



Stock liquidity during COVID-19 crisis: A cross-country analysis of developed and emerging economies, and economic policy uncertainty

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ABSTRACT

We investigate the impact of the COVID-19 on firms' stock liquidity across six developed and emerging economies. Unlike prior literature, we further compare the effects of the pandemic between developed and emerging economies, high and low economic policy uncertainty (EPU), and large and small firms. Our results document the significant negative impact of infection cases and deaths on firms' stock liquidity across the sample countries, and the similar effect of their interaction term. We find that the impact is more pronounced in the developed economies, high EPU and small firms, compared to emerging economies, low EPU and large firms, respectively.

1. Introduction

COVID-19 (hereafter C-19) pandemic has triggered an unprecedented crisis around the world with regard to the fact that the virus is highly contagious and deadly. Since C-19 caused by the novel coronavirus (SARS-CoV-2 disease) emerged in December 2019 in China and spread globally to over 200 countries, the outbreak constituted a public health emergency of international concern announced by the World Health Organization (WHO) on 30 January 2020 and later characterised as the world's health pandemic on 12 March 2020. This pandemic supposedly sparked the greatest disturbance in history with widespread impacts on the world's economy across different aspects in 188 countries (Bapuji et al., 2020). The coverage of the dimensions of the current C-19 outbreak fostered severe impacts in all sectors across the globe (Baker et al., 2020b). The world has been witnessing the devastating economic effects of C-19 looming in the shadow of high inflation, high-interest rate, and economic recession. The World Bank (2020) predicts that the global economy will shrink by 5.2% in 2020 and experience the deepest recession since the Second World War (Ellul et al., 2020). Carracedo et al. (2021) present the effects of the C-19 pandemic on business worldwide and mark the explicit downturn of the global economic development that has been caused since the onset of the pandemic. Due to the devastating impacts on economies and financial markets all over the world, many countries have entered a recession following the outbreak, stock markets have become highly volatile with a

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significant decline in stock prices and the global economic uncertainty has reached its peak (Ashraf, 2020; Baker et al., 2020a & b; Zaremba et al., 2020; Zhang et al., 2020a). While the equity market and most stock indices worldwide have fallen sharply in this continuing economic turmoil (World Economic Forum, 2020), C-19 triggered a 38% drop in the Dow Jones Industrial Average Index by March 2020 (Johnston, 2020) and daily stock market movements 24-fold (Baker et al., 2020a).

Given the ongoing global pandemic, the effects of C-19 on the world's real economy as well as financial markets liquidity have been investigated by numerous studies (Haroan and Rizvi, 2020; Huo and Qiu, 2020; Zaremba et al., 2021; Umar et al., 2021; Rahman et al., 2021; Ftiti et al., 2021). However, most of these previous studies are restricted to a relatively short event window normally less than 6 months and mainly use equity index-level data for capturing the reactions of financial markets to the announcement of the pandemic. Moreover, sample countries are used irrespective of the severe impacts of C-19 on those economies. In fact, the effects of C-19 on financial markets and liquidity using firm-level daily data for a longer period (i.e. 12 months or more) with cross-country developed and emerging economy samples most of whom are hugely affected by C-19 have not yet been empirically examined. This study fills this gap in the literature by shedding light on the impacts of the C-19 pandemic on stock market liquidity using firm-level daily data for the full year of the pandemic in 2020 with cross-country evidence for the six stock markets (3 developed and 3 emerging economies).

The motivation for our study originates from two sources. Firstly, while evidence shows a general decline in share prices and dramatic stock market volatility worldwide (Baker et al., 2020a & b; Baig et al., 2021; Chebbi et al., 2021) and some studies examined market reactions to the influence of C-19 on the crude oil and exchange rate return (Iyke, 2020a; Liu et al., 2020a & b; Phan and Narayan, 2020; Gharib et al., 2021), no study has yet examined the acute impact of C-19 on stock market liquidity from a comparative perspective between developed and emerging economies. Most of these countries are immensely affected by C-19 in terms of daily infections and deaths. Unlike prior studies, we investigate the impact of C-19 for a longer period (i.e. 12 months in 2020) on stock market liquidity in 6 countries and compare between 3 developed and 3 emerging economies. Secondly, following the onset of the C-19 pandemic, a decline in the stock market index has been observed with increased market volatility. However, we know little about the role and interplay effects of economic policy uncertainty (EPU) on stock market liquidity during the C-19 pandemic. The recent market volatility due to C-19 provides us the opportunity to examine the interplay effects between C-19 and EPU on stock market liquidity. Thus, this investigation is a timely research agenda and it adds to the evolving literature on market response to pandemics.

Using data from 1255 firms (i.e. 240,007 country-firm-day observations) in 6 developed and emerging countries, we examine the association between C-19 impact and stock market liquidity, and whether this association is significantly different between developed and emerging countries as well as between high CPU and low CPU economies. We measure C-19 impact using two variables at the country level: (i) the total number of infections (ii) the total number of deaths from 1 January to 31 December 2020. We follow recent studies on stock liquidity (e.g., Brogaard et al., 2017; Trinh et al., 2021), and employ two liquidity proxies, namely Effective Spread and Quoted Spread. Our main results show a significant negative impact of both infection cases and deaths on firms' stock liquidity across sample countries, as well as a stronger effect of their interaction term showing lower stock market liquidity. We further study the effects of the pandemic on a subset of developed and developing countries, high and low EPU countries, as well as small and large firms. We find that the impact is more pronounced in the developed, high EPU countries and small firms, compared to emerging, low EPU countries and large firms, respectively.

Our paper contributes to the rapidly growing thread of studies that examine the effects of the C-19 pandemic on financial markets. Firstly, it is the first study to examine the impact of C-19 on stock market liquidity using firm-level daily data in 3 developed and 3 emerging economies, most of which are severely affected by C-19 in terms of total infection cases and deaths. Secondly, unlike prior studies, we test the interactive (joint) effect of C-19 total cases and deaths on stock market liquidity of sample countries. Thirdly, concerning the effect of C-19 on stock liquidity, our study offers a comparison between 3 developed and 3 emerging economies, as well as between high CPU and low CPU economies, and between small and large firms. Finally, our study provides important practical implications for governments and corporate firms across the world in decision-making to combat the new waves of the coronavirus, given that C-19 has severely damaged health and economic well-being worldwide.

The rest of this paper is organized as follows. Section 2 reviews the literature and proposes the hypotheses. Section 3 describes the research methodology and data. Section 4 presents the empirical results including robustness tests and additional analyses and discussion on them. Finally, Section 5 concludes the paper and highlights its implications.

2. Literature review

The spread of the coronavirus has had destructive effects on the economy of the countries in the world (Padhan and Prabheesh, 2021). C-19 has negatively impacted both developed and emerging economies worldwide with lockdown, quarantine measures, social distancing, restrictions on imports, etc. that heavily affected economic activities, sudden surges in unemployment (Campello et al., 2020), sharp shortfalls in stock prices and revenues (Fahlenbrach et al., 2020) and disruption to commerce in most industries (Bapuji et al., 2020). World Bank (2020) has estimated that economic activity has dropped by 7% in developed economies and 2.5% in developing countries. The economic impact of C-19 attracts great attention of scholars and has been investigated on various macro and micro-economic issues such as business confidence, demand shock, sharp drop in oil prices and foreign exchange etc., (Ambrocio, 2021; Goodell, 2020; Iyke, 2020a & b; Mensi et al., 2020; Teresiene et al., 2021; Xu, 2020). The devastating global economic shutdown has escalated across financial sectors, including equity markets, that have an intense influence on world equity markets (Dawson, 2020). Stock markets across the world have fallen and market volatility has increased dramatically worldwide resulting in an unprecedented level of risk (Zhang et al., 2020b; Baker et al., 2020a; Ali et al., 2020). Almost all major stock markets indexes dropped significantly, such as Nasdaq Composite Index, S&P 500 Index, Shanghai Stock Exchange Composite Index, Nikkei Stock Average, Dow Jones Industrial Average Index, and Index in Europe and Australia.

Liu et al. (2020a, 2020b) examine the impact of the C-19 on stock market returns in 21 leading stock markets in the US, UK, Germany, Italy, Japan, South Korea, and Singapore, etc. and report that the pandemic has adversely affected the stability of stock markets where Asian markets have suffered more negative abnormal returns in comparison to other countries. Baker et al. (2020a) also examine the stock market reactions to C-19 and find an extraordinary impact of dramatic decline because of mandatory business closures, social distancing, restrictions on commercial activity, lockdowns, and curfews. Khan et al. (2020) investigated the effect of C-19 on the stock markets of 16 countries and provide evidence that all of the stock markets indices have declined negative significantly to C-19 news of new transmitted cases and deaths. Ali et al. (2020) also explored the reaction of financial markets globally in terms of their decline and volatility, and report that global stock markets have declined significantly due to C-19.

Using index-level daily data for 49 stock markets between January and April 2020, Zaremba et al. (2021) document the negative impacts of government responses to the C-19 pandemic on stock market liquidity, indicating that 'infrastructure channels' such as workplaces and school closings weaken stock market liquidity in emerging economies, while stock trading activity has been facilitated by informational campaigns in mitigating the spread of coronavirus outbreak. Similarly, Phan and Narayan (2020) investigate whether government responses to C-19 have led to any stock price reaction in the top 25 countries and report a possible overreaction of stock markets and market correction over time. In an international context, Foley et al. (2021) show that the C-19 outbreak increases the margin of the global equity market by over 300% overnight. During the pandemic, the binding margins induce market makers to withdraw from stock markets. The withdrawals of market makers lead to an upward illiquidity spiral while decreasing market depth and increasing transaction costs. Stocks with extreme negative impacts caused by the pandemic are found to be most exposed to high-frequency market makers.

Again, using the equity indexes of 23 economies for the period of January – April 2020, Haroon and Rizvi (2020) present an inverse relation between stock market liquidity and the C-19 pandemic measured by the number of new cases and deaths. The findings imply the role of policy interventions in the sample countries in improving stock market liquidity during the pandemic as well as flattening the curves of coronavirus to diminish the uncertainty among investors during the health pandemic. Employing VAR and GARCH (1,1) methods, Umar et al. (2021) indicate an extreme increase in stock market illiquidity in the 4 sample countries surrounding the beginning of the pandemic with the time ranging from July 2019 to July 2020. Again, Ftiti et al. (2021) present the positive effects of non-fundamental news related to the pandemic such as the numbers of new cases and deaths on the stock market returns volatility and illiquidity, while fundamental macroeconomic news does not show significant effects on the Shanghai stock market for the period of December 2019 – April 2020. Using the quantile regression approach, the results imply the pessimism of investors as well as the incompetence in the country's health care systems given extremely high C-19 patients since the onset of the pandemic leading to an increase in the stock market risk associated with higher returns volatility and lower market liquidity during the pandemic. In the US, using the S&P 500 index for the period 13 January to 17 April, 2020, Baig et al. (2021) report that increases in confirmed cases and deaths due to coronavirus are associated with a significant increase in market illiquidity and volatility. Chebbi et al. (2021) also show that there is a significant negative relationship between C-19 (cases and deaths) and stock liquidity of S&P 500 firms during the period from 1 January to 31 December 2020. However, Farzami et al. (2021) reveal the significant but uneven effects of the C-19 pandemic on the interlinkages of liquidity among the US industry groups. The authors find that the liquidity interrelationships are divergent among sectors in the pre-C-19 period and the outbreak leads to an increase in the interconnectedness in all the US sectors. The effects are different among sectors with the utility being the most affected sector, while the telecommunication services sector is the least affected one.

Regarding the response of the financial sector to the pandemic, Nguyen et al. (2021) find the inverse effects of the C-19 outbreak on stock return and liquidity in the Vietnam financial services sector. The government's mandatory strict lockdown as an effort to mitigate the C-19 impacts has positively contributed positive outcomes to the market performance of the country. Also, the pandemic impacts on the Vietnam financial services sector are divergent among small- and large-cap firms. In the context of the Middle East region, Tissaoui et al. (2021) document the significant effect of market volatility on market illiquidity in the Saudi stock market and the negative impact of the C-19 outbreak on market illiquidity with its high response to the total confirmed cases through the use of multiple Wavelet technique (MWC). The test also documents that extreme volatility is like to appear in the short- and medium-term. Again, in the context of Australia, Rahman et al. (2021) find an inverse reaction of the Australian stock market to the announcement of the C-19 pandemic, however, the market shows its positive reactions to the announcement of AUD130 billion 'Job Keeper' package by the government. The authors show that the least profitable and smallest value portfolios experienced the most extreme impacts caused by the pandemic. Similarly, Huo and Qiu (2020) report the reversal reactions of China's stock market to the announcement of the C-19 pandemic at both the firm- and industry levels due to the overreactions of investors. The authors imply that investors' overreactions to the pandemic are more pronounced in firms with a higher proportion of retail investors (lower institutional ownership). Zhang et al. (2021) also examine the market liquidity and firm value of A-shared listed stocks in China. The study detects a negative relationship between firm value and market liquidity in the first three days of the C-19 pandemic, while the relationship remains positive in the following days. The authors find that the negative relationship between firm value and market liquidity becomes more extreme for small firms, non-state-owned enterprises, and firms in highly affected regions.

Based on the above discussion of the recent literature on the impacts of the C-19 pandemic, we argue that firms operating in countries suffering much more serious C-19 outbreaks have experienced a sharp decline in their share prices due to the overreactions of investors that lead to illiquidity in stock markets. Accordingly, we claim that the C-19 pandemic has inverse impacts on stock market liquidity. In other words, a higher number of confirmed infection cases and total deaths lead to a decrease in stock market liquidity. Again, given the recent news on the world's pandemic circumstance, both developed and emerging countries experience reversal impacts of the C-19 pandemic on their stock market liquidity. However, the study predicts that developed countries with worse performance in controlling the pandemic would experience highly interplay effects of the C-19 pandemic than emerging countries. The

study also assumes that countries with high EPU are more exposed to significant interplay effects of the C-19 pandemic on market liquidity than low EPU countries. Finally, since the official announcement of the WHO that C-19 is a global health pandemic, the illiquidity of the sample stock markets has negatively responded to the WHO's announcement overall and is particularly extreme to small firms.

3. Data and methodology

3.1. Data

This study employs non-random criteria of purposive sample for selecting the sample countries. More specifically, the sample countries for this study include three major developed economies including Australia, Japan, and the United States, and three major emerging economies including Brazil, China, and India. The main basis of country selection includes financial market size, geographical location, and the impact of C-19 in terms of confirmed infection cases and deaths in the sample countries. C-19 data including total daily confirmed cases and deaths across the sample countries are collected from the Coronavirus Resource Centre of Johns Hopkins University.¹ The daily data on the number of C-19 reported cases and deaths start from 1 January 2020 and continued until 31 December 2020.

Daily bid, ask, and closing stock prices as well as firm-level accounting data are extracted from the Thompson Reuter DataStream (TRDS) database. DataStream provides accurate and reliable data for equity indexes across the globe and it features 70 years of data, across 175 countries using the major equity indexes used in this research including the S&P/ASX 200 for Australia, BOVESPA for Brazil, SSE180 for China, BSE National 100 for India, NIKKI 225 for Japan, and S&P 500 Composite for the US Economic Policy Uncertainty (EPU) indexes are sourced from the EPU database following Baker et al. (2016).² In order to eliminate the influence of extreme values in the sample, we winsorize the 1% and 99% percentiles of all continuous variables (Brogaard et al., 2017; Trinh et al., 2021). Our final sample consists of 240,007 country-firm-day observations, representing 1255 unique firms across six developed and emerging countries, after winsorizing to mitigate the influences of outliers. All the selected variables, definitions, and sources are presented in Appendix 1.

3.2. Methodology

3.2.1. Stock liquidity proxies

Following recent literature on stock liquidity (Brogaard et al., 2017; Fang et al., 2014; Le and Gregoriou, 2020; Nadarajah et al., 2021; Trinh et al., 2021), we employ two well-established liquidity proxies in the literature - Effective Spread and Quoted Spread.³ Given the recent studies investigating comparable accuracy of using daily data rather than intra-day data for estimating liquidity proxies, we follow Abdi and Rinaldo (2017) to estimate effective spread as our first liquidity proxy as follows.

$$Effective\ Spread_{i,c,d,y} = \frac{2|Price_{i,c,d,t} - M_{i,c,d,y}|}{M_{i,c,d,y}}, M_{i,c,d,y} = \frac{Bid_{i,c,d,y} + Ask_{i,c,d,y}}{2} \quad (1)$$

where $P_{i,c,d,t}$ is the closing price for stock i of country c on day d in year y . $Bid_{i,c,d,y}$ and $Ask_{i,c,d,y}$ indicate the closing bid and closing ask price for stock i of country c on day d in year y . $M_{i,c,d,y}$ is the midpoint of bid price ($Bid_{i,c,d,y}$) and ask price ($Ask_{i,c,d,y}$). Effective spread is estimated as twice the difference between closing price and the midpoint of the bid-ask quote divided by the midpoint of the bid-ask quote. The higher the effective spread the lower the liquidity.

Following Marshall et al. (2012), the second liquidity proxy quoted spread is measured as follows:

$$Quoted\ Spread_{i,c,d,y} = \frac{(A_{i,c,d,y} - B_{i,c,d,y})}{M_{i,c,d,y}} \quad (2)$$

Similarly, the characters of i, c, d, y denote stock i of country c on day d in year y .

Where $A_{i,c,d,y}$, $B_{i,c,d,y}$ and $M_{i,c,d,y}$ are the daily ask price, bid price, and the midpoint of the bid and ask prices, respectively. Spread is defined as the benchmark of best transaction costs in which at the best bid and ask price, the spread consider the best transaction costs and this cost amount is for security executed at the best bid-ask quote (Marshall et al., 2012). The higher the values of effective spread and quoted spread the lower the liquidity and vice versa.

¹ For the global COVID-19 data, please visit the website <https://coronavirus.jhu.edu/>

² The EPU database can be accessed at <https://www.policyuncertainty.com/>

³ Since liquidity measures are employed diversely in the literature on market microstructure, we decide to employ effective spread by Abdi and Rinaldo (2017) and quoted spread by Marshall et al. (2012) for our main liquidity proxies in this study based on the daily bid-ask spread. Hence, it is critical to note that the sign of estimated coefficients may change when authors employ liquidity proxies constructed by different methods in recent literature; however, the overall explanations are still consistent and robust when we interpret our empirical findings which are in line with the literature.

3.2.2. Empirical settings

We examine the effects of C-19 (infection cases, deaths) on stock liquidity with the following baseline regression model in Eq. (3).

$$\text{Stock liquidity}_{i,c,d,y} = \alpha + \beta_1 C - 19_{i,c,d,y} + \beta_2 Y_{i,c,d,y} + \varphi \text{ Time} + \omega \text{ Firm} + \theta \text{ Country} + \varepsilon_{i,c,d,y} \quad (3)$$

where the characters of i, c, d, y indicate firm i in country c on trading day d in year y . Stock liquidity $_{i,c,d,y}$ is measured by either effective spread or quoted spread in which the regression results for each liquidity measure are reported separately in the next sections. $C - 19_{i,c,d,y}$ is captured by using total confirmed infection cases or total confirmed deaths that are converted into their log form for estimations. $Y_{i,c,d,y}$ presents a vector of eight firm-level control variables including four accounting-based (e.g., firm size, leverage, profitability, market-to-book ratio) and four market-based variables (e.g., total return index, price volatility, one-half stock price, market capitalization). All the selected variables, definitions, and sources are presented in Appendix 1. The characters of $\varphi, \omega,$ and θ are for time, firm, and country fixed effects (FE), respectively. Following the literature on market microstructure for stock liquidity (Brogaard et al., 2017; Le and Gregoriou, 2020; Nadarajah et al., 2021; Trinh et al., 2021), we employ pairs of time-, firm-, and country-fixed effects for our multivariate regressions. Despite the fact that cross-sectional one-year data are less likely to be subjected to possible unobserved heterogeneity and auto-correlation problems., we include firm-fixed effects (country-fixed effects) in all the regressions to account for time-invariant unobservable firm (country) characteristics that may differ between firms (countries) and time-varying factors that are constant between firms. Time-fixed effects are also included in our regressions to account for common macroeconomic shocks. Following the literature, the selection of time- and country-fixed effects are important to our study with international evidence of six countries using daily market prices for liquidity measures and firm-level accounting data for the C-19 one-year period data.

After investigating the relationships between C-19 (cases, deaths) and stock liquidity using Eq. (3), we consider the interaction between C-19 (cases, deaths), country economic classifications (developed vs. emerging countries), Economic Policy Uncertainty (high EPU vs. low EPU) and their interplaying effects on stock market liquidity through estimating the following regression models below in Eqs. (4), (5) and (6), respectively.

$$\text{Stock liquidity}_{i,c,d,y} = \alpha + \beta_1 C - 19 \text{ Infection Cases}_{i,c,d,y} + \beta_2 C - 19 \text{ Deaths}_{i,c,d,y} + \beta_3 C - 19 \text{ Infection Cases}_{i,c,d,y} * C - 19 \text{ Deaths}_{i,c,d,y} + \beta_4 Y_{i,c,d,y} + \varphi \text{ Time} + \omega \text{ Firm} + \theta \text{ Country} + \varepsilon_{i,c,d,y} \quad (4)$$

$$\text{Stock liquidity}_{i,c,d,y} = \alpha + \beta_1 C - 19 * \text{Country}_{i,c,d,y} + \beta_2 Y_{i,c,d,y} + \varphi \text{ Time} + \omega \text{ Firm} + \varepsilon_{i,c,d,y} \quad (5)$$

$$\text{Stock liquidity}_{i,c,d,y} = \alpha + \beta_1 C - 19 * \text{EPU}_{i,c,d,y} + \beta_2 Y_{i,c,d,y} + \varphi \text{ Time} + \omega \text{ Firm} + \varepsilon_{i,c,d,y} \quad (6)$$

In Eq. (4), we examine the interactive effect of C-19 infection cases and deaths on stock liquidity of the sample countries. In Eq. (5), our study examines the interplaying effects between C-19 (cases, deaths) and country economic types (developed and emerging countries) on stock liquidity and whether the effects are significantly different between two groups of sample countries. Similarly, in Eq. (6), we investigate the interplaying effects between C-19 (cases, deaths) and the Economic Policy Uncertainty index (high EPU and low EPU) on stock liquidity and whether the effects are significantly different between high and low EPU sample countries.

Table 1
Confirmed COVID-19 infection cases & deaths by country and month.

| Panel A: Confirmed Infection Cases and Deaths by Country | | | |
|--|-------------------|----------------|--------------------------------------|
| Country | Total Cases | Total Deaths | No. of Country-Firm-Day Observations |
| Australia | 16,069 (0.13%) | 420 (0.14%) | 35,666 |
| Brazil | 2,977,768 (25%) | 90,910 (31%) | 14,443 |
| China | 81,483 (0.68%) | 4145 (1.4%) | 25,760 |
| India | 3,635,011 (30%) | 57,714 (19%) | 18,066 |
| Japan | 56,379 (0.47%) | 1113 (0.38%) | 47,747 |
| USA | 5,186,118 (47%) | 142,185 (48%) | 98,325 |
| Total | 11,952,828 (100%) | 296,487 (100%) | 240,007 |
| Panel B: Confirmed Infection Cases and Deaths by Quarter | | | |
| Quarter | Total Cases | Total Deaths | No. of Country-Firm-Day Observations |
| 1st Quarter | 281,864 (3%) | 4980 (2%) | 33,366 |
| 2nd Quarter | 649,723 (7%) | 35,131 (14%) | 68,477 |
| 3rd Quarter | 2,558,697 (28%) | 79,906 (33%) | 70,755 |
| 4th Quarter | 5,771,200 (62%) | 122,911 (51%) | 67,409 |
| Total | 9,261,484 (100%) | 242,928 (100%) | 240,007 |

This table reports the distribution of the total cases and death incidents of C-19 pandemic by countries and quarters. Panels A and B show the total confirmed cases and death incidents across sample countries and across four quarters of 2020, respectively.

4. Empirical results and discussions

4.1. Descriptive statistics and correlation matrix

Table 1 reports the summary statistics of C-19 confirmed infection cases and deaths by country and quarters in 2020, respectively. Panel A indicates that the total cases and deaths are highest for the USA (47% and 48%, respectively), followed by India (30% and 19%) and Brazil (25% and 31%). Panel B exhibits that in the sample countries C-19 spreads out and becomes worse in the 4th quarter of 2020 (62% of all cases and 51% of all deaths) than in previous quarters.

Table 2 presents the descriptive statistics of liquidity measures, C-19, and firm-level variables, respectively. In Panel A, the mean (and median) values of the liquidity measure effective spread and quoted spread are 0.8123 (0.8109) and 0.0034 (0.0007), respectively, with a minimum of 0.65 and a maximum of 1.0865 for the former, and 0.00 and 0.0446 for the latter. Panel B presents the mean (and median) values of total confirmed infection cases and deaths in their logarithmic form as 12.1224 (11.4939) and 8.5974 (8.4414), respectively. Finally, Panel C shows the mean (and median) values of firm-level control variables including firm size (total assets), leverage, profitability (ROA), market-to-book value (Mktbk), stock return, volatility, one divided by stock price, and market capitalization (in million).

Table 3 reports the Pearson correlation matrix among the selected independent and control variables. While the majority of the correlations are statistically significant, there is no sign of a multicollinearity problem except for the variables of interest log C-19 total infection cases and deaths (0.947) that are used alternatively in the regression models. Moreover, a multicollinearity diagnostic test Variance Inflation Factors (VIF) indicates no potential problem of serious multicollinearity.

4.2. Regression results - baseline

In **Table 4** (Columns 1–8), we present the regression results (with standard errors corrected for clustering at the firm level as well as time, firm, and country fixed effects) of the relationships between C-19 (confirmed infection cases and deaths) and stock liquidity measures (effective spread and quoted spread), and firm-level control variables. We implement the regression model twice for each liquidity measure with both time- and firm-fixed effects (Columns 1, 3, 5 and 7) and country fixed effects (Columns 2, 4, 6 and 8). Columns 1 and 2 in **Table 4** show significant positive effects of C-19 total confirmed cases on effective spread suggesting that number of confirmed C-19 cases leads to higher (lower) stock illiquidity (liquidity), consistent with our predictions that liquidity affected by the pandemic impact on financial markets. Columns 5 to 6 in **Table 4** demonstrate the identical relationship between the total number of confirmed C-19 cases and quoted spread, as reported in Columns 1 to 2, implying that given a 1 % increase in the total infection cases, the stock market liquidity is decreased by 0.01% with time- and firm-fixed effects and decreased by 0.02% with time- and country-fixed effects only.

In regard to control variables in Columns 1 and 2, while firm size can improve stock liquidity, 1/stock price can deter such liquidity improvement. In contrast, volatility, ROA, growth, leverage and market capitalization are showing mixed results effective spread depending on the firm and year FE or year and country FE. Again, control variables in Columns 5 and 6 also indicate similar effects as mentioned before, except for stock return showing stock liquidity improvement effect.

Further, in **Table 4** Columns 3–4 and 7–8, we replicate Columns 1–2 and 5–6 by replacing C-19 total confirmed cases with the total number of deaths. The findings in Columns 3 to 4 and 7 to 8 reveal a significant positive relationship between C-19 total confirmed number of deaths and stock liquidity measured by effective spread and quoted spread, similar to Columns 1 to 2 and 5 to 6 findings. These findings suggest that given a 1 % increase in the total deaths, the stock market liquidity is decreased by 0.01% with time- and firm-fixed effects and decreased by 0.02% with time- and country-fixed effects only. The estimated results in **Table 4** affirm the inverse effects of C-19 on stock liquidity, indicating a decrease in stock liquidity due to the C-19 pandemic across the sample countries. The control variables in Columns 3 to 4 and 7 to 8 also indicate comparable effects as mentioned earlier in Columns 1 to 2 and 5 to 6.

Following the significant inverse effects of C-19 infection cases and deaths on stock liquidity in **Table 4**, we also focus on testing the interactive effect of C-19 infection cases and deaths on stock liquidity in the sample countries. In **Table 5**, we first check the effect of C-19 infection cases and deaths together in Columns 1a, 2a, 3a and 4a, and then their interactive effect in Columns 1b, 2b, 3b and 4b. The results in the former columns (i.e. 1a, 2a, 3a and 4a) show either insignificant or mixed (i.e. positive/negative) effects of C-19 infection cases and deaths on both liquidity measures. However, our main variable of interest in the latter columns (i.e. 1b, 2b, 3b and 4b) in **Table 5** still demonstrates a significant positive impact of the interaction term variable (i.e. Ln Total Infection Cases * Ln Total Deaths) on stock illiquidity. This result suggests that the interactive effect of C-19 pandemic cases and deaths remains intense and overwhelming market response and deteriorating stock liquidity, consistent with **Table 4** findings. Thus, our baseline findings show that the C-19 pandemic inversely affects stock liquidity in international stock markets during the C-19 pandemic of 2020.

4.3. Robustness tests

In **Tables 6, 7 and 8**, we provide robustness tests of our baseline findings. **Table 6** exhibits the impact of the C-19 on firms' stock liquidity using alternative measurement proxies of total infection cases and deaths, such as (i) the ratio of the total number of

Table 2
Descriptive statistics.

| Variable | Mean | SD | Min | p25 | p50 | p75 | Max |
|-----------------------------------|---------|---------|----------|---------|---------|---------|---------|
| Panel A: Dependent variables | | | | | | | |
| <i>Effective Spread</i> | 0.8123 | 0.0076 | 0.6500 | 0.8106 | 0.8109 | 0.8122 | 1.0865 |
| <i>Quoted Spread</i> | 0.0034 | 0.0074 | 0.0000 | 0.0001 | 0.0007 | 0.0027 | 0.0446 |
| Panel B: Independent variables | | | | | | | |
| <i>Ln (Total Infection Cases)</i> | 12.1224 | 3.3381 | 2.6391 | 10.1561 | 11.4939 | 15.3193 | 16.8210 |
| <i>Ln (Total Deaths)</i> | 8.5974 | 3.3874 | 0.0000 | 6.8035 | 8.4414 | 11.8334 | 12.7196 |
| Panel C: Firm-level Variables | | | | | | | |
| <i>Size</i> | 16.3775 | 1.6942 | 12.2810 | 15.2946 | 16.3049 | 17.4129 | 20.8545 |
| <i>Leverage</i> | 1.2467 | 2.3584 | -4.7463 | 0.2765 | 0.6546 | 1.3757 | 15.4501 |
| <i>ROA</i> | 0.0581 | 0.0818 | -0.1932 | 0.0170 | 0.0464 | 0.0927 | 0.3645 |
| <i>MktBk</i> | 5.0963 | 10.4034 | -11.9200 | 1.1300 | 2.2300 | 4.9000 | 75.5000 |
| <i>Stock Return</i> | 0.0011 | 0.0293 | -0.0941 | -0.0129 | 0.0000 | 0.0143 | 0.1001 |
| <i>Volatility</i> | 25.4989 | 7.4944 | 13.3500 | 19.9300 | 24.4100 | 29.6700 | 50.2700 |
| <i>1/Stock Price</i> | 0.1374 | 0.1974 | 0.0002 | 0.0133 | 0.0460 | 0.1762 | 0.8784 |
| <i>Market Cap (Millions)</i> | 17.2410 | 2.0851 | 13.3955 | 15.8733 | 16.8622 | 18.3879 | 22.5526 |

This table presents descriptive statistics for the variables used in this study. The sample consists of 240,007 country-firm-day observations which range from 1 January to 31 December 2020, representing 1255 unique firms. Detailed variable definitions are provided in [Appendix 1](#).

Table 3
Correlation matrix.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| (1) <i>Ln (Total Infection Cases)</i> | 1.000 | | | | | | | | | |
| (2) <i>Ln (Total Deaths)</i> | 0.947* | 1.000 | | | | | | | | |
| (3) <i>Size</i> | 0.216* | 0.168* | 1.000 | | | | | | | |
| (4) <i>Leverage</i> | 0.059* | 0.049* | 0.184* | 1.000 | | | | | | |
| (5) <i>ROA</i> | 0.032* | 0.034* | -0.298* | -0.073* | 1.000 | | | | | |
| (6) <i>MktBk</i> | 0.123* | 0.113* | -0.194* | 0.557* | 0.288* | 1.000 | | | | |
| (7) <i>Stock Return</i> | 0.020* | 0.017* | -0.018* | -0.004* | 0.016* | 0.015* | 1.000 | | | |
| (8) <i>Volatility</i> | -0.188* | -0.150* | -0.362* | -0.046* | -0.008* | 0.015* | 0.024* | 1.000 | | |
| (9) <i>1/Stock Price</i> | -0.332* | -0.270* | -0.193* | 0.049* | -0.105* | -0.127* | -0.001 | 0.271* | 1.000 | |
| (10) <i>Market Cap</i> | -0.059* | -0.053* | 0.546* | 0.002 | -0.052* | -0.055* | -0.010* | -0.211* | -0.401* | 1.000 |

This table presents the Pearson correlation matrix and correlation significance at the 5% level for the sample consisting of 240,007 country-firm-day observations which range from 1 January to 31 December 2020, representing 1255 unique firms. Detailed variable definitions are provided in [Appendix 1](#).

confirmed infection cases to the overall population (in Columns 1, 2, 7 and 8), (ii) the ratio of the total number of deaths to the overall population (in Columns 3, 4, 9 and 10) and (iii) the ratio of the total number of deaths to the total number of infection cases (in Columns 5, 6, 11 and 12).⁴ The results in Columns 1–12 reveal significant positive effects of these C-19 alternative measure proxies on both effective spread and quoted spread measures of stock liquidity. That is to say, a higher number of C-19 infection cases as well as death caused by Covid-19 is associated with a higher (lower) stock illiquidity (liquidity), which is consistent with our baseline findings in [Table 4](#).

Further, in [Table 7](#), we test the lead-lag effect of C-19 total infection cases (in Columns 1, 2, 5 and 6) and deaths (in Columns 3, 4, 7 and 8) on firms' stock liquidity.⁵ Since our data are daily, we use 1-day period lag for the independent variables of interest (i.e. dependent variable is in time t and lagged independent variables are in time $t-1$) and as a result, the total number of observations is reduced compared with the main baseline tables. The results in Columns 1–8 demonstrate significant positive effects of C-19 total infection cases and deaths on higher stock illiquidity (i.e. lower liquidity).

Finally, in [Table 8](#), we check the effect of C-19 total infection cases (in Columns 1, 2, 5 and 6) and deaths (in Columns 3, 4, 7 and 8) on changes in stock liquidity measurement variables. While keeping all independent/control variables unchanged, the changes in the dependent variables is calculated as 'liquidity in time t - liquidity in time $t-1$ '. This resulted in a reduced total number of observations compared with the main baseline tables. The findings in Columns 1–8 document significant positive effects of C-19 total infection cases and deaths on changes in stock liquidity measurement variables (i.e. Δ Effective Spread and Δ Quoted Spread), indicating lower liquidity (i.e. higher stock illiquidity). Thus, these findings in [Tables 6, 7 and 8](#) reconfirm our assertion for the effect of C-19 on stock liquidity and baseline findings therein.

⁴ We thank the reviewers for providing these thoughtful ideas on alternative measurement proxies.

⁵ We thank the reviewers for providing this insightful idea on the lead-lag effect.

Table 4
Effect of confirmed COVID-19 infection cases and deaths on stock liquidity.

| | Effective spread | | | | Quoted spread | | | |
|-----------------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| <i>Ln (Total Infection Cases)</i> | 0.0001** (2.41) | 0.0002*** (6.39) | | | 0.0001*** (4.18) | 0.0002*** (8.00) | | |
| <i>Ln (Total Deaths)</i> | | | 0.0001*** (2.61) | 0.0002*** (6.08) | | | 0.0001*** (2.86) | 0.0001*** (6.96) |
| <i>Size</i> | -0.0139*** (-4.96) | -0.0001*** (-2.61) | -0.0139*** (-4.97) | -0.0001*** (-2.64) | -0.0141*** (-5.18) | -0.0002*** (-2.59) | -0.0143*** (-5.19) | -0.0003*** (-2.60) |
| <i>Leverage</i> | 0.0002 (1.29) | -0.0000 (-0.52) | 0.0002 (1.30) | -0.0000 (-0.51) | 0.0001 (0.76) | -0.0000 (-0.96) | 0.0001 (0.81) | -0.0000 (-0.95) |
| <i>ROA</i> | -0.0003 (-0.04) | 0.0015* (1.84) | -0.0003 (-0.04) | 0.0015* (1.84) | 0.0005 (0.10) | 0.0031* (1.83) | 0.0007 (0.13) | 0.0031* (1.83) |
| <i>MktBk</i> | -0.0000 (-0.90) | -0.0000 (-0.88) | -0.0000 (-0.90) | -0.0000 (-0.90) | 0.0000 (0.10) | -0.0000 (-0.00) | 0.0000 (0.02) | -0.0000 (-0.02) |
| <i>Stock Return</i> | -0.0283*** (-13.71) | -0.0294*** (-13.88) | -0.0283*** (-13.74) | -0.0294*** (-13.91) | 0.0003 (0.77) | 0.0003 (0.68) | 0.0004 (0.96) | 0.0004 (0.92) |
| <i>Volatility</i> | 0.0005** (2.57) | -0.0000*** (-3.14) | 0.0005** (2.57) | -0.0000*** (-3.14) | 0.0005*** (3.07) | -0.0001*** (-3.13) | 0.0006*** (3.25) | -0.0001*** (-3.13) |
| <i>1/Stock Price</i> | 0.0145*** (6.78) | 0.0012** (2.17) | 0.0146*** (6.79) | 0.0012** (2.22) | 0.0065*** (6.54) | 0.0015* (1.83) | 0.0068*** (6.71) | 0.0015* (1.87) |
| <i>Market Cap</i> | 0.0002 (0.22) | -0.0003*** (-4.35) | 0.0002 (0.23) | -0.0003*** (-4.32) | 0.0001 (0.09) | -0.0007*** (-5.41) | -0.0000 (-0.01) | -0.0006*** (-5.39) |
| Time FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | NO | YES | NO | YES | NO | YES | NO |
| Country FE | NO | YES | NO | YES | NO | YES | NO | YES |
| Observations | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 |
| Adjusted R ² | 0.187 | 0.142 | 0.187 | 0.142 | 0.734 | 0.591 | 0.734 | 0.590 |

This table presents regression results on the relation between (i) total infection cases and stock liquidity, and (ii) total deaths and stock liquidity. Detailed variable definitions are provided in [Appendix 1](#). Regressions control for firm, country- and year-fixed effects. Standard errors are corrected for clustering at the firm level and t-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

4.4. Additional analyses - developed vs. emerging economies; high vs. low economic policy uncertainty (EPU) index; small and large firms

In [Table 9](#), we explore whether the adverse effects of C-19 (cases and deaths) on stock liquidity measures are significantly different between the sample developed and emerging countries. We split the sample countries into developed and emerging economies and create the developed (emerging) countries' dummies for the interplay between total confirmed cases or confirmed deaths and developed or emerging countries' dummy variables. Both Panels A and B of [Table 9](#) reveal the interactions between C-19 measures and countries' dummies that reaffirm significant inverse effects of C-19 on stock liquidity proxies for both developed and emerging countries. However, the results imply severe effects of C-19 on stock liquidity in developed countries, compared to emerging countries as the difference in estimated coefficients are statistically significant except for liquidity measured by quoted spread with C-19 number of cases. These findings suggest that, compared to emerging countries, stock liquidity in developed countries is severely affected by C-19.

We further examine the significant differences between the sample countries regarding the adverse effects of C-19 cases and deaths on stock liquidity measures in [Table 10](#). We create dummy variables by splitting the sample countries into high and low economic policy uncertainty (EPU).⁶ EPU reflects the relative frequency of own-country newspaper articles that contain a trio of terms pertaining to the economy (E), policy (P), and uncertainty (U). In other words, each monthly national EPU index value is proportional to the share of own-country newspaper articles that discuss economic policy uncertainty in that month. The high (low) Economic Policy Uncertainty Index is a dummy that takes the value of one if the index value is above (below) the cross-sectional median of our sample. The interactions between C-19 total confirmed cases and confirmed deaths, and high (low) EPU appear to have significant adverse effects on stock liquidity measures in Panels A and B of [Table 10](#). Nevertheless, the interplay effects between C-19 and EPU on stock liquidity are significantly different between high EPU and low EPU countries as reflected in the statistically significant difference in estimated coefficients. This implies that the negative effects of C-19 on stock liquidity in high EPU countries are more devastating than in low EPU countries. In other words, the higher the countries with the number of confirmed C-19 cases and deaths, the high volatility of their EPU movements lead to lower stock market liquidity during the coronavirus pandemic.

Additionally, in [Table 11](#) we present the mean differences in stock liquidity between small and large firms during a month before

⁶ According to [Baker et al. \(2016\)](#), the trio of terms includes "uncertain" or "uncertainty"; "economic" or "economy"; and the policy-related terms as follows: "regulation", "legislation", "Federal Reserve", "Congress", "deficit" or "White House" that might contain variants like "regulatory", "the Fed" or "uncertainties".

Table 5
Interactive effect of confirmed COVID-19 infection cases and deaths on stock liquidity.

| | Effective spread | | | | Quoted spread | | | |
|---|------------------------|------------------------|------------------------|------------------------|-----------------------|------------------------|-----------------------|------------------------|
| | (1a) | (1b) | (2a) | (2b) | (3a) | (3b) | (4a) | (4b) |
| <i>Ln (Total Infection Cases)</i> | -0.0001 (-0.24) | -0.0006*** (-5.08) | 0.0006*** (4.26) | -0.0002* (-1.84) | 0.0005*** (5.28) | -0.0002*** (-2.90) | 0.0009*** (8.61) | -0.0001 (-0.11) |
| <i>Ln (Total Deaths)</i> | 0.0001 (0.82) | -0.0006*** (-3.99) | -0.0004*** (-3.03) | -0.0011*** (-6.82) | -0.0004*** (-4.59) | -0.0013*** (-10.88) | -0.0007*** (-7.37) | -0.0016*** (-12.70) |
| <i>Ln (Total Infection Cases) * Ln (Total Deaths)</i> | | 0.0001*** (9.29) | | 0.0001*** (10.18) | | 0.0001*** (15.79) | | 0.0001*** (17.03) |
| <i>Size</i> | -0.0140*** (-4.96) | -0.0113*** (-4.82) | -0.0001** (-2.57) | -0.0001*** (-2.96) | -0.0137*** (-5.13) | -0.0104*** (-4.84) | -0.0002** (-2.55) | -0.0003*** (-2.78) |
| <i>Leverage</i> | 0.0002 (1.30) | 0.0003** (2.10) | -0.0000 (-0.54) | -0.0000 (-0.08) | 0.0001 (0.66) | 0.0002** (2.17) | -0.0000 (-0.98) | -0.0000 (-0.71) |
| <i>ROA</i> | -0.0003 (-0.04) | -0.0031 (-0.47) | 0.0015* (1.84) | 0.0015* (1.79) | 0.0005 (0.09) | -0.0030 (-0.71) | 0.0031* (1.83) | 0.0030* (1.80) |
| <i>MktBk</i> | -0.0000 (-0.91) | -0.0000* (-1.77) | -0.0000 (-0.86) | -0.0000 (-1.52) | 0.0000 (0.17) | -0.0000 (-1.11) | 0.0000 (0.03) | -0.0000 (-0.37) |
| <i>Stock Return</i> | -0.0283*** (-13.69) | -0.0279*** (-13.71) | -0.0295*** (-13.86) | -0.0288*** (-13.88) | 0.0002 (0.38) | 0.0006 (1.57) | 0.0001 (0.31) | 0.0009** (2.15) |
| <i>Volatility</i> | 0.0005*** (2.59) | 0.0003* (1.80) | -0.0000*** (-3.14) | -0.0000*** (-2.98) | 0.0005*** (3.02) | 0.0003* (1.87) | -0.0001*** (-3.12) | -0.0001*** (-3.03) |
| <i>1/Stock Price</i> | 0.0146*** (6.72) | 0.0141*** (6.61) | 0.0012** (2.10) | 0.0012** (2.09) | 0.0058*** (5.85) | 0.0052*** (5.69) | 0.0014* (1.73) | 0.0014* (1.72) |
| <i>Market Cap</i> | 0.0002 (0.23) | 0.0022** (2.08) | -0.0003*** (-4.40) | -0.0002*** (-3.85) | 0.0000 (0.03) | 0.0024*** (2.82) | -0.0007*** (-5.45) | -0.0006*** (-5.14) |
| <i>Time FE</i> | YES | YES | YES | YES | YES | YES | YES | YES |
| <i>Firm FE</i> | YES | YES | NO | NO | YES | YES | NO | NO |
| <i>Country FE</i> | NO | NO | YES | YES | NO | NO | YES | YES |
| <i>Observations</i> | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 |
| <i>Adjusted R²</i> | 0.187 | 0.190 | 0.142 | 0.148 | 0.734 | 0.740 | 0.592 | 0.599 |

This table presents regression results of the interaction effect of total infection cases and deaths on stock liquidity. Detailed variable definitions are provided in Appendix 1. Regressions control for firm, country- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

and after the WHO's official announcement of making the C-19 outbreak the Global Pandemic on 11th March 2020.⁷ Small and larger firms are classified based on whether their total assets are lower or higher than the cross-sectional median of the sample. For small firms presented in Panel A of Table 11, the results document a statistically significant difference in their stock liquidity measured by effective spread and quoted spread. In contrast, Panel B of Table 11 reports a statistically insignificant difference in the stock liquidity of large firms measured by effective spread and quoted spread. Again, in Table 11, we classify small firms that have total assets value below the bottom 30% of the sample and larger firms above the top 30% of the sample to show their mean differences in stock liquidity. For small firms exhibited in Panel C, we find a statistically significant difference in their stock liquidity, similar to Panel A. For larger firms shown in Panel D, the results indicate a statistically insignificant difference in stock liquidity, consistent with Panel B finding. These results of negative volatility in stock liquidity (i.e. increase in stock illiquidity) pre- and post-Pandemic announcement period signify that while both small and large firms are negatively affected by the C-19 pandemic on their stock liquidity, small firms have experienced extreme effects on their stock liquidity, compared to large firms.

5. Conclusion and implications

Since the onset of the C-19 pandemic, there have been studies examining its impacts on financial markets, reactions, and liquidity in specific countries as well as in a cross-country examination. However, the latest studies are limited to a relatively short window due to the data availability and the pandemic that has appeared recently. Therefore, the examination of C-19's effects on stock market liquidity has been in early its stages and authors mainly use time-series equity indexes for capturing stock market liquidity in a short window leading to limited evidence on the impacts of the pandemic on firms' stock liquidity. Motivated by those reasons, using firm-daily data for the period ranging from 1 January to 31 December of 2020, this paper empirically examines the impacts of the C-19 pandemic on firms' stock liquidity in both developed (Australia, Japan, and the USA) and developing (Brazil, China, and India) countries, as well as their comparison between 3 developed and 3 developing countries and between high and low economic policy uncertainty (EPU) index.

The study reports that USA, India, and Brazil have experienced extreme effects of the pandemic with the highest total number of

⁷ For more details about the WHO' announcement, please see <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>

Table 6
Effect of confirmed COVID-19 infection cases and deaths on stock liquidity – alternative measurement proxies.

| | Effective spread | | | | | | Quoted spread | | | | | |
|--|------------------|------------|------------|------------|------------|------------|---------------|------------|------------|------------|------------|------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| <i>Ln (Total Infection Cases/ Pop)</i> | 0.0001*** | 0.0003*** | | | | | 0.0001*** | 0.0003*** | | | | |
| | (2.69) | (6.32) | | | | | (4.73) | (7.92) | | | | |
| <i>Ln (Total Deaths/Pop)</i> | | | 0.0001** | 0.0002*** | | | | | 0.0001** | 0.0002*** | | |
| | | | (2.33) | (5.82) | | | | | (2.53) | (6.31) | | |
| <i>Total Deaths/Total Cases</i> | | | | | 0.0159*** | 0.0077** | | | | | 0.0058** | 0.0026* |
| | | | | | (4.40) | (2.29) | | | | | (2.10) | (1.66) |
| <i>Size</i> | -0.0138*** | -0.0001*** | -0.0140*** | -0.0001*** | -0.0128*** | -0.0001*** | -0.0140*** | -0.0002*** | -0.0144*** | -0.0003*** | -0.0121*** | -0.0003*** |
| | (-4.96) | (-2.62) | (-4.96) | (-2.66) | (-4.80) | (-2.83) | (-5.17) | (-2.59) | (-5.18) | (-2.61) | (-4.91) | (-24.68) |
| <i>Leverage</i> | 0.0002 | -0.0000 | 0.0002 | -0.0000 | 0.0002 | -0.0000 | 0.0001 | -0.0000 | 0.0001 | -0.0000 | 0.0001 | -0.0000*** |
| | (1.29) | (-0.50) | (1.32) | (-0.49) | (1.60) | (-0.23) | (0.77) | (-0.95) | (0.83) | (-0.94) | (1.42) | (-6.73) |
| <i>ROA</i> | -0.0004 | 0.0015* | -0.0004 | 0.0015* | -0.0018 | 0.0015* | 0.0003 | 0.0031* | 0.0006 | 0.0031* | -0.0017 | 0.0031*** |
| | (-0.06) | (1.84) | (-0.05) | (1.83) | (-0.26) | (1.82) | (0.06) | (1.83) | (0.12) | (1.83) | (-0.37) | (15.39) |
| <i>MktBk</i> | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000* |
| | (-0.89) | (-0.90) | (-0.91) | (-0.92) | (-1.19) | (-1.32) | (0.11) | (-0.01) | (-0.00) | (-0.03) | (-0.43) | (-1.91) |
| <i>Stock Return</i> | -0.0283*** | -0.0295*** | -0.0283*** | -0.0294*** | -0.0281*** | -0.0291*** | 0.0003 | 0.0003 | 0.0004 | 0.0004 | 0.0004 | 0.0007 |
| | (-13.70) | (-13.88) | (-13.73) | (-13.90) | (-13.78) | (-13.92) | (0.68) | (0.63) | (0.97) | (0.93) | (0.98) | (1.46) |
| <i>Volatility</i> | 0.0005*** | -0.0000*** | 0.0005*** | -0.0000*** | 0.0005** | -0.0000*** | 0.0005*** | -0.0001*** | 0.0006*** | -0.0001*** | 0.0004*** | -0.0001*** |
| | (2.59) | (-3.13) | (2.66) | (-3.13) | (2.30) | (-3.04) | (3.08) | (-3.12) | (3.32) | (-3.12) | (2.58) | (-28.68) |
| <i>1/Stock Price</i> | 0.0144*** | 0.0012** | 0.0146*** | 0.0012** | 0.0145*** | 0.0012** | 0.0064*** | 0.0015* | 0.0068*** | 0.0015* | 0.0057*** | 0.0014*** |
| | (6.76) | (2.16) | (6.80) | (2.22) | (6.54) | (2.10) | (6.43) | (1.82) | (6.72) | (1.87) | (5.70) | (13.39) |
| <i>Market Cap</i> | 0.0003 | -0.0003*** | 0.0003 | -0.0003*** | 0.0009 | -0.0002*** | 0.0002 | -0.0006*** | -0.0000 | -0.0006*** | 0.0011 | -0.0006*** |
| | (0.26) | (-4.33) | (0.23) | (-4.29) | (0.84) | (-4.05) | (0.17) | (-5.40) | (-0.01) | (-5.38) | (1.17) | (-47.20) |
| <i>Time FE</i> | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| <i>Firm FE</i> | YES | NO | YES | NO | YES | NO | YES | NO | YES | NO | YES | NO |
| <i>Country FE</i> | NO | YES | NO | YES | NO | YES | NO | YES | NO | YES | NO | YES |
| <i>Observations</i> | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 | 240,007 |
| <i>Adjusted R²</i> | 0.187 | 0.142 | 0.187 | 0.142 | 0.188 | 0.144 | 0.734 | 0.591 | 0.734 | 0.590 | 0.735 | 0.594 |

This table presents regression results on the relation between (i) total infection cases scaled by population and stock liquidity, (ii) total deaths scaled by population and stock liquidity, and (iii) total deaths scaled by total infection cases and stock liquidity. Detailed variable definitions are provided in Appendix 1. Regressions control for firm, country- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

Table 7
Effect of confirmed COVID-19 cases and deaths on stock liquidity – lag analysis.

| | Effective spread | | | | Quoted spread | | | |
|-----------------------------------|------------------------|-----------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| <i>Ln (Total Infection Cases)</i> | 0.0001*** (5.35) | 0.0002*** (14.41) | | | 0.0001*** (15.44) | 0.0002*** (26.46) | | |
| <i>Ln (Total Deaths)</i> | | | 0.0001*** (6.71) | 0.0002*** (13.44) | | | 0.0001*** (11.56) | 0.0001*** (20.71) |
| <i>Size</i> | -0.0135*** (-26.27) | -0.0004*** (-7.52) | -0.0135*** (-26.36) | -0.0004*** (-7.70) | -0.0135*** (-47.98) | -0.0012*** (-17.13) | -0.0137*** (-48.82) | -0.0012*** (-17.55) |
| <i>Leverage</i> | 0.0002*** (2.85) | -0.0000 (-0.93) | 0.0002*** (2.87) | -0.0000 (-0.88) | 0.0001** (2.52) | -0.0001*** (-3.23) | 0.0001*** (2.69) | -0.0001*** (-3.13) |
| <i>ROA</i> | -0.0030** (-2.01) | -0.0009 (-1.41) | -0.0030** (-2.04) | -0.0009 (-1.44) | -0.0001 (-0.15) | -0.0053*** (-7.91) | -0.0000 (-0.01) | -0.0053*** (-7.98) |
| <i>MktBk</i> | -0.0000** (-2.41) | -0.0000 (-0.06) | -0.0000** (-2.41) | -0.0000 (-0.13) | 0.0000 (0.17) | 0.0000*** (6.62) | -0.0000 (-0.11) | 0.0000*** (6.42) |
| <i>Stock Return</i> | 0.0005 (0.96) | -0.0003 (-0.48) | 0.0005 (0.98) | -0.0002 (-0.36) | -0.0007** (-2.32) | -0.0009*** (-2.87) | -0.0006** (-2.07) | -0.0007** (-2.49) |
| <i>Volatility</i> | 0.0005*** (7.07) | -0.0000*** (-6.83) | 0.0005*** (6.99) | -0.0000*** (-6.85) | 0.0005*** (12.64) | -0.0001*** (-5.18) | 0.0005*** (13.39) | -0.0001*** (-5.11) |
| <i>1/Stock Price</i> | 0.0102*** (26.23) | 0.0047*** (19.49) | 0.0104*** (26.59) | 0.0048*** (20.12) | 0.0060*** (28.19) | 0.0070*** (35.44) | 0.0063*** (29.33) | 0.0074*** (37.50) |
| <i>Market Cap</i> | -0.0002 (-0.53) | 0.0000 (0.10) | -0.0001 (-0.38) | 0.0000 (0.30) | 0.0001 (0.60) | 0.0001 (0.75) | 0.0000 (0.20) | 0.0001 (0.95) |
| Time FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | NO | YES | NO | YES | NO | YES | NO |
| Country FE | NO | YES | NO | YES | NO | YES | NO | YES |
| Observations | 239,183 | 239,183 | 239,183 | 239,183 | 239,183 | 239,183 | 239,183 | 239,183 |
| Adjusted R ² | 0.024 | 0.024 | 0.072 | 0.067 | 0.024 | 0.024 | 0.072 | 0.066 |

This table presents regression results on the relation between (i) lagged total infection cases and stock liquidity, and (ii) lagged total deaths and stock liquidity. Detailed variable definitions are provided in [Appendix 1](#). Regressions control for firm, country- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

Table 8
Confirmed COVID-19 cases, deaths and stock liquidity – change analysis.

| | Δ Effective spread | | | | Δ Quoted spread | | | |
|--------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| <i>Ln (Total Cases)</i> | 0.0001*** (5.36) | 0.0001*** (3.80) | | | 0.0001** (2.47) | 0.0000*** (5.01) | | |
| <i>Ln (Total Deaths)</i> | | | 0.0001*** (7.68) | 0.0001*** (6.84) | | | 0.0001*** (8.39) | 0.0001*** (8.02) |
| <i>Size</i> | 0.0012*** (2.94) | -0.0000*** (-3.62) | 0.0012*** (2.95) | -0.0000*** (-3.62) | -0.0000 (-0.01) | 0.0000** (2.00) | 0.0001 (0.46) | 0.0000 (0.89) |
| <i>Leverage</i> | -0.0000 (-1.27) | 0.0000 (0.28) | -0.0000 (-1.26) | 0.0000 (0.30) | 0.0000 (0.29) | 0.0000 (0.77) | 0.0000 (0.14) | 0.0000 (0.32) |
| <i>ROA</i> | -0.0011 (-0.98) | 0.0001* (1.72) | -0.0011 (-1.00) | 0.0001* (1.74) | -0.0005 (-1.35) | 0.0000 (1.09) | -0.0005 (-1.48) | 0.0000 (0.03) |
| <i>MktBk</i> | 0.0000** (1.98) | 0.0000 (0.16) | 0.0000** (2.02) | 0.0000 (0.17) | -0.0000 (-0.02) | -0.0000 (-0.95) | 0.0000 (0.32) | -0.0000 (-0.50) |
| <i>Stock Return</i> | -0.0356*** (-14.59) | -0.0354*** (-14.62) | -0.0357*** (-14.60) | -0.0355*** (-14.63) | 0.0016*** (3.12) | 0.0008* (1.82) | 0.0016*** (3.09) | 0.0016*** (3.16) |
| <i>Volatility</i> | -0.0000 (-0.69) | 0.0000*** (3.51) | -0.0000 (-0.90) | 0.0000*** (3.50) | 0.0000 (0.20) | -0.0000 (-1.28) | -0.0000 (-0.85) | -0.0000 (-1.35) |
| <i>1/Stock Price</i> | -0.0004 (-1.49) | 0.0000 (0.20) | -0.0004 (-1.38) | 0.0000 (0.19) | -0.0006*** (-4.54) | -0.0001*** (-5.47) | -0.0006*** (-4.72) | -0.0001*** (-3.71) |
| <i>Market Cap</i> | 0.0004** (2.55) | 0.0000*** (4.03) | 0.0005*** (2.73) | 0.0000*** (4.04) | -0.0000 (-0.50) | -0.0000** (-2.21) | 0.0000 (0.20) | -0.0000 (-1.64) |
| Time FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | NO | YES | NO | YES | NO | YES | NO |
| Country FE | NO | YES | NO | YES | NO | YES | NO | YES |
| Observations | 231,915 | 231,915 | 231,915 | 231,915 | 231,915 | 231,915 | 231,915 | 231,915 |
| Adjusted R ² | 0.022 | 0.026 | 0.002 | 0.007 | 0.022 | 0.026 | 0.002 | 0.007 |

This table presents regression results on the relation between (i) total infection cases and change in stock liquidity, and (ii) total deaths and change in stock liquidity. Detailed variable definitions are provided in [Appendix 1](#). Regressions control for firm, country- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

Table 9
Confirmed COVID-19 infection cases and deaths, and stock liquidity - developed vs. emerging economies.

| Panel A: Interplay between total infection cases and developed vs. emerging economies | | |
|---|---------------------|---------------------|
| | Effective spread | Quoted spread |
| | (1) | (2) |
| <i>Ln (Total Infection Cases) * Developed Economies (1)</i> | 0.0002*** (5.89) | 0.0001*** (5.61) |
| <i>Ln (Total Infection Cases) * Emerging Economies (2)</i> | 0.0001 (1.25) | 0.0001*** (3.31) |
| Difference in Coefficients (1)-(2) | 0.0001*** | 0.0000 |
| F-statistics | [11.31] | [0.20] |
| Control Variables | Included | Included |
| Firm & Time FE | YES | YES |
| Observations | 240,007 | 240,007 |
| Adjusted R ² | 0.182 | 0.733 |
| Panel B: Interplay between total deaths and developed vs. emerging economies | | |
| | Effective Spread | Quoted Spread |
| | (1) | (2) |
| <i>Ln (Total Deaths) * Developed Economies (1)</i> | 0.0001*** (4.58) | 0.0001*** (3.20) |
| <i>Ln (Total Deaths) * Emerging Economies (2)</i> | 0.0000 (1.25) | 0.0000*** (2.64) |
| Difference in Coefficients (1)-(2) | 0.0001*** | 0.0001*** |
| F-statistics | [66.46] | [9.22] |
| Control Variables | Included | Included |
| Firm & Time FE | YES | YES |
| Observations | 240,007 | 240,007 |
| Adjusted R ² | 0.182 | 0.733 |

This table presents regression results of separating the sample into developed and emerging economies. We interact total infection cases or total deaths with the developed and emerging economies dummies separately and estimate the same regression as Table 4. The dependent variables are stock liquidity measures. Developed (emerging) economies dummy is equal one if countries are Australia, Japan, and the USA (Brazil, China, and India) and zero otherwise. Detailed variable definitions are provided in Appendix 1. Regressions control for firm- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

confirmed infection cases and deaths, while Australia is the most effective country in controlling the pandemic. The pandemic became worse across all the sample countries since the 3rd quarter with the average number of total confirmed cases being over 2.5 million. The baseline empirical results demonstrate a positive relationship between the severity of the C-19 and the stock illiquidity, i.e. statistically significant inverse impact of the C-19 pandemic total confirmed infection cases and deaths at the 1% level for both effective spread and quoted spread as the two main liquidity measures in the study. The results are robust in showing similar impact on stock market liquidity with the use of alternative measurements of infection cases and deaths and their lagged values, as well as change in firms' stock liquidity measures. The results are consistent when we examine the interplay effects of C-19 cases and deaths between emerging and developed markets as the two sub-samples. The interplay effects of C-19 and developed markets on stock market liquidity appear to be strongly confirmed for both liquidity measures compared to emerging markets. Again, the study further exhibits the importance of the economic policy uncertainty (EPU) index to stock market liquidity during the global pandemic. The estimated results imply that countries with high EPU experience significant negative impacts on their market liquidity during the pandemic. Finally, the results also document that small firms have experienced extreme effects on their stock liquidity compared to large firms.

With the cross-country evidence using both the daily stock market and firm-level data for six countries within the central time of the global pandemic, the study provides critical empirical evidence and implications as follows. Firstly, the study affirms the reversal effects of the C-19 pandemic on market liquidity across all the sample countries including Australia, Brazil, China, India, Japan, and the USA. During the year of the global pandemic, Australia has shown its high efficiency in mitigating the impacts of the C-19 pandemic demonstrated by the lowest number of confirmed cases and deaths compared to the other countries with 16,069 total confirmed infection cases and 420 confirmed deaths only. While the US, India, and Brazil show extremely high impacts of the pandemic with the accumulated number of nearly 12 million total confirmed infection cases for the three countries. This unexpected outcome alerts the reality that the spread of the global pandemic could put any specific country into a worse circumstance within a very short time if we are not seriously aware and making effective response policies to the pandemic timely. Secondly, the study highlights the importance of economic policy uncertainty (EPU) in mitigating the effects of global shocks such as the emerging pandemic on stock market liquidity in recent years. The consequences of the recent pandemic might need more research works on the roles of policy uncertainty in mitigating the effects of global shocks on the financial markets, illiquidity as well as the world's real economy in the post-pandemic era. These require more attention from the policymakers across the countries at a time when the developed and high EPU economies are fast approaching economic recessions and C-19 has still been taking its toll on people's lives and livelihoods. Furthermore, there is a need for regulators and lawmakers to establish the necessary macro-prudential policy instruments and support mechanisms to help

Table 10
Confirmed COVID-19 infection cases and deaths, and stock liquidity – high vs. low economic policy uncertainty (EPU) index.

| Panel A: Interplay between total infection cases and high vs. low EPU Index | | |
|---|---------------------|---------------------|
| | Effective spread | Quoted spread |
| | (1) | (2) |
| <i>Ln (Total Infection Cases) * High EPU (1)</i> | 0.0001*** (4.68) | 0.0002*** (7.06) |
| <i>Ln (Total Infection Cases) * Low EPU (2)</i> | -0.0000 (-0.88) | 0.0000 (0.98) |
| Difference in Coefficients (1)–(2) | 0.0002*** | 0.0001*** |
| F-statistics | [94.89] | [151.83] |
| Control Variables | Included | Included |
| Firm & Time FE | YES | YES |
| Observations | 240,007 | 240,007 |
| Adjusted R ² | 0.190 | 0.737 |
| Panel B: Interplay between total deaths and high vs. low EPU Index | | |
| | Effective Spread | Quoted Spread |
| | (1) | (2) |
| <i>Ln (Total Deaths) * High EPU (1)</i> | 0.0002*** (5.82) | 0.0002*** (7.16) |
| <i>Ln (Total Deaths) * Low EPU (2)</i> | -0.0000 (-1.24) | -0.0000* (-1.76) |
| Difference in Coefficients (1)–(2) | 0.0002*** | 0.0002*** |
| F-statistics | [91.69] | [145.28] |
| Control Variables | Included | Included |
| Firm & Time FE | YES | YES |
| Observations | 240,007 | 240,007 |
| Adjusted R ² | 0.190 | 0.737 |

This table presents regression results of separating the sample into high and low Economic Policy Uncertainty (EPU) Index. High (low) Economic Policy Uncertainty Index is a dummy takes the value of one if the index value is above (below) the cross-sectional median of our sample. We interact total infection cases or total deaths with high and low Economic Policy Uncertainty Index dummies separately and estimate the same regression as Table 4. The dependent variables are stock liquidity measures. EPU reflects the relative frequency of own-country newspaper articles that contain a trio of terms pertaining to the economy (E), policy (P) and uncertainty (U). In other words, each monthly national EPU index value is proportional to the share of own-country newspaper articles that discuss economic policy uncertainty in that month. Detailed variable definitions are provided in Appendix 1. Regressions control for firm- and year-fixed effects. Standard errors are corrected for clustering at the firm level and *t*-statistics are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

their citizens and economy and handle similar pandemics in the future. While there is no sign of ceasing the impact of C-19 in health and economic arenas, the world is now observing new variants of C-19 (such as Omicron BA4, BA5, etc.) as well as new viruses (e.g. Monkeypox). Therefore, a lesson learned from the C-19 pandemic would be governments across the world must be instrumental in adopting swift and productive policy responses to protect human lives and minimise the negative impact on the economy.

Given the demonstrated impacts of the 2019 global pandemic on international market liquidity in both developing and developed economies, the study's findings not only provide supportive evidence to the implications of information asymmetry with implied transaction costs caused by the C-19 pandemic in the streams of market microstructure but also support the perspectives of financial markets and contagion during the C-19 pandemic (see recent studies by Zhang et al. (2020a) and Akhtaruzzaman et al. (2021)). For instance, a good definition of contagion is a significant increase of cross-market linkages from a shock to one country which happened to be more pronounced during crises, such as the GFC (Forbes and Rigobon, 2002). Financial channels, however, appear to be the main route for such a contagion owing to the financial connectedness across major stock exchanges around the globe (Smimou and Khallouli, 2015). Moreover, the literature further classifies four separate spillover channels, including correlated-information, liquidity, flight-to-quality, and risk channels. As far as liquidity is concerned, the liquidity shock in one market/country would transmit to other markets/countries via what is known as liquidity spirals (Brunnermeier and Pedersen, 2009). Specifically, funding liquidity, the easiness to borrow using the security as collateral, and constraints force market makers to reduce liquidity and increase transaction costs, which hampers the availability of liquidity further. For instance, Grillini et al. (2022) investigate static and dynamic liquidity spillovers in ten Eurozone countries (2000–2021) and find strong evidence for the transmission of shocks through the liquidity channel in Eurozone countries. Using effective spread and quoted spread as the main proxies for stock market liquidity under the C-19 world pandemic, the study enriches previous studies on commonality in liquidity not only for the advanced economy like the US documented by Chordia et al. (2000) but also for an international context with potential volatile commonality in market liquidity presented by Karolyi et al. (2012).

Finally, this study is not free from some limitations that we acknowledge and highlight as potential future research. First and foremost, the sample data is for one year in 2020 and from selected six developed and emerging countries only. Future studies can use

Table 11
Stock liquidity of small and large firms - before and after WHO announcement.

| Panel A: Small Firms (Cross-Sectional Median) | | | |
|--|--------|-------|------------|
| Variable | Before | After | Difference |
| <i>Effective Spread</i> | 0.815 | 0.818 | 0.003*** |
| <i>Quoted Spread</i> | 0.007 | 0.008 | 0.001** |
| Panel B: Large Firms (Cross-Sectional Median) | | | |
| Variable | Before | After | Difference |
| <i>Effective Spread</i> | 0.811 | 0.812 | 0.001 |
| <i>Quoted Spread</i> | 0.001 | 0.002 | 0.001 |
| Panel C: Small Firms (Upper Vs, lower Tertile) | | | |
| Variable | Before | After | Difference |
| <i>Effective Spread</i> | 0.822 | 0.817 | 0.005*** |
| <i>Quoted Spread</i> | 0.011 | 0.010 | 0.001* |
| Panel D: Large Firms (Upper Vs, lower Tertile) | | | |
| Variable | Before | After | Difference |
| <i>Effective Spread</i> | 0.812 | 0.811 | 0.001 |
| <i>Quoted Spread</i> | 0.002 | 0.001 | 0.001 |

This table presents mean differences of stock liquidity of small and large firms during a month before and after C-19 announced as a global pandemic by WHO on 11th March 2020 [-30, +30].

In Panel A and Panel B, small (large) firms are those firms that have total assets value below (above) the cross-sectional median of our sample. In Panel C and Panel D, small (large) firms are those firms that have total assets value below (above) the bottom (top) 30% percentile of our sample. Detailed variable definitions are provided in [Appendix 1](#). ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

datasets for at least a couple or more years and from many other developed and emerging economies for robust comparative analysis. Second, the scope of the study is limited to the impact of the C-19 pandemic on firms' stock liquidity, rather than on stock return or mechanisms including lead-lag through which the outbreak of coronavirus affects the stock liquidity around the world or its spill-over across the countries that are financially integrated with other markets. Future research should extend our work by covering these important research attributes and provide comprehensive insights regarding the underlying mechanisms of how the Covid-19 pandemic affects firms' stock liquidity and stock return. Despite these potential limitations, our study is timely and relevant in the macro-prudential policy context in providing some insightful findings. Our findings deserve due attention on the part of policymakers and regulators across the globe.

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CRedit authorship contribution statement

Omar Al Farooque: Conceptualization, Methodology, Visualization, Validation, Investigation, Supervision, Writing - original draft, Writing - review & editing, literature review. **Ghasan A. Baghdadi:** Conceptualization, Formal analysis, Software. **Hai Hong Trinh:** Conceptualization, Methodology, Data curation, Software. **Sarod Khandaker:** Data curation, Software.

Data availability

I have shared data file at the Attached File step.

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Appendix A

Appendix 1

Variable definitions.

| Variables | Definition | Source |
|--|--|--|
| Stock liquidity measures | | |
| Effective Spread (ES) | $ES = 2 \cdot \ln(P_{close}) - \ln(\text{Midpoint}_{bid-ask}) $ <p>Where: P_{close} = daily closing price Midpoint = the midpoint of bid and ask quote = $(Ask_t + Bid_t) / 2$ The higher the effective spread the lower the liquidity and vice versa.</p> | Datatype (P) represents the official closing price. PA - Price - Ask. This is the asking price quoted at close of market. |
| Quoted Spread (QS) | $QS = (Ask_t - Bid_t) / \text{Midpoint}_t$ <p>The higher the quoted spread the lower the liquidity and vice versa.</p> | \underline{PB} - Price - Bid. This is the bid price offered at close of market. |
| COVID-19 Pandemic Measures | | |
| Total Infection Cases | Presents the daily total confirmed cases due to coronavirus disease and the measure is used in log form for empirical analysis. | Coronavirus Resource Centre of Johns Hopkins University |
| Total Deaths | Presents the daily total confirmed deaths due to coronavirus disease and the measure is used in log form for empirical analysis. | Coronavirus Resource Centre of Johns Hopkins University |
| Economic Policy Uncertainty – EPU data | | |
| EPU | Economic policy uncertainty (EPU) is a newspaper-based EPU index developed by Baker et al. (2016) that is constructed based on the frequency of media coverage with leading newspapers reflecting a country's volatility in policy-related economic policy uncertainty. Please see the paper of Baker et al. (2016) for more details on measuring Economic Policy Uncertainty – EPU index. | Collected from EPU database followed by Baker et al. (2016) |
| Control variables | | |
| Size | Total assets represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets. | WC02999 - Total Assets |
| Leverage | $(\text{Long Term Debt} + \text{Short Term Debt} \& \text{Current Portion of Long-Term Debt}) / \text{Common Equity} * 100$ | WC08231 - Total Debt % Common Equity |
| ROA | $(\text{Net Income} - \text{Bottom Line} + ((\text{Interest Expense on Debt} - \text{Interest Capitalized}) * (1 - \text{Tax Rate}))) / \text{Average of Last Year's and Current Year's Total Assets} * 100$ | WC08326 - Return on Assets |
| MTBK | This is defined as the market value of the ordinary (common) equity divided by the balance sheet value of the ordinary (common) equity in the company (World scope item 03501). | MTBV - Market to Book Value |
| Total Return Index | A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date. | RI - Total return index \$USD |
| Price Volatility | A measure of a stock's average annual price movement to a high and low from a mean price for each year. For example, a stock's price volatility of 20% indicates that the stock's annual high and low price has shown a historical variation of +20% to -20% from its annual average price. | WC08806 - Price Volatility |
| 1/Stock Price | Equals to one divided by daily stock price (P) Market Price-Year End * Common Shares Outstanding | Authors' calculation |
| Market Capitalization (millions) | Where: Market price – year end represents the closing price of the company's stock at 31 December for U.S. Corporations. For non-U.S. corporations, this item represents the closing price of the company's stock at their fiscal year end. | WC08001 - Market Capitalization |

(i) The values of bid, ask, closing prices as well as total assets and market capitalization are converted into US dollar for all the six selected countries.

(ii) Variables' definitions for stock prices and accounting data are represented based on Thompson Reuter DataStream – TRDS.

Appendix B. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ememar.2023.101025>.

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