACHS                     | IT       | −0.153   | −0.299      | −0.035   |
| BERKSHIRE HATHAWAY                      | FIN      | −0.166   | −0.456      | −0.201   |
| STARBUCKS CORP                          | CD       | −0.102   | −0.302      | −0.054   |
|                                          |          |          |              |          |
| Small (Employees)                       |          |          |              |          |
| PINNACLE WEST CAPIT.                   | CD       | −0.194   | −0.454      | −0.154   |
| HOST HOTELS                             | RE       | −0.048   | −0.220      | −0.010   |
| REALITY INCOME CORP                    | RE       | −0.132   | −0.742      | −0.232   |
| HEALTHPEA PROPERTIES                   | RE       | −0.110   | −0.352      | −0.033   |
| FEDERAL REALTY INVST                   | RE       | −0.142   | −0.325      | 0.028    |
| DUKE REALTY CORP                       | RE       | −0.074   | −0.222      | 0.045    |
| WELL_TOWER INC                         | RE       | −0.191   | −0.570      | −0.272   |
| REGENCY CENTERS CORP                   | RE       | −0.087   | −0.381      | −0.091   |
| VENTAS, INC                            | RE       | −0.103   | −0.429      | −0.202   |
| ALEXANDRIA REAL ESTA                   | RE       | −0.092   | −0.274      | 0.005    |

#### Panel B: UK

| Large (Employees)                        | March 12 | March 18 | February 16 | March 04 |
|-----------------------------------------|----------|----------|--------------|----------|
|                                         | Sector   | AR       | CAR          |          |
| COMPASS GROUP                           | CS       | 0.041    | −0.050       | 0.002    |
| G4S DEAD                                 | Misc.    | 0.065    | −0.200       | 0.069    |
| TESCO                                   | CS       | −0.038   | 0.067        | 0.034    |
| HSBC HOLDINGS                           | RE       | 0.009    | 0.159        | 0.030    |
| SAINSURY J                               | CD       | −0.050   | 0.068        | 0.134    |
| ROYAL MAIL                              | INDUS    | −0.023   | −0.056       | 0.115    |
| UNILEVER (UK)                           | CD       | −0.009   | −0.042       | 0.015    |
| GLENCORE                                | MATE     | −0.008   | 0.009        | 0.009    |
| ASSOCIATED BRIT.FOODS                   | CS       | 0.043    | 0.058        | −0.042   |
| MORRISON(WMSFHKTS)                      | CS       | −0.036   | 0.074        | 0.112    |
| Small (Employees)                       |          |          |              |          |
| BBGI GLOBAL INFLASA                     | FIN      | 0.037    | −0.088       | −0.123   |
| RIT CAPITAL PARTNERS                    | FIN      | 0.043    | −0.043       | −0.037   |
| PURETECH HEALTH                         | CD       | 0.055    | 0.064        | 0.048    |
| CAPITAL & CNTS.PROPS.                   | RE       | 0.035    | 0.063        | −0.039   |
| ASSURA                                  | RE       | −0.016   | 0.035        | 0.048    |
| IG GROUP                                | FIN      | 0.048    | 0.112        | −0.065   |
| GREAT PORTLAND ESTATES                  | RE       | −0.017   | −0.010       | −0.016   |
| G4S HOLDINGS                            | RE       | 0.025    | 0.018        | −0.079   |
| DERWENT LONDON                          | RE       | −0.017   | −0.011       | 0.033    |
| LAW DEBENTURE                           | RE       | 0.102    | −0.016       | −0.066   |

#### Panel C: Europe

| Large (Employees)                        | March 12 | March 18 | February 16 | March 04 |
|-----------------------------------------|----------|----------|--------------|----------|
|                                         | Sector   | AR       | CAR          |          |
| VOLKSWAGEN AG                           | CD       | 0.020    | 0.117        | −0.062   |
| VOLKSWAGEN AG                           | INDUS    | 0.030    | −0.086       | −0.076   |
| DEUTSCHE POST AG                        | CD       | 0.017    | 0.107        | 0.048    |
| SODEXO                                  | INDUS    | −0.089   | −0.395       | 0.031    |
| KONINKLIJE AHOLD                        | CS       | 0.000    | 0.052        | 0.053    |
| TELEPERFORMANCE SE                      | IT       | −0.071   | −0.258       | 0.052    |
| CARREFOUR S.A.                          | CS       | −0.035   | 0.158        | 0.069    |
| FRENCHIUS SE                            | CD       | 0.040    | −0.077       | −0.006   |
| SIEMENS AG                              | HE       | 0.026    | 0.019        | −0.050   |
| DAIMLER AG                              | FIN      | 0.009    | −0.021       | −0.019   |
| Small (Employees)                       |          |          |              |          |
| GROEP BRUSSEL LAM                       | UTL      | −0.107   | −0.002       | 0.050    |
| DEUTSCHE WOHNEN SE                      | IT       | −0.017   | −0.177       | −0.042   |
| GECINA                                  | EN       | −0.098   | −0.517       | −0.088   |
| AROUNDOWN SA                            | FIN      | −0.142   | −0.547       | −0.108   |
| PORSCHE AUTOMOBIL                       | FIN      | 0.003    | −0.191       | −0.096   |

(continued on next page)
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. We do this exercise to confirm whether the impact of coronavirus outbreak is limited to only large firms or small firms are also equally impacted. Do we observe any variations in the effect of the pandemic of these firms? The analysis may help understand the impact at the micro-level, which is a major research gap in the existing literature and also the main objectives of this study.

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 larger 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 significant with negative and positive AR and CAR values. Focussing on 2021, February 16, and March 04 are statistically significant, with negative AR and CAR values across large and small firms based on the number of employees. The impact of coronavirus events is favourable green shoots. The 2021 event dates reflect the upward shifts in the mood of the large and small firms analysed across markets, as the 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 longer 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). 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 firms operating in 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.

### Table 2 (continued)

| Panel C: Europe | | | | |
| --- | --- | --- | --- | --- |
| Large | Sector | March 12 | March 18 | February 16 | March 04 |
| | | AR | CAR | AR | CAR | AR | CAR | AR | CAR |
| KLEPIERRE SA | RE | 0.002 | 0.050 | 0.003 | 0.066 | 0.00 | 0.111 | 0.008 | 0.012 |
| NIPPON TELECOM/TELEPH. | CD | 0.005 | 0.029 | 0.021 | 0.008 | 0.001 | 0.018 | 0.001 | 0.024 |
| PANASONIC CORP | CD | 0.006 | 0.031 | 0.009 | 0.041 | 0.005 | 0.008 | 0.006 | 0.015 |
| CANON INC. | IT | 0.006 | 0.031 | 0.007 | 0.016 | 0.002 | 0.029 | 0.004 | 0.026 |
| Small | Sector | March 12 | March 18 | February 16 | March 04 |
| | | AR | CAR | AR | CAR | AR | CAR | AR | CAR |
| MATSU SECURITIES | FIN | 0.006 | 0.031 | 0.007 | 0.016 | 0.002 | 0.029 | 0.004 | 0.026 |
| TOYO ELECTRIC | FIN | 0.006 | 0.031 | 0.007 | 0.016 | 0.002 | 0.029 | 0.004 | 0.026 |
| DENSO CORP | CD | 0.006 | 0.031 | 0.007 | 0.016 | 0.002 | 0.029 | 0.004 | 0.026 |

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.
## 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 |
| MICROSOFT | IT     | -0.166   | -0.203      | -0.050   | -0.123 |
| AMAZON.COM | CD     | -0.087   | -0.064      | 0.008    | -0.015 |
| FACEBOOK CLASS A | IT     | -0.104   | -0.242      | -0.021   | -0.152 |
| ALPHABET 'C' | IT     | -0.114   | -0.306      | -0.167   | -0.296 |
| ALPHABET A | FIN     | -0.079   | -0.231      | -0.023   | -0.143 |
| JOHNSON & JOHNSON | HE     | -0.057   | -0.133      | -0.015   | -0.184 |
| JP MORGAN CHASE & CO. | FIN   | -0.114   | -0.369      | -0.026   | -0.160 |
| VISA 'A' | FIN     | -0.090   | -0.257      | -0.066   | -0.149 |
| PROCTOR & GAMBLE | HE    | -0.094   | -0.136      | -0.011   | -0.198 |

### Small

| Large | March 12 | March 18 | February 16 | March 04 |
|-------|----------|----------|-------------|----------|
|       | Sector   | AR CAR   | AR CAR      | AR CAR   |
| UNDER ARMOUR A | CD | -0.106   | -0.402      | -0.036   | -0.277 |
| GAP | CD       | -0.078   | -0.155      | -0.006   | -0.030 |
| UNUM GROUP | FIN   | -0.095   | -0.334      | -0.108   | -0.227 |
| RALPH LAUREN CL. A | CD  | -0.117   | -0.519      | -0.127   | -0.381 |
| DISCOVERY SERIES A | TEL | -0.157   | -0.284      | 0.059    | -0.228 |
| HOLLYFRONTIER | EN     | -0.109   | -0.349      | -0.134   | -0.221 |
| PVH | CD       | -0.110   | -0.455      | -0.174   | -0.312 |
| NEWS 'A' | CD     | -0.137   | -0.368      | -0.066   | -0.208 |
| NOV | INDUS    | -0.080   | -0.233      | -0.019   | -0.147 |
| HANESBRANDS | CD   | -0.201   | -0.670      | -0.119   | -0.130 |

### Panel B: UK

| Large | March 12 | March 18 | February 16 | March 04 |
|-------|----------|----------|-------------|----------|
|       | Sector   | AR CAR   | AR CAR      | AR CAR   |
| ASTRAZENECA | HE   | -0.049   | -0.115      | 0.008    | -0.111 |
| HSBC HOLDINGS | FIN  | 0.009    | 0.159       | 0.030    | 0.034  |
| GLAXOSMITHKLINE | HE | -0.021   | -0.105      | -0.026   | -0.091 |
| UNILEVER (UK) | CD   | -0.009   | -0.042      | 0.015    | -0.119 |
| DIAGEO | CD       | 0.023    | 0.017       | -0.027   | -0.062 |
| BP | EN       | 0.021    | -0.119      | -0.036   | 0.122  |
| BRITISH AMERICAN TOBACCO | CD | -0.028   | -0.084      | 0.021    | -0.159 |
| ROYAL DUTCH SHELL A | EN    | -0.007   | -0.051      | -0.039   | 0.003  |
| RIO TINTO | MATE   | -0.009   | 0.078       | 0.006    | 0.142  |
| ROYAL DUTCH SHELL B | EN   | -0.004   | -0.124      | -0.040   | 0.155  |

### Small

| Large | March 12 | March 18 | February 16 | March 04 |
|-------|----------|----------|-------------|----------|
|       | Sector   | AR CAR   | AR CAR      | AR CAR   |
| BAKKAVOR GROUP | CS     | 0.027    | 0.052       | 0.002    | 0.284  |
| CONTOURGLOBAL | EN     | -0.024   | 0.031       | 0.084    | 0.247  |
| PETE HOTEL GROUP | RE  | -0.132   | -0.153      | -0.123   | 0.068  |
| BANK GROUP | INDUS    | 0.015    | -0.022      | 0.004    | -0.014 |
| HYVE GROUP | INDUS    | 0.044    | -0.007      | 0.125    | -0.128 |
| STAGECOACH GROUP | INDUS | 0.051    | 0.017       | -0.007   | 0.020  |
| SENIOR | INDUS    | 0.082    | 0.128       | -0.164   | -0.211 |
| CLIS HOLDINGS | RE    | 0.025    | 0.018       | -0.079   | -0.045 |
| PAYPOINT | FIN    | 0.018    | -0.031      | -0.133   | -0.179 |
| EQUINTI GROUP | IT   | 0.106    | 0.083       | 0.003    | -0.068 |

### Panel C: Europe

| Large | March 12 | March 18 | February 16 | March 04 |
|-------|----------|----------|-------------|----------|
|       | Sector   | AR CAR   | AR CAR      | AR CAR   |
| NORDEA BANK ABP | FIN  | 0.009    | 0.138       | 0.068    | 0.006  |
| LVHM MOET HENNESSY | CD   | 0.099    | 0.157       | -0.058   | 0.112  |
| LOREAL SA | CD       | 0.075    | 0.132       | -0.011   | 0.041  |
| SAP SE | IT       | 0.080    | 0.123       | -0.010   | 0.156  |
| ANHEUSER BUSCH IN | CS   | -0.010   | -0.136      | -0.009   | -0.118 |
| UNILEVER | CS      | -0.028   | -0.245      | -0.089   | 0.086  |
| TOTAL SA | EN      | 0.026    | 0.019       | -0.050   | 0.040  |
| SANOFI | HE       | -0.022   | -0.188      | -0.007   | -0.074 |
| ASM HOLDING NV | INDUS | -0.058   | -0.157      | 0.007    | -0.142 |
| AIRBUS SE | INDUS  | -0.004   | -0.118      | 0.029    | -0.022 |

### Small

| Large | March 12 | March 18 | February 16 | March 04 |
|-------|----------|----------|-------------|----------|
|       | Sector   | AR CAR   | AR CAR      | AR CAR   |
| BANK OF IRELAND GROUP | FIN  | 0.013    | 0.216       | 0.110    | 0.038  |
| METSO | INDUS    | 0.037    | 0.332       | 0.003    | 0.078  |
| GEA GROUP AG | INDUS | -0.014   | -0.016      | 0.053    | 0.055  |
| UNITED INTERNET AG | IT    | 0.015    | 0.156       | -0.014   | 0.186  |

(continued on next page)
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).

### 4.2. Idiosyncratic risk analysis

It is apparent from above analysis that the coronavirus pandemic has impacted the performance of firms and it would be wise to analyze 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 Eq. (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 eqs. (2).

\[ IVOL_t = \sigma_t \]  

(5)

We have used a time-varying regression of eqs. (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.

\[ IVOL_t = a_0 + \beta X_t + Controls_t + \epsilon_t \]  

(6)

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.

Where \( IVOL_t \) is the monthly idiosyncratic volatility of sample firms, \( X_t \) 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 \( \text{Controls}_0 \), 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. The variables are sourced from the Refinitiv DataStream.

Table 4 shows the results of panel fixed-effect regression Eq. (6). We find that firm-specific factors such as cash flow (Cash) and market capitalization (MC) exhibit a negative relationship 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 US leads to a 10.8% decrease in the idiosyncratic risk. The result implies that as the firm's profitability increases, idiosyncratic risk declines and is much stronger during the crisis period. However, the coefficient of trading volume (Volume) picks a positive sign that implies that the increase in trading volume leads to an increase in idiosyncratic risk. It has happened during the crisis period as the sample period of monthly analysis covers the coronavirus outbreak.

The coefficients of controls such as COVID-19 (COVID) cases and Stringency measures positively explain firms' idiosyncratic risk that implies 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 et al. (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. The 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 USA 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 MC exhibit a negative relationship with firms' idiosyncratic risk. However, the coefficients are not significant for all the countries. The
Overall, the stock (firm) level analysis reveals interesting patterns as far as the impact of the coronavirus outbreak is concerned. Our empirical analysis confirms the significant impact of coronavirus outbreak events on the stock markets of sample countries. However, the event-study approach confirms the significant impact of coronavirus outbreak on stock markets of sample countries. The determinants of idiosyncratic risk of small firms (size): Fama and Macbeth cross-section regressions.

| Variables | USA | UK | Europe | Japan |
|-----------|-----|----|--------|-------|
| Cash      | −0.213*** | −0.201*** | −0.153*** | −0.0191 |
| (0.0363)   | (0.0360) | (0.0366) | (0.0402) |
| MC (Size)  | −0.142*** | −0.259*** | −0.0581 | −0.0843*** |
| (0.0330)   | (0.0428) | (0.0493) | (0.0241) |
| Volume    | 0.329*** | 0.106*** | 0.0106 | 0.0640 |
| (2.033-07) | (0.0356) | (0.0130) | (0.0270) |
| COVID     | 0.0286*** | 0.0194*  | −0.0165 | 0.2566-05 |
| (0.0054)   | (0.0111) | (0.0109) | (7.72-05) |
| OXV       | 0.190*** | 0.119*** | 0.639*** | 0.358*** |
| (0.0558)   | (0.112)  | (0.0460) | (0.0343) |
| Stringency | −0.0552*** | 0.0213 | 0.0970*** | 0.0573*** |
| (0.0112)   | (0.0162) | (0.0285) | (0.00999) |
| Constant  | −3.980*** | −0.928**  | −0.632*  | 0.581 |
| (0.384)    | (0.438)  | (0.362)  | (0.546)  |

Overall, the micro-analysis reveals that the differential impact of the COVID-19 cases and stringency measures show a positive relationship with idiosyncratic risk for the USA, UK, and Japan. However, the overall analysis reveals that the differential impact of the COVID-19 cases and stringency measures on firms' idiosyncratic risk, which is 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.

5. Conclusion and policy implications

Overall, the stock (firm) level analysis reveals interesting patterns as far as the impact of the coronavirus outbreak is concerned. Our empirical setup contributes to the literature in the following manner. First, the applications of linear and nonlinear structural break models helped identify the major event related to the coronavirus outbreak, including the Black swan events reported during the first and second waves of March 2020 and also the recovery phase of 2021. Second, the analysis of the event-study approach confirms the significant impact of coronavirus outbreak events on the stock markets of sample countries. However, 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 show a positive relationship 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 that the differential impact of the COVID-19 cases and stringency measures on firms' idiosyncratic risk, which is 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.
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 observe an almost similar impact on small and large stocks for the UK, but large firms seemed more responsive than small firms. 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 analysis as AR and CAR values as 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 Reubuc (2020), and Haroon and Rizvi (2020), Huang et al. (2021) and Chebbi et al. (2021). Some results also differ with multi-country studies by Hu and Zhang (2021) and

However, the idiosyncratic analysis further substantiates the above findings as firm-specific factors establish a negative relationship 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 outbreak events based on their sizes. Based on these results, we can say that the stock level analysis provides a better picture than the country and sectoral analysis, and the study can be extended to cover more countries and even emerging markets.

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