11-15-2022

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Routledge
Taylor & Francis Group

Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

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To cite this article: Muhammad Umar, Ghulame Rubbaniy, Amjad Iqbal, Syed Kumail Abbas Rizvi & Yan Xu (2022): Covid-19 and stock market liquidity: international evidence, Economic Research-Ekonomska Istraživanja, DOI: 10.1080/1331677X.2022.2142257

To link to this article: https://doi.org/10.1080/1331677X.2022.2142257

Published online: 15 Nov 2022.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
https://doi.org/10.1080/1331677X.2022.2142257

Covid-19 and stock market liquidity: international evidence

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ABSTRACT

This study analyzes the impact of Covid-19 on stock market liquidity of China and four worst hit countries by the pandemic. Using daily data for the stock market illiquidity spanning over July 1, 2019 to July 10, 2020 and the data for new cases and deaths over the period from December 31, 2019 to July 10, 2020, the results of our GARCH analysis show that liquidity in stock markets of all the sampled countries hit hard by the news of the Covid-19 outbreak. We find that for all sampled countries increase in illiquidity due to temporary shocks reverts to long term trend shortly, suggesting that the liquidity shocks due to the incidence of Covid-19 were short lived. The findings of our VAR analysis show an absence of any short-term relationship between Covid-19 new cases or deaths and illiquidity. Since the series are not integrated at same level, long-term relationship between Covid-19 and stock market illiquidity do not exist as well suggesting no evidence of the effect of Covid-19 on stock market liquidity.

ARTICLE HISTORY
Received 26 September 2021
Accepted 24 October 2022

KEYWORDS
Covid-19; stock market liquidity; GARCH; VAR; BRIC

JEL SPECIFICATION
G10; G01; I15

1. Introduction

The phenomenon of epidemics, particularly the ones led by the viruses, is an ancient one in the human history and their roots can be traced back in thousands of years ago. Nonetheless modern history has also recorded some virus led epidemics such as Ebola, Swine flu, SARS, plague, dengue, AIDS, influenza, and last but not the least the most recent Covid-19 or Coronavirus that has attained the status of pandemic owing to its widespread scale.

The Covid-19 virus reportedly first diagnosed in Wuhan, a Chinese province, in December of 2019 and spread rapidly across the globe. In a desperate attempt to control the contagion spread of the virus, governments and political leadership in

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different countries started imposing partial or complete lockdowns as a preventive measure. Some countries put a complete halt on national and international mobility that caused businesses to suspend their activities completely. The biggest toll of these preventive measures was taken by the financial markets and it came as loudly as possible on February 20, 2020 when most of the financial markets crashed globally. The subsequent days were even worst when during February 24 to 28, stock markets across the world experienced largest one-week decline since the global financial crisis of 2007–08 (KPMG, 2020) and during crisis period the stock liquidity deteriorates (Brunnermeier, 2009; Brunnermeier & Pedersen, 2009).

In order to provide stability to the financial markets, central banks including FED and ECB started to repurchase assets to provide liquidity to the market. Some of the banks started special programs to inject required liquidity in the system (Alaoui Mdaghri et al., 2020). These interventions by the central banks were done based on the lessons learned from Global Financial Crisis (GFC). However, this health crisis is different from that of GFC because it's biological in nature and GFC was due to problems in financial system, so this pandemic is expected to affect the liquidity differently. Therefore, this study attempts to analyze the impact of Covid-19 pandemic on stock markets of some worst hit countries. The findings of this study will enhance our understanding of how different black swan events affect stock market liquidity. The impact of Covid-19 on financial markets was so strong that policy makers started viewing it as an economic crisis (Sharif et al., 2020). This situation completely changed the perspective of the market participants who were still viewing Covid-19 as a short-lived phenomenon. The updated measures and changing policy stances resulted enormous reallocation of capital and resources that triggered capital outflows and left almost all financial markets in dearth of liquidity.

One must not be shocked on this outcome as the relationship between crisis and illiquidity is a well acknowledged fact and it goes like hand in glove. Ironically, crisis is exactly the time when we need liquidity at most and if the markets are dried up, it can even exacerbate the already worsen situation. Hence, the immediate objective of regulators and policy makers in the wake of any crisis is to maintain or restore liquidity in the financial markets so that the recovery can be paced up. Global Financial Crisis of 2007–2008 exacerbated due to immense shock to liquidity (Chudik & Fratzscher, 2011). As Covid-19 pandemic is the major crisis after Global financial crisis so its very important to understand, how it affected the liquidity of stock markets.

Some of the existing studies have explored the important linkage between the incidence of Covid-19 and stock liquidity. Chebbi et al. (2021) used the data from S&P500 firms for the year 2020 and concluded that Covid-19 measured by daily growth in Covid-19 cases adversely affected stocks liquidity. In another study, Suardi et al. (2022) concluded that incidence of Corona virus pandemic intensified liquidity risk, worsened the vulnerability of individual stocks leading to aggregate shocks in financial markets. Alaoui Mdaghri et al. (2020) also studied the impact of Covid-19 on stock market liquidity of MENA countries and found the adverse relationship between Corona pandemic and stock market liquidity. The results of the study conducted by Nguyen et al. (2021) are also the same that there exist inverse relationship

between incidence of Covid-19 and stock market liquidity. The findings of some of the studies are different than these above mentioned studies. Marozva and Magwedere (2021) concluded that there exists a positive relationship between stock market liquidity and incidence of Covid-19 pandemic. In another study, Kumar Tiwari et al. (2022) found a lead lag relationship between Covid-19 and stock market liquidity using continuous wavelet coherence analysis. So, the findings of different studies are contradicting and inconclusive. Therefore, this study attempts to explore the relationship between the incidence of Covid-19 and stock market liquidity.

It is important to note that the impact of Covid-19 is enormous and multidimensional and thus not restricted to the issue of liquidity. Simultaneous linkages of this pandemic with the businesses, their operations, financial markets and the overall economy are so strong and abrupt that it has triggered a spree of investigations by the researchers in multiple areas. In a study Al-Awadhi et al. (2020) looked at the impact of Covid-19 on Chinese stock market and found the daily growth in the new cases of Covid-19 and the deaths negatively affected the returns in Chinese stock market. In another relatively broader study, (Liu et al., 2020) investigated the impact of Covid-19 on 21 leading stock exchanges in the world. Their findings suggest that the stock markets across the globe responded immediately to the threat of Covid-19 and fell across the board. However, the decline was more severe and prominent in Asian economies. The similar conclusion is drawn by Ashraf (2020) in his study of 64 stock markets in the world. In addition, there have been several studies that analyze the impact of Covid-19 at an aggregate market level including stocks, cryptocurrency and some energy markets (Albulescu, 2021; Gil-Alana et al., 2020; Haroon & Rizvi, 2020a; Mishra et al., 2020; Phan & Narayan, 2020; Zhang et al., 2020).

However, at a relatively micro level and across asset classes, Mirza et al. (2020) are among the first to look at the reaction in prices and volatility exhibited by the Latin American mutual funds during the period of January to June of 2020 in response to the Covid-19 and the preventive measures taken by different European governments to control it. It is also investigated whether the reaction to Covid-19 and the performance of different mutual funds vary across their investment management style Rizvi et al. (2020) and if yes what could be the factors that may be helpful in keeping these mutual funds liquid and remain profitable such as human capital efficiency (Mirza et al., 2020).

Similarly, at a macroeconomic level Hevia and Neumeyer (2020) compared Covid-19 with the great depression and concluded that the negative impact of different non-preventive interventions (NPI), including social distancing and lockdowns, on the economy and output may exceed that of great depression.

Finally, the dimension of liquidity in which we primarily are interested is also being investigated rigorously by the researchers. Using bid/ask spreads in the emerging bond markets Gubareva (2021) shows that despite improvements due to the bail-out packages, liquidity in the bond market has not returned to the pre-Covid-19 level. She also reports the decoupling in the dynamics of credit risk and liquidity risk metrics. As far as the equity markets are concerned, Haroon and Rizvi (2020b) looked at the sample of 23 emerging markets and conclude the association of liquidity with the number of confirmed Covid-19 cases.

The aim of this article is to analyze the impact of Covid-19 on stock market liquidity of China and four worst hit countries by the pandemic that include United States, Brazil, India and Russia. The importance of Chinese stock market due to its sheer size, strategic, geo-political and economic factors is huge and most importantly China is the country where the Covid-19 cases were first identified. In addition, during times of Covid-19 Chinese stock market has been the epicentre of not only the physical contagion of the virus but also the financial contagion across the global financial markets (Corbet et al., 2020). Due to these reasons, it is inevitable to monitor its state closely to make more realistic ex-ante forecasts. In the same vein, Brazil, India and Russia being the part of BRIC economies have significant and dominant role in the world trade and growth, and an economic slowdown or financial turbulence in any of these markets can cause huge volatility spill-overs across the globe (Syriopoulos et al., 2015). These three countries are also amongst the worst hit by Covid-19 virus. Finally, we also include United States in our sample owing to its predominant role being the largest stock market in the world as well as its increasing integration and connectedness with China (Mohammadi & Tan, 2015) and other economies particularly the European economies and the financial institutions therein (Diebold & Yilmaz, 2015). The other reason for selecting US markets is that America is the worst hit country by the current pandemic.

In order to find the impact of Covid-19 on major stock markets' liquidity, we apply two step procedure in this article to first estimate the robust indicator of volatility of stock market illiquidity using GARCH (1, 1) model originally proposed by (Bollerslev, 1986) and utilised by a large number of researchers for the purpose of volatility estimation in different economic and financial constructs (Guesmi & Fattoum, 2014; Rizvi et al., 2020; Umar et al., 2021). In second state we utilise the estimated volatility as an input in VAR model to find the short-term relationship between the incidence of Covid-19 and stock markets' illiquidity. The time span of our analysis is ranging from December 31, 2019 to July 10, 2020 which is exactly the period of unprecedented uncertainty and termed by analyst as "Ice Age" (Quantifying the Coming Recession - The Atlantic).

Our results indicate that the US stock markets has highest liquidity, while Indian share market exhibits the lowest liquidity amongst our sample countries. US is the worst hit country so far and China is least affected amongst the five countries. The results of our GARCH analysis reveal that illiquidity and its volatility increased with the breaking news of Covid-19 but the adverse impact of the news on stock market liquidity was short lived as the liquidity reverted to its long term trend very soon. This study contributes to literature in several ways. First, it answers a very basic and important question that how the incidence of Covid-19 pandemic affected the liquidity of major stock markets around the world. Second, it highlights the impact of Covid-19 on stock markets of worst hit countries. Third, it informs us that different black swan events affect liquidity differently. Fourth, the impact of Covid-19 on stock market is very short lived as the variance of liquidity reverts to long run equilibrium very quickly.

Rest of the article is as follows. In Section 2 we elaborate our methodology and the data. Section 3 presents and discusses the results; and finally, Section 4 concludes.

2. Data and methodology

Data has been collected from two different sources. The variables to calculate stock market illiquidity have been obtained from 'investing.com' (https://www.investing.com/indices) and data regarding new Covid-19 cases and deaths has been obtained from 'Our World in Data' (https://ourworldindata.org/coronavirus-data). The data for the illiquidity range from July 1, 2019 to July 10, 2020 and the data for new cases and deaths range from December 31, 2019 to July 10, 2020. Stock markets' illiquidity has been calculated by using (Amihud, 2002). The illiquidity has been measured as the average of the ratio of daily absolute return to total volume traded and multiplying this number with one million for all four countries and one billion for US stock market. Covid-19 new cases represent the daily number of new Covid-19 patients and new deaths caused by the Corona, worldwide.

This study uses two stage methodology. In the first stage, volatility of the stock market illiquidity series ranging from July 1, 2019 to June 22, 2020 has been measured using GARCH (1, 1) model. The purpose of measuring volatility is to conclude whether the incidence of Covid-19 has affected the stock market liquidity or not? The mathematical expressions for GARCH (1, 1) is given below.

$$Illiquidity_t = \mu + \Phi Illiquidity_{t-1} + \theta\varepsilon_{t-1} + \varepsilon_t \quad (1)$$

Equation (1) is mean equation for Illiquidity where μ represents average, Φ depicts autoregression, θ shows moving average, and ε displays the error term. The subscripts t and t-1 represent the current and lagged values respectively.

$$\delta_t^2 = \beta_0 + \theta_k \delta_{t-k}^2 + b_1 u_{t-1}^2 \quad (2)$$

Equation (2) is the variance equation where β_0 is constant, θ_k incorporates ARCH effect and b_1 captures the GARCH effect. It shows that volatility in the period t depends on magnitude of squared errors in the previous periods. It examines the mean and variance of a series simultaneously. After running this model, we predicted the variance as a new variable. The graphs of conditional variance for the series of illiquidity for five countries have been drawn to finalise whether stock market liquidity has reacted to the news of pandemic or not. The graphs show that stock markets' illiquidity clearly reacted to the Covid-19 news. In the second stage, the study used VAR model to find the short-term relationship between the incidence of Covid-19 and stock markets' illiquidity because the series were not integrated of same level. The researchers concluded to go ahead with VAR analysis after performing different tests. A list of all the steps performed to decide why VAR should be used to find relationship between Covid-19 and stock markets' illiquidity of different countries is given below.

In the first step of second stage, the study used the Augmented Dickey Fuller Test (ADF) to know whether the series are stationary or not and at which difference they become stationary. The illiquidity and Covid-19 series were stationary at different levels i.e. co-integration was not possible. Therefore, instead of using Vector Error Correction Model (VECM) technique to find the long-term relationship, this study

used VAR technique to find short term relationship between Covid-19 and Gig economy. The lag length for VAR for different countries was decided on the basis of AIC, FPE and HQIC criteria. Post estimation stability test was also run to know about the stability of our results. All our results are robust.

Following VAR models have been used for the analysis. The main dependent variable is stock markets' illiquidity where Covid-19 new cases and recorded deaths are main independent variables.

$$\sum_{k}^{C,U,B,I,R} Illiquidity_{k,t} = \alpha_0 + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} Iilliquidity_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Cases_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Deaths_{k,t-i} \tag{3}$$

$$\sum_{k}^{C,U,B,I,R} New\ Cases_{k,t} = \alpha_0 + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} Iilliquidity_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Cases_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Deaths_{k,t-i} \tag{4}$$

$$\sum_{k}^{C,U,B,I,R} New\ Deaths_{k,t} = \alpha_0 + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} Iilliquidity_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Cases_{k,t-i} + \sum_{k}^{C,U,B,I,R}\sum_{i=1}^{4} New\ Deaths_{k,t-i} \tag{5}$$

The symbols used in the Equations (3)–(5) are self-explanatory. α_0 Represent the constant and ε stands for error term. The subscripts k stands for country i.e. China, US, Brazil, India, Russia, t denotes time and i stands for lag which ranges from 1 to 4. Lag length varies from country to country depending on the values of AIC, FPE and HQIC criteria. For China $i = 1$ i.e. lag length of one was used, for US $i = 4$ i.e. lag length of four has been used, for Brazil $i = 4$ means lag length of four has been used, $i = 2$ for India and lag length of four was also used for Russia. The results calculated on the basis of above-mentioned models have been discussed in Section 3 of this article.

Table 1. Descriptive statistics.

China								
	Mean	Median	Std.	Minimum	Maximum	Skewness	Kurtosis	N
Panel (a):								
Illiquidity	0.03	0.027	0.022	0	0.101	0.829	3.159	194
Panel (b):								
Illiquidity	0.03	0.026	0.023	0.001	0.101	1.056	3.675	98
New Cases	483	30	1734	0	15141	6.595	53.773	98
New Deaths	30	0	134	0	1290	8.611	80.75	98
US								
	Mean	Median	Std.	Minimum	Maximum	Skewness	Kurtosis	N
Panel (a):								
Illiquidity	0.00224	0.00159	0.00219	0.00001	0.0124	1.811	6.97421	202
Panel (b):								
Illiquidity	0.00284	0.00223	0.00256	0.00008	0.0124	1.493	5.161	105
New Cases	16118	18822	15917	0	63004	0.672	2.922	105
New Deaths	772	493	917	0	4928	1.424	5.755	105
Brazil								
	Mean	Median	Std.	Minimum	Maximum	Skewness	Kurtosis	N
Panel (a):								
Illiquidity	0.0018	0.0015	0.0016	0.00001	0.0123	2.5926	13.559	194
Panel (b):								
Illiquidity	0.002	0.002	0.002	0	0.012	2.579	11.562	99
New Cases	9311	1119	13614	0	48105	1.398	3.758	99
New Deaths	393	58	493	0	1473	0.832	2.104	99
India								
	Mean	Median	Std.	Minimum	Maximum	Skewness	Kurtosis	N
Panel (a):								
Illiquidity	0.51	0.309	0.552	0.005	3.245	2.042	7.879	187
Panel (b):								
Illiquidity	0.752	0.552	0.63	0.031	3.245	1.5	5.413	99
New Cases	4549	540	6826	0	26506	1.554	4.404	99
New Deaths	133	17	247	0	2003	4.665	34.247	99
Russia								
	Mean	Median	Std.	Minimum	Maximum	Skewness	Kurtosis	N
Panel (a):								
Illiquidity	0.001	0.001	0.001	0	0.005	1.1	4.156	200
Panel (b):								
Illiquidity	0.001	0.001	0.001	0	0.003	0.759	2.995	97
New Cases	3600	954	4024	0	11231	0.462	1.502	97
New Deaths	56	7	72	0	312	1.095	3.314	97

Notes: Table 1, Reports the descriptive statistics of five worst hit countries by Covid-19. Panel (a) in each country discloses the summary statistics of the stock markets' illiquidity from July 1, 2019 to July 10, 2020. Panel (b) in each country shows the illiquidity from December 31, 2019 to July 10, 2020 along with Covid-19 New Cases and New Deaths.
Source: calculated by the authors based on the data used in this study.

3. Results

China section of Table 1, Panel (a) provides the descriptive statistics for Chinese Stock market illiquidity for the period ranging from July 1, 2019 to July 10, 2020. The average value of illiquidity over the period is 0.03 with a standard deviation of 0.027. The series is normally distributed as per the statistics of Skewness and kurtosis. Panel (b) of China section shows the descriptive statistics for SSEC illiquidity and Covid-19 for the December 31, 2019 to July 10, 2020. The illiquidity statistics are

same for both the period. It shows no increase or decline in illiquidity in pre and overall Covid-19 periods. This finding of no significant change in stock market liquidity of Chinese stocks contradict with the findings of some existing studies (Chebbi et al., 2021; Nguyen et al., 2021; Suardi et al., 2022; Zhang et al., 2021). As far as the Covid-19 statistics are concerned, China reported 483 new cases per day with a standard deviation of 1,734. The series is positively skewed and have fat tails. As far as the recorded deaths are concerned, China lost 30 people daily due to Covid-19.

US part of Table 1, Panel (b) provides the descriptive statistics for S&P 500 illiquidity for the period ranging from July 1, 2019 to July 10, 2020. The average value of illiquidity over the period is 0.00224 with a standard deviation of 0.00219. The series is positively skewed and have fat tails as per the statistics of Skewness and kurtosis. Panel (b) of US part shows the descriptive statistics for S&P 500 illiquidity and Covid-19 for December 31, 2019 to July 10, 2020. The illiquidity statistics for post Corona period are higher than overall period which implies that illiquidity in US stock market has increased due to the incidence of Covid-19. These descriptive statistics support the finding of many existing studies (Chebbi et al., 2021; Nguyen et al., 2021; Suardi et al., 2022). As far as the Covid-19 statistics are concerned, US reported 16,118 new cases per day with a standard deviation of 18,822. As far as the recorded deaths are concerned, US lost 772 people daily due to Covid-19.

Brazil fragment of Table 1, Panel (a) provides the descriptive statistics for Brazilian stock market illiquidity for the period ranging from July 1, 2019 to July 10, 2020. The average value of illiquidity over the period is 0.0018 with a standard deviation of 0.0016. The series is positively skewed and have fat tails as per the statistics of Skewness and kurtosis. Panel (b) of Brazilian fragment shows the descriptive statistics for IBOVESPA illiquidity and Covid-19 for the December 31, 2019 to July 10, 2020. The illiquidity statistics for post Corona period and overall period are almost same, which implies that incidence of Corona did not impact illiquidity in Brazilian stock market. This finding of no significant change in stock market liquidity of Chinese stocks contradict with the findings of some existing studies (Chebbi et al., 2021; Nguyen et al., 2021; Suardi et al., 2022; Zhang et al., 2021). As far as the Covid-19 statistics are concerned, Brazil reported 9,311 new cases per day with a standard deviation of 13,614. As far as the recorded deaths are concerned, Brazil lost 393 people daily due to Covid-19.

Indian portion of Table 1, Panel (a) provides the descriptive statistics for SENSEX illiquidity for the period ranging from July 1, 2019 to July 10, 2020. The average value of illiquidity over the period is 0.510 with a standard deviation of 0.552. The illiquidity value of Indian stock exchange is highest compared to China, US and Brazil. The illiquidity series is positively skewed and have fat tails as per the statistics of Skewness and kurtosis. Panel (b) of Indian portion shows the descriptive statistics for SENSEX illiquidity and Covid-19 for the December 31, 2019 to July 10, 2020. The illiquidity statistics for post Corona period are higher compared to the overall sample which implies that Covid-19 has certainly affected market liquidity. These descriptive statistics support the finding of many existing studies (Chebbi et al., 2021; Nguyen et al., 2021; Suardi et al., 2022). As far as the Covid-19 statistics are concerned, India

reported 4,594 new cases per day with a standard deviation of 6,826. As far as the recorded deaths are concerned, India lost 133 people daily due to Covid-19. The severity of loss in India is lesser compared to the previous mentioned countries except China.

Russian section of Table 1, Panel (a) provides the descriptive statistics for MOEX Stock market illiquidity for the period ranging from July 1, 2019 to July 10, 2020. The average value of illiquidity over the period is 0.001 with a standard deviation of 0.001. The series is normally distributed as per the statistics of Skewness and kurtosis. Panel (b) of Russian section shows the descriptive statistics for Russian Stock Exchange illiquidity and Covid-19 for the December 31, 2019 to July 10, 2020. The illiquidity statistics are same for both the periods. It shows no increase or decline in illiquidity in post Covid-19 and overall periods. As far as the Covid-19 statistics are concerned, Russia reported 3,600 new cases per day with a standard deviation of 4,024. As far as the recorded deaths are concerned, Russia lost 56 people daily due to Covid-19.

Table 2 shows the correlation coefficients between stock markets' illiquidity and Covid-19 for all five countries. The data for all the series range from December 31, 2019 to July 10, 2020. According to the statistics, there is no correlation between Chinese stock market illiquidity and Covid-19. As per the numbers, there is no correlation between US stock market illiquidity and Covid-19 as well. There is weak negative correlation between Brazilian stock market illiquidity and Covid-19. The correlation between Indian stock market illiquidity and Covid-19 is also weak and negative. There is weak negative correlation between Russian stock market illiquidity and Covid-19. Overall, we can say that there is no straight-line relationship between stock markets' illiquidity and Covid-19.

Figure 1 shows the illiquidity series of SSEC over July 1, 2019 to July 10, 2020. The series shows lot of variation indicating that liquidity in Chinese market fluctuates a lot. The highest value is recorded at the point of incidence of Covid-19 which implies that the news about spread of Covid-19 increased the illiquidity of the Chinese stock market. The values after that are by and large like pre-Covid-19 period i.e. the effect of Covid-19 on market illiquidity did not last long. This result support the findings of these existing studies that the incidence of pandemic adversely impacted stock market liquidity (Alaoui Mdaghri et al., 2020; Chebbi et al., 2021). The analysis of this study reveals that the adverse impact of Covid-19 on stock liquidity was short lived. The right-hand side of the Figure 1 shows the volatility of the series measured by using GARCH (1, 1) model. It shows two peaks, one at the time of the breaking of Covid-19 news and the other peak coincides with the second wave of Covid-19 in China. It shows that the Chinese stock market reacted to the news of Covid-19 but the effect of Covid-19 on illiquidity was not long lasting.

Figure 2 shows the illiquidity series of S&P 500 over July 1, 2019 to July 10, 2020. The series shows small peaks at the beginning of the series and large ones at the beginning of the year 2020. The illiquidity started to increase in February and reached the highest value in the end of March 2020. This surge in illiquidity coincides with the incidence of Covid-19 in US. The illiquidity declined in the month of April and a sudden peak is seen at the end of June 2020 which coincides with the second wave of

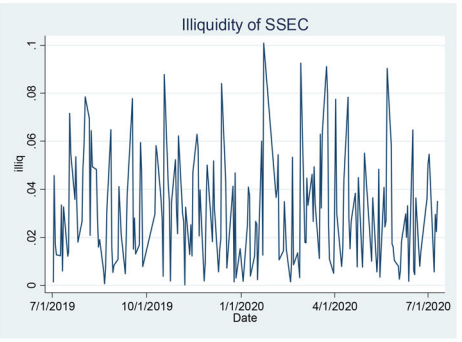
Table 2. Correlation coefficients.

China			
	Illiquidity	New Cases	New Deaths
Illiquidity	1		
New Cases	−0.034	1	
	(0.743)		
New Deaths	−0.026	0.223**	1
	(0.798)	(0.028)	
United States			
	Illiquidity	New Cases	New Deaths
Illiquidity	1		
New Cases	−0.081	1	
	(0.414)		
New Deaths	−0.061	0.637***	1
	(0.534)	(0.000)	
Brazil			
	Illiquidity	New Cases	New Deaths
Illiquidity	1		
New Cases	−0.278***	1	
	(0.005)		
New Deaths	−0.322***	0.923***	1
	(0.001)	(0.000)	
India			
	Illiquidity	New Cases	New Deaths
Illiquidity	1		
New Cases	−0.286***	1	
	(0.004		
New Deaths	−0.250**	0.691***	1
	(0.013)	(0.000)	
Russia			
	Illiquidity	New Cases	New Deaths
Illiquidity	1		
New Cases	−0.146	1	
	(0.153)		
New Deaths	−0.258**	0.849***	1
	(0.011)	(0.000)	

Notes: Table 2 reports the pair-wise correlation matrix of the series used in this study from five worst hit countries by Covid-19; the sample period for all the series ranges from December 31, 2019 to July 10, 2020. Parentheses denote *p* values, and ** and *** represent levels of statistical significance at 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

Covid-19 in China. The right-hand side of the Figure 2 shows the volatility of the series measured by using GARCH (1, 1) model. The volatility of liquidity spiked in March and declined in April, 2020. A small increase is also seen towards the end of June. It shows that the US stock market reacted to the news of Covid-19 but the effect of Covid-19 on illiquidity was not long lasting. Compared to Chinese stock market the illiquidity of US stock market responded strongly to the incidence of pandemic. The findings regarding the impact of Covid-19 on US stock liquidity support the findings of Chebbi et al. (2021), which studied the impact of Covid-19 on S&P500 liquidity and found an inverse relationship.

Figure 3 shows the illiquidity series of BOVESPA over July 1, 2019 to July 10, 2020. The series shows one notable peak in March 2020 i.e. the illiquidity of Brazilian



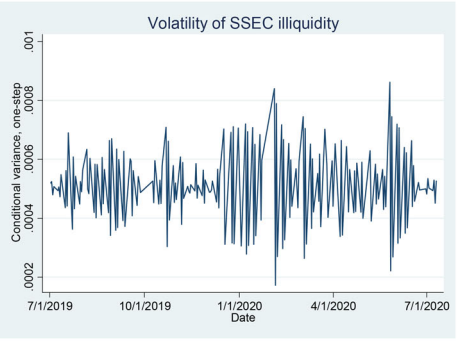


Figure 1. Left panel of the figure shows the illiquidity of Shanghai Stock Exchange Composite (SSEC) index of China over July 1, 2019 to July 10, 2020. The right panel shows the volatility of SSEC illiquidity. The illiquidity of the market increased with the news of Covid-19 incidence.
Source: calculated by the authors based on the data used in this study.

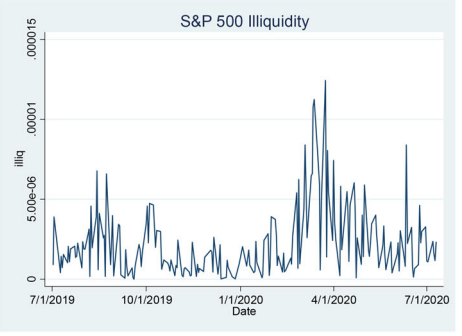
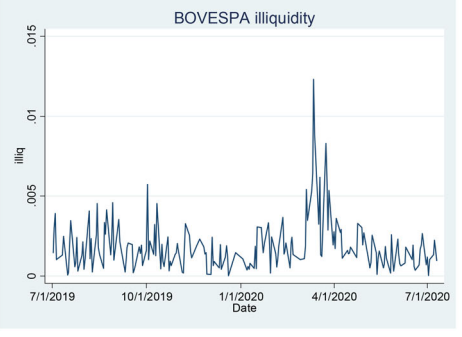


Figure 2. Left panel of the figure shows the illiquidity of S&P 500 index of United States over July 1, 2019 to July 10, 2020. The right panel shows the volatility of S&P 500 illiquidity. The illiquidity of the market increased with the news of Covid-19 incidence.
Source: calculated by the authors based on the data used in this study.



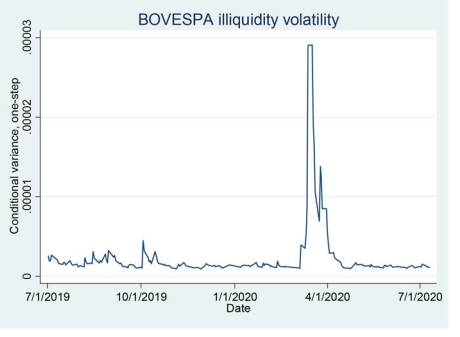


Figure 3. Left panel of the figure shows the illiquidity of IBOVESPA index of Brazil over July 1, 2019 to July 10, 2020. The right panel shows the volatility of IBOVESPA illiquidity. The illiquidity of the market increased with the news of Covid-19 incidence.
Source: calculated by the authors based on the data used in this study.

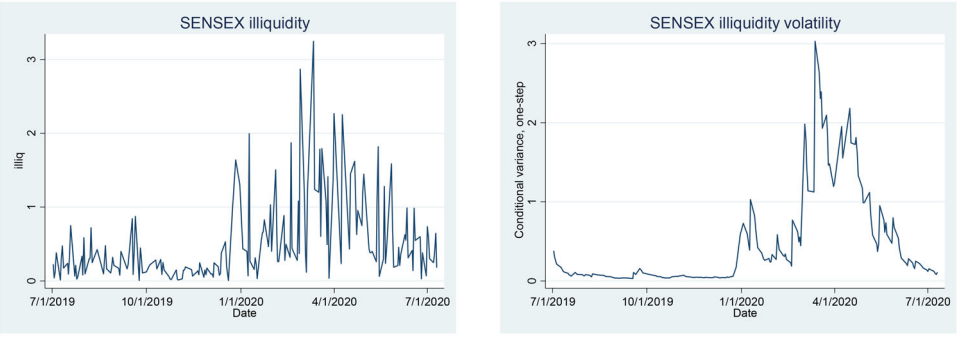


Figure 4. Left panel of the figure shows the illiquidity of BSE SENSEX index of India over July 1, 2019 to July 10, 2020. The right panel shows the volatility of BSE SENSEX illiquidity. The illiquidity of the market increased with the news of Covid-19 incidence.
Source: calculated by the authors based on the data used in this study.

stock exchange increased when the Covid-19 struck the country. The illiquidity peak flattened quickly and reached back to pre-Covid-19 level. It implies that the market panicked when the news of Covid-19 broke in Brazil but the marked calmed soon after. This finding is in accordance with many existing studies (Chebbi et al., 2021; Suardi et al., 2022). The right-hand side of the Figure 3 shows the volatility of the series measured by using GARCH (1, 1) model. The volatility of liquidity spiked in March and declined in April, 2020 and reached back to pre-Covid-19 level. The figures show that the Brazilian stock market reacted to the news of Covid-19 but the effect of Covid-19 on illiquidity was not long lasting in case of Brazil as well. Unlike US, illiquidity in Brazilian stock market surged just once.

Figure 4 shows the illiquidity series of SENSEX over July 1, 2019 to July 10, 2020. The series shows that illiquidity of Indian stock market started to increase at the end of the year 2019 reached its highest point in the middle of March 2020. The illiquidity in Indian market started to increase with breaking of Covid-19 news in China and the illiquidity peaked when the Corona virus engulfed India in March 2020. The illiquidity started to decline afterwards but the decline was slow compared to other countries. It's clear from the figure that the illiquidity reached pre-Covid-19 period towards the end of June and beginning of July 2020. The adverse impact of Covid-19 on Indian stock market liquidity was relatively prolonged compared to the other four countries under study. The right-hand side of the Figure 4 shows the volatility of the series measured by using GARCH (1, 1) model. The volatility of liquidity started to increase in the year 2020 and peaked in March. The volatility of liquidity declined gradually and reached pre-Covid-19 period at the beginning of July 2020. Indian market took the longest to absorb the uncertainty caused by Covid-19.

Figure 5 shows the illiquidity series of MOEX over July 1, 2019 to July 10, 2020. The series shows that liquidity of Russian stock market is very volatile. The largest increase in volatility corresponds to the news of Covid-19. The illiquidity shows a sudden increase however it came to pre-Covid-19 period very quickly. The increase in illiquidity coincides with the breaking of Covid-19 news in China it implies that the connection between SSEC and MOEX is strong. The reaction of Russian stock market liquidity to the incidence of Covid-19 is like the reaction of US and MENA

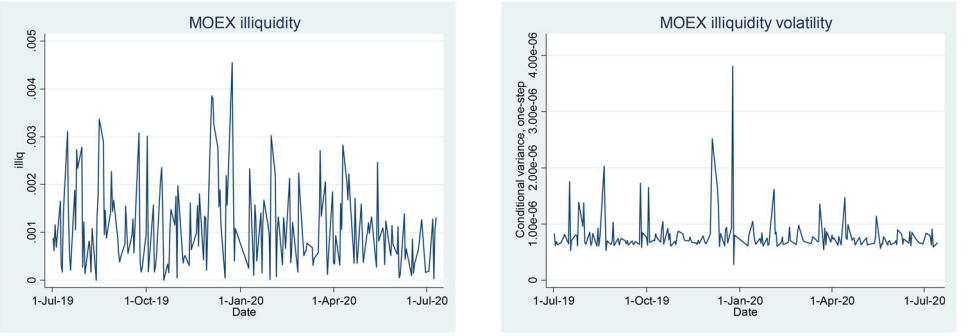


Figure 5. Left panel of the figure shows the illiquidity of MOEX index of Russia over July 1, 2019 to July 10, 2020. The right panel shows the volatility of MOEX illiquidity. The illiquidity of the market increased with the news of Covid-19 incidence.
Source: calculated by the authors based on the data used in this study.

Table 3. Augmented Dickey fuller test.

China		
	Level	First difference
Illiquidity	−9.094***	–
	(0.000)	
New Cases	−5.885***	–
	(0.000)	
New Deaths	−9.562***	–
	(0.000)	
United States		
Illiquidity	−7.108***	
	(0.000)	
New Cases	0.492	−15.723***
	(0.9846)	(0.000)
New Deaths	−3.655***	
	(0.0048)	
Brazil		
Illiquidity	−5.11***	
	(0.000)	
New Cases	−1.756	−15.612***
	(0.4026)	(0.000)
New Deaths	−2.353	−21.61***
	(0.1555)	(0.000)
India		
Illiquidity	−9.185***	
	(0.000)	
New Cases	8.531	−7.067***
	(1.000)	(0.000)
New Deaths	−5.306***	
	(0.000)	
Russia		
Illiquidity	−9.821***	
	(0.000)	
New Cases	−0.823	−10.942***
	(0.8123)	(0.000)
New Deaths	−1.972	−14.823***
	(0.299)	(0.000)

Notes: Table 3 provides the results of Augmented Dickey–Fuller test for unit roots. Parentheses denote *p* values, *** represent levels of statistical significance at 1% level of significance.
Source: calculated by the authors based on the data used in this study.

Table 4. VAR model results for China.

	Dependent variables		
	Illiquidity	New Cases	New Deaths
$Illiq_{t-1}$	0.069074	6593.648	−320.1569
	(0.493)	(0.324)	(0.584)
New $Cases_{t-1}$	−1.19E-06	0.4641029	0.0058083
	(0.389)	(0.000)	(0.720)
New $Deaths_{t-1}$	6.97E-06	0.2633104	0.0010486
	(0.696)	(0.824)	(0.992)
Cons.	0.028239	57.70219	36.91697
	(0.000)	(0.823)	(0.103)

Notes: Table 4 represents the relationship between stock market illiquidity and Covid-19 new cases and new deaths; parentheses denote *p* values, and *, ** and *** represent statistical significance at 10%, 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

stock liquidity (Alaoui Mdaghri et al., 2020; Suardi et al., 2022). The right-hand side of the Figure 5 shows the volatility of the series measured by using GARCH (1, 1) model. The volatility of liquidity show a shock at the end of December 2019 which corresponds with the news regarding spread of Covid-19 in china. The volatility of liquidity is even lesser in post Covid-19 period compared to pre-Covid-19 period.

To understand the impact of Covid-19 incidence on stock markets' illiquidity of different countries, we have performed a series of steps whose detail is discussed below. First, this study ran Augmented Dickey Fuller (ADF) test to know about the stationary of the series. ADF test was run at level and at first difference for illiquidity and Covid-19 new cases and deaths for all countries. The results of ADF tests are presented in Table 3. All the series were stationary at level for China however, illiquidity of S&P500 and new deaths in US were stationary at level but new cases had a trend component. New cases of American Covid-19 series became stationary at first difference. In case of Brazil, illiquidity of BOVESPA was stationary at level but both Covid-19 new cases and deaths caused by virus became stationary at first difference. Indian story regarding ASF is exactly similar to US. Illiquidity of SENSEX and deaths caused by Corona were stationary at level, but Covid-19 new cases had a trend component and became stationary at first difference. Finally, the Russian story is exactly like Brazilian story. Illiquidity series of MOEX was stationary at level but Covid-19 new cases and deaths were stationary at first difference.

As the series of illiquidity and Covid-19 were not co-integrated i.e. there exist no long run relationship between the incidence of Covid-19 and stock markets' illiquidity. To know the short term relationship between the series, VAR model has been used. Different lag lengths were decided on the basis of AIC, FPE and HQIC criteria for different countries. The number of lags used has already been described in the methodology section of this study.

Table 4 provides the results for VAR analysis for China. The results show that there is no significant relationship between incidence of Covid-19 and SSEC illiquidity. This finding of insignificant relationship may be due to the fact that the adverse impact of Covid-19 news on Chinese stock liquidity was very short lived and the data for this study ranges from July 1, 2019 to July 10, 2020 i.e. more than a year. The breaking of Covid-19 news did affect stock market liquidity, but the series came back

Table 5. VAR model results for US.

	Dependent variables		
	Illiquidity	New Cases	New Deaths
Illiqt-1	0.177*	−4552.709	21840.13
	(0.077)	(0.970)	(0.224)
Illiqt-2	0.179*	−82721.64	13281.75
	(0.075)	(0.493)	(0.461)
Illiqt-3	0.187*	122764.6	−25097.27
	(0.062)	(0.308)	(0.162)
Illiqt-4	0.022602	304775.7***	40073.27**
	(0.819)	(0.010)	(0.024)
New $Cases_{t-1}$	9.20E-09	0.454***	−0.089***
	(0.908)	(0.000)	(0.000)
New $Cases_{t-2}$	8.22E-08	0.592***	0.072***
	(0.433)	(0.000)	(0.000)
New $Cases_{t-3}$	−1.18E-07	−0.158	0.045**
	(0.277)	(0.227)	(0.022)
New $Cases_{t-4}$	−8.75E-09	0.2997**	−0.0085
	(0.932)	(0.015)	(0.643)
New $Deaths_{t-1}$	5.28E-07	0.814	0.417***
	(0.341)	(0.222)	(0.000)
New $Deaths_{t-2}$	2.75E-07	−2.956***	0.079
	(0.630)	(0.000)	(0.438)
New $Deaths_{t-3}$	−5.41E-08	0.958	−0.032
	(0.926)	(0.172)	(0.763)
New $Deaths_{t-4}$	−4.83E-07	−1.799***	0.208**
	(0.348)	(0.004)	(0.024)
Cons.	0.002***	−427.528	−97.825
	(0.003)	(0.483)	(0.282)

Notes: Table 5 represents the relationship between stock market illiquidity and Covid-19 new cases and new deaths; parentheses denote *p* values, and *, ** and *** represent statistical significance at 10%, 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

to normal very quickly. The results also show that new cases and new deaths are not explained by any of the independent variables.

Table 5 shows the results of VAR analysis for US. None of the lags of Covid-19 new cases and new deaths explain variation in illiquidity of S&P 500. This finding contradicts with the conclusions of many existing studies (Alaoui Mdaghri et al., 2020; Chebbi et al., 2021; Marozva & Magwedere, 2021; Suardi et al., 2022) and this difference may be due to sample size as the sample size of this study is larger than one year but the sample size for many of the above mentioned studies span over a small period. As per the results, illiquidity does depend on first to third lags of its own. The number of new cases depend on first, second and fourth lag of its own and there is inverse relationship between second and fourth lag of Covid-19 deaths and new cases. It implies, the increase in deaths do scare people to maintain social distancing and adopt preventive measures. New deaths also depend on first to third lags of new cases. The relationship between first lag of new cases and new deaths is inverse and the relationship between second and third lag of new cases and current value of new deaths is positive. First and fourth lag of new deaths also explain variation in current new deaths.

Table 6 shows the results of VAR analysis for Brazil. There is no significant relationship between incidence of Covid-19 and Brazilian stock market illiquidity as neither of Covid-19 series explain variation in BOVESPA illiquidity. Illiquidity of Brazilian stock market is explained by all four lags of its own. First and third lags

Table 6. VAR model results for Brazil.

	Dependent variables		
	Illiquidity	New Cases	New Deaths
$Illiq_{t-1}$	0.478***	105766.6	−1081.781
	(0.000)	(0.643)	(0.902)
$Illiq_{t-2}$	−0.046***	−142849.2	3359.509
	(0.667)	(0.558)	(0.721)
$Illiq_{t-3}$	0.307***	−88780.16	−5349.25
	(0.005)	(0.716)	(0.571)
$Illiq_{t-4}$	−0.155***	120406.8	−430.9463
	(0.124)	(0.595)	(0.961)
New $Cases_{t-1}$	2.78E-08	0.261**	−0.0015591
	(0.574)	(0.02)	(0.719)
New $Cases_{t-2}$	−6.52E-09	−0.064	−0.009**
	(0.903)	(0.594)	(0.033)
New $Cases_{t-3}$	1.53E-08	0.191	0.004
	(0.801)	(0.165)	(0.406)
New $Cases_{t-4}$	−3.48E-08	0.425	0.0007
	(0.574)	(0.002)	(0.895)
New $Deaths_{t-1}$	−1.51E-06	−2.777	0.169
	(0.271)	(0.369)	(0.158)
New $Deaths_{t-2}$	4.60E-07	1.223	0.384***
	(0.746)	(0.703)	(0.002)
New $Deaths_{t-3}$	−8.78E-07	−3.664	−0.082
	(0.554)	(0.274)	(0.526)
New $Deaths_{t-4}$	1.18E-06	12.361***	0.705***
	(0.432)	(0.000)	(0.000)
Cons.	0.001***	315.1726	35.433
	(0.001)	(0.698)	(0.259)

Notes: Table 6 represents the relationship between stock market illiquidity and Covid-19 new cases and new deaths; parentheses denote *p* values, and *, ** and *** represent statistical significance at 10%, 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

positively affect illiquidity but the effect of second and fourth lag is negative. The results for Brazil also contradict with many existing studies as mentioned in the VAR results for US stocks. There is significant positive relationship between first lag of new cases and the current number of new cases. The relationship between fourth lag of new deaths and number of new cases is also significant and positive and there is inverse relationship between second lag of new cases and current number of deaths. There is significant positive relationship between second and fourth lag of new deaths and current number of demises as a result of Covid-19.

Table 7 provides the results of VAR analysis for India. None of the Covid-19 series explain variation in illiquidity of Indian stock market i.e. there is also no short-term relationship between incidence of Covid-19 and liquidity of SENSEX. As per the results of VAR analysis, there exist no significant relationship between incidence of Covid-19 and stock market liquidity like the other countries studied in this research. New cases are explained by the first and second lags of their own. The relationship between first lag of death and new cases is also significant and positive. The relationship between first lag of new cases and new deaths is significant and negative but the second lag of new cases have positive effect on new deaths.

Table 8 shows the VAR analysis results for Russia. The results of VAR analysis for Russia are not different than other countries. Like many other countries, there is no relationship between the incidence of Covid-19 and liquidity of MOEX. The illiquidity of Russian market is explained by its fourth lag only. The relationship between

Table 7. VAR model results for India.

	Dependent variables		
	Illiquidity	New Cases	New Deaths
$Illiq_{t-1}$	0.003	71.975	−13.137
	(0.978)	(0.240)	(0.649)
$Illiq_{t-2}$	−0.020	75.065	−2.108
	(0.842)	(0.222)	(0.942)
New $Cases_{t-1}$	7.58E-05	0.731***	−0.101**
	(0.640)	(0.000)	(0.028)
New $Cases_{t-2}$	−0.00011	0.325***	0.1281**
	(0.508)	(0.001)	(0.008)
New $Deaths_{t-1}$	2.08E-04	0.551***	0.058934
	(0.550)	(0.009)	(0.551)
New $Deaths_{t-2}$	−1.27E-04	0.162	0.152936
	(0.729)	(0.462)	(0.140)
Cons.	0.881***	−93.198	33.455
	(0.000)	(0.289)	(0.419)

Notes: Table 7 represents the relationship between stock market illiquidity and Covid-19 new cases and new deaths; parentheses denote *p* values, and *, ** and *** represent statistical significance at 10%, 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

Table 8. VAR model results for Russia.

	Dependent variables		
	Illiquidity	New Cases	New Deaths
$Illiq_{t-1}$	−0.013	−39103.91	−516.332
	(0.897)	(0.646)	(0.898)
$Illiq_{t-2}$	−0.051	25204.78	2466.631
	(0.605)	(0.764)	(0.533)
$Illiq_{t-3}$	0.146	152843.6*	−5058.421
	(0.132)	(0.065)	(0.196)
$Illiq_{t-4}$	−0.269***	−77348.26	2437.777
	(0.007)	(0.367)	(0.547)
New $Cases_{t-1}$	7.83E-08	0.851***	0.0045
	(0.485)	(0.000)	(0.317)
New $Cases_{t-2}$	2.96E-08	0.227*	−0.0005
	(0.838)	(0.066)	(0.929)
New $Cases_{t-3}$	4.42E-09	0.276**	−0.0079
	(0.976)	(0.024)	(0.174)
New $Cases_{t-4}$	−6.98E-08	−0.367***	0.0085*
	(0.538)	(0.000)	(0.061)
New $Deaths_{t-1}$	−2.91E-06	1.496	0.4115***
	(0.220)	(0.458)	(0.000)
New $Deaths_{t-2}$	2.91E-06	1.878	0.1125
	(0.255)	(0.388)	(0.274)
New $Deaths_{t-3}$	−1.79E-06	−0.977	−0.1614
	(0.490)	(0.658)	(0.122)
New $Deaths_{t-4}$	−3.54E-06	−2.696	0.381***
	(0.137)	(0.183)	(0.000)
Cons.	0.0013***	33.099	2.344
	(0.000)	(0.869)	(0.805)

Notes: Table 8 represents the relationship between stock market illiquidity and Covid-19 new cases and new deaths; parentheses denote *p* values, and *, ** and *** represent statistical significance at 10%, 5% and 1% levels, respectively.
Source: calculated by the authors based on the data used in this study.

fourth lag of illiquidity and current value is significant and negative. Variation in new cases is explained by all four lags of them. The relationship between first three lags of new cases and current value of new cases is positive and there is inverse relationship between fourth lag and the current value of new cases. The variation in

deaths is only explained by first and fourth lag of itself. None of the other variables explain variation in number of deaths in case of Russia.

This study concludes from the above-mentioned results that the stock markets in the worst hit countries by Corona, panicked with breaking of Covid-19 news and their liquidity plummeted but settled back to normal quickly afterwards. Chinese and US stock markets' illiquidity not only increased with the news of Covid-19 but also responded positively to the news of second wave in China. However, the study has failed to find any steady long- or short-term relationship between the incidence of Covid-19 and illiquidity of stock markets of worst hit countries. The findings of this study partially support the findings of many existing studies that the incidence of Covid-19 pandemic adversely affected stock market liquidity (Alaoui Mdaghri et al., 2020; Chebbi et al., 2021; Nguyen et al., 2021; Suardi et al., 2022). However, as per the results of this study, the impact of Covid-19 on stock market liquidity of major stock exchanges from worst hit countries was very short lived. The adverse reaction by stock market was short enough that even VAR analysis could not capture any significant relationship between the incidence of Covid-19 and stock market liquidity.

4. Conclusion

The study concludes that the US stock markets has highest liquidity while Indian has the lowest liquidity amongst our sample countries. Liquidity of the US stocks is the worst hit country so far and China is least affected amongst the five countries. The results of our GARCH analysis show that illiquidity and its volatility increased with the breaking news of Covid-19 but the adverse impact of the news on stock market liquidity was short lived as the liquidity went back to its normal very soon. Further analysis shows that the illiquidity and Covid-19 series are not integrated at the same level so there is no existence of any longer-term relationship between incidence of Covid-19 and stock market liquidity. The results of our VAR analysis also show absence of any short run relationship between these two series.

The implication of the study is that illiquidity issue is not important in the current crisis unlike the global financial crisis (GFC). The reason may be the origin of the problem as GFC originated from the financial sector which shattered the trust of the investors but the source of this crisis is biological. So, the stocks liquidity impact of Covid-19 is expected to be short lived. Therefore, investors and policy makers should not panic because the situation may revert to long-term equilibrium sooner than expected. The investors do not have to increase their cash position and shatter their long positions and the central banks do not have to do open market operations and Repos etc. for long term to inject the liquidity into the market.

As far as the future research is concerned, it would be very interesting to find, what are the reasons for short term reaction of liquidity to the incidence of Covid-19. Is it the timely intervention of governments or anything else? Lot of work has been done on the impact of Covid-19 on stock markets but the impact of the incidence of the pandemic on global economy is relatively less explored question. So, studying this dimension of literature may provide us new insights and policies to avoid adverse impact of pandemic on the overall economy. Our study explores the impact of first

wave of Covid-19 on stock market liquidity, it would be interesting to analyze the impact of second, third and further waves of Covid-19 on stock markets liquidity and overall performance. This study is confined to five worst hit countries only and further studies may study the impact of Covid-19 on stock market liquidity of other countries as well.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Natural Science Foundation of China (no. 12026239) and Humanities and Social Sciences of Ministry of Education Planning Fund #22YJA910004#.

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References

Alaoui Mdaghri, A., Raghibi, A., Thanh, C. N., & Oubdi, L. (2020). Stock market liquidity, the great lockdown and the COVID-19 global pandemic nexus in MENA countries. *Review of Behavioral Finance*, *13*(1), 51–68. https://doi.org/10.1108/RBF-06-2020-0132/FULL/XML

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

Albulescu, C. T. (2021). COVID-19 and the United States financial markets' volatility. *Finance Research Letters*, *38*, 101699. https://doi.org/10.1016/j.frl.2020.101699

Amihud, Y. (2002). Illiquidity and stock returns – II: Cross-section and time-series effects. *Journal of Financial Markets*, *5*(1), 31–56. https://doi.org/10.2139/ssrn.3139180

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

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, *31*(3), 307–327. https://doi.org/10.1016/0304-4076(86)90063-1

Brunnermeier, M. K. (2009). Deciphering the liquidity and credit crunch 2007–2008. *Journal of Economic Perspectives*, *23*(1), 77–100. https://doi.org/10.1257/jep.23.1.77

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial Studies*, *22*(6), 2201–2238. https://doi.org/10.1093/rfs/hhn098

Chebbi, K., Ammer, M. A., & Hameed, A. (2021). The COVID-19 pandemic and stock liquidity: Evidence from S&P 500. *The Quarterly Review of Economics and Finance*, *81*, 134–142. https://doi.org/10.1016/j.qref.2021.05.008

Chudik, A., & Fratzscher, M. (2011). Identifying the global transmission of the 2007–2009 financial crisis in a GVAR model. *European Economic Review*, *55*(3), 325–339. https://doi.org/10.1016/j.euroecorev.2010.12.003

Corbet, S., Larkin, C., & Lucey, B. (2020). The contagion effects of the COVID-19 pandemic: Evidence from gold and cryptocurrencies. *Finance Research Letters*, *35*(April), 101554. https://doi.org/10.1016/j.frl.2020.101554

Diebold, F. X., & Yilmaz, K. (2015). Trans-Atlantic equity volatility connectedness: U.S. and European Financial Institutions, 2004–2014. *Journal of Financial Econometrics*, *14*(1), nbv021–127. https://doi.org/10.1093/jjfinec/nbv021

Gil-Alana, L. A., Abakah, E. J. A., & Rojo, M. F. R. (2020). Cryptocurrencies and stock market indices. Are they related? *Research in International Business and Finance*, *51*, 101063. https://doi.org/10.1016/j.ribaf.2019.101063

Gubareva, M. (2021). The impact of Covid-19 on liquidity of emerging market bonds. *Finance Research Letters*, *41*, 101826. https://doi.org/10.1016/j.frl.2020.101826

Guesmi, K., & Fattoum, S. (2014). Return and volatility transmission between oil prices and oil-exporting and oil-importing countries. *Economic Modelling*, *38*, 305–310. https://doi.org/10.1016/j.econmod.2014.01.022

Haroon, O., & Rizvi, S. A. R. (2020a). Flatten the curve and stock market liquidity–An inquiry into emerging economies. *Emerging Markets Finance and Trade*, *56*(10), 2151–2161. https://doi.org/10.1080/1540496X.2020.1784716

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

Hevia, C., & Neumeyer, A. (2020). *A conceptual framework for analyzing the economic impact of COVID-19 and its policy implications*. COVID19 Policy Document Series.

KPMG. (2020). COVID-19 and valuation considerations - KPMG Global. https://home.kpmg/xx/en/home/insights/2020/07/covid-19-and-valuation-considerations.html

Kumar Tiwari, A., Joel Aikins Abakah, E., Kwasi Karikari, N., & Alberiko Gil-Alana, L. (2022). The outbreak of COVID-19 and stock market liquidity: Evidence from emerging and developed equity markets. *The North American Journal of Economics and Finance*, *62*, 101735. https://doi.org/10.1016/j.najef.2022.101735

Liu, H., Manzoor, A., Wang, C., Zhang, L., & Manzoor, Z. (2020). The COVID-19 outbreak and affected countries stock markets response. *International Journal of Environmental Research and Public Health*, *17*(8), 2800. https://doi.org/10.3390/ijerph17082800

Marozva, G., & Magwedere, M. R. (2021). COVID-19 and stock market liquidity: An analysis of emerging and developed markets. *Scientific Annals of Economics and Business*, *68*(2), 129–144. https://www.ceeol.com/search/article-detail?id=962080

Mirza, N., Hasnaoui, J. A., Naqvi, B., & Rizvi, S. K. A. (2020). The impact of human capital efficiency on Latin American mutual funds during Covid-19 outbreak. *Swiss Journal of Economics and Statistics*, *156*(1), 1–7. https://doi.org/10.1186/S41937-020-00066-6/TABLES/5

Mishra, A. K., Parikh, B., & Spahr, R. W. (2020). Stock market liquidity, funding liquidity, fi nancial crises and quantitative easing. *International Review of Economics & Finance*, *70*, 456–478. https://doi.org/10.1016/j.iref.2020.08.013

Mohammadi, H., & Tan, Y. (2015). Return and volatility spillovers across equity markets in mainland China, Hong Kong and the United States. *Econometrics*, *3*(2), 215–232. https://doi.org/10.3390/econometrics3020215

Nguyen, C. T., Hai, P. T., & Nguyen, H. K. (2021). Stock market returns and liquidity during the COVID-19 outbreak: Evidence from the financial services sector in Vietnam. *Asian Journal of Economics and Banking*, *5*(3), 324–342. https://doi.org/10.1108/AJEB-06-2021-0070

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

Rizvi, S. K. A., Mirza, N., Naqvi, B., & Rahat, B. (2020). Covid-19 and asset management in EU: A preliminary assessment of performance and investment styles. *Journal of Asset Management*, *21*(4), 281–291. https://doi.org/10.1057/S41260-020-00172-3/TABLES/7

Sharif, A., Aloui, C., & Yarovaya, L. (2020). COVID-19 pandemic, oil prices, stock market and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach. *SSRN Electronic Journal*, *70*, 101496. https://doi.org/10.2139/ssrn.3574699

Suardi, S., Xu, C., & Zhou, Z. I. (2022). COVID-19 pandemic and liquidity commonality. *Journal of International Financial Markets, Institutions and Money*, *78*, 101572. https://doi.org/10.1016/j.intfin.2022.101572

Syriopoulos, T., Makram, B., & Boubaker, A. (2015). Stock market volatility spillovers and portfolio hedging: BRICS and the financial crisis. *International Review of Financial Analysis*, *39*, 7–18. https://doi.org/10.1016/j.irfa.2015.01.015

Umar, M., Rizvi, S. K. A., & Naqvi, B. (2021). Dance with the devil? The nexus of fourth industrial revolution, technological financial products and volatility spillovers in global financial system. *Technological Forecasting and Social Change*, *163*, 120450. https://doi.org/10.1016/j.techfore.2020.120450

Zhang, P., Gao, J., & Li, X. (2021). Stock liquidity and firm value in the time of COVID-19 pandemic. *Emerging Markets Finance and Trade*, *57*(6), 1578–1591. https://doi.org/10.1080/1540496X.2021.1898368

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