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RESEARCH ARTICLE

COVID-19 fear and volatility index movements: empirical insights from ASEAN stock markets

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Abstract

This research aims to look into the effect of COVID-19 on emerging stock markets in seven of the Association of Southeast Asian Nations' (ASEAN-7) member countries from March 21, 2020 to April 31, 2020. This paper uses a ST-HAR-type Bayesian posterior model and it highlights the stock market of this ongoing crisis, such as, COVID-19 outbreak in all countries and related industries. The empirical results shown a clear evidence of a transition during COVID-19 crisis regime, also crisis intensity and timing differences. The most negatively impacted industries were health care and consumer services due to the Covid-19 drug-race and international travel restrictions. More so, study results estimated that only a small number of sectors are affected by COVID-19 fear including health care, consumer services, utilities, and technology, significance at the 1%, 5%, and 10%, that measure current volatility's reliance on weekly and monthly variables. Secondly, it is found that there is almost no chance that the COVID-19 pandemic would positively affect the stock market performance in all the countries, mainly Indonesia and Singapore were the countries most affected. Thirdly, results shown that Thailand's stock market output has dropped by 15%. Results shows that COVID-19 fear causes an eventual reason of public attention towards stock market volatility. The study presented comprehensive way forwards to stabilize movement of ASEAN equity market's volatility index and guided the policy implications to key stakeholders that can better help to mitigate drastic impacts of COVID-19 fear on the performance of equity markets.

Keywords COVID-19 fear · Volatility analysis · Investment management · Equity markets · ASEAN countries

Introduction

Equity markets respond to significant events that can be classified as either endogenous or exogenous shocks. The 2008 Global Financial Crises (Cheema et al. 2020; Doidge et al. 2020) and the Covid-19 pandemic (Daniel 2020) are the most recent examples. And more recently, an unforeseen coronavirus delivered an "exogenous shock" which causes fiscal and monetary changes to cope with rising difficulties. Long-term financial consequences are anticipated to take years to unfold. Some degree of regulation started to emerge following the lockdown, with recent estimates indicating an initial economic downturn of 3 to 6% (Stubbs et al. 2020). Early in December 2019, the pandemic was detected, and by the end of February 2020, its effects had spread across financial markets. Following that, a slew of lockdown steps hampered the operation. Economic behavior has implications for capital markets.

The COVID-19 outbreak is one the largest public health crisis and economic shock worldwide (Ahani and Nilashi

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2020; Cascella et al. 2020). The Covid-19 shock will prompt the recession in most part of the world and decelerate the annual global growth rate below 2.5%. The growth rate is taken as recessionary threshold for the world economy. It would worse the global economy and cost the trillions of dollars (International Monetary Fund 2020). Three factors can determine the duration and depth of crisis: (a) how far and fast the virus spread; (b) how long before the vaccine is found; and (c) how effective policy is designed to reduce to cost to health, economy, and well-being. One other major factor is panic, uncertainty, and fear which will shape the crisis outcomes (Iqbal et al. 2021a, b; Alemzero et al. 2020a, b). The Covid-19 outbreak has two possible economic consequences: firstly, the shock has a great potential to upset the economies but a sound policy at hand can mitigate the original threat to a renewed economic confidence. Bring an optimistic growth forecast for the next year.

The volatility of global stock markets is mostly interrupted due to widespread of the coronavirus pandemic (COVID-19). COVID-19 global fear index (e.g., reported case index, reported death index and corona fear index), aimed as co-moving with stock market volatility, do not found their intended relationship (Salisu and Akanni 2020). There is a need to understand how stock market volatility holds the nexus with global fear index of COVID-19 pandemic and what are the circumstances under which policy formulation and implementation is effective and efficient (Iqbal et al. 2021a), (Li et al. 2021a) and (Anh Tu et al. 2021). However, motivation of this study is to test the co-movement of COVID-19 Global Fear Index with stock market volatility, and, to present the way forward for stock market stability and efficiency during the crises periods like COVID-19 outbreak (Salisu et al. 2020a).

It is reported that coronavirus has adversely affected more 30 million people around the world and 946,000 lives have engulfed untill now. This vicious virus caused unembellished damages not only to the supply chain systems, health care systems, and labor markets but also to the international stock markets (Singh 2020;) and (Chen et al. 2020). Notably, a non-linear reaction of international stock markets is caused from COVID-19 outbreak and this reaction is emerged in March 2020. In addition, looking at the broader prespective, the wider and intense effects of the COVID-19 have taken more than 200 countries and put them on the financial risk (Sharif et al. 2020). Soom after March 2020, concerned governments, financial institutions, and regulatory authorities started planning on contingent basis and implemented numerous financial policies and adhoc programs to mitigate the fear of perceived financial distress (Li et al. 2021a) and potential financial consequences of lock PSXn (Michail and Melas 2020).

Thus, COVID-19 outbreak is declared as a global pandemic issue, which has affected national as well as international financial markets at large. Since the trigger of COVID-19 pandemic, a sentiment of fear has been emerged, stock markets became highly volatile, and volume of volatility declined rapidly. Meanwhile, bearish trend in stock returns has been observed (Li et al. 2021b). Several studies have shown that such global crises raise uncertainty and volatility in market prices during the period of crises (Yoshino et al. 2020; Broadstock et al. 2020), and there is significant cointegration between global structural crises period and financial markets (Narayan et al. 2020). Unstable global conditions can not let business be in balance (Tunio et al. 2020) nor can leave space or support system for the markets to grow (Gilal et al. 2020). However, there is a need to accurately estimate the movement of sentiment of fear, often termed as global fear of COVID-19 pandemic with stock market volatility in the period of crises (Iqbal et al. 2021c). This concept of market stability during COVID-19 outbreak has upsurge the interest of policy makers and academics to provide an innovative financial solution for international stock markets (Phan and Narayan 2020).

This study directly focuses on the analysis of the volatility index and the COVID-19 outbreak fear index during the development of the COVID-19 pandemic, with particular emphasis on the coronavirus indexes and their impact on the volatility of ASEAN equity markets. However, study objective is to answer following research questions:

> ***Question # 1*:** How global fear index of COVID-19 outbreak co-move with volatility index of ASEAN equity markets?
> ***Question # 2*:** What are the possible innovative financial solutions to mitigate the sentiment of fear and in ASEAN equity markets?

Salisu and Akanni 2020 developed the index of global fear of COVID-19 outbreak and later studied commodity prices and market expectation. However, there is missing link in present literature on the co-movement of international stock market volatility and global fear index of COVID-19 outbreak. Studying this missing link is the first theoretical contribution of recent study. Secondly, the study advanced the literature by verifying the assumptions of market efficiency theory with respect to recent topicality. This is second theoretical contribution to fill the novel gap using modern reality often termed as COVID-19 outbreak. Thirdly, the study addresses the novel call for research to provide an "innovative solution for financial markets on the basis of learned lessons of COVID-19 in terms of stock markets volatality." Practically, the study contributes in COVID-19 outbreak, policies of financial institutions, and international stock markets by suggesting the innovative financial solutions or way forwards. This is the major practical contribution of current research. To achieve all these contribution study operationalized global fear index (GFI) with international stock market volatility to assess the co-movement between related constructs. As Salisu et al. (2020a, b) p. 4 written:

> [….] One of the strengths of the index lies in its coverage, as all the countries, regions and continents in the world are considered in the construction of the index.

The remainder of the paper is set out as follows. Section 2 offers a related review of the literature. The data and methods are presented in Section 3. The empirical results are summarized in Section 4. Section 5 provides a comparison of other global events. In section 6, you'll find robustness tests in the final section 7 to conclude the study.

Litrature review

The outbreak of COVID-19 has disrupted all global supply chains of stock markets. Supply chain disruptions of sustainable management of stock markets occur due to economic recession yielded by COVID-19. Many international countries are striving for economic excellence and financial stability. For this, international stock markets are participating by advancing the structure of economic growth and, financial integration at national level. Several scholars studied co-movement of stock markets as measure of financial integration (Zhang et al. 2020; Ashraf 2020). There are adverse consequences on financial systems, such as, stock markets caused by different crises and this impact of crises negatively co-moves by limiting activates of markets (Ali et al. 2020). Through co-movement while a means to evaluate the economic addition, recent study is testing Global fear index of COVID-19 with volatility of international stock markets. In other words, the study analyzes how these stock market indexes integrated and co-moved with COVID-19 global fear index. Co-movement of stock indexes in terms of stock volatility is significant in published literature. Iqbal et al. (2021c) endorsed that the investigation about general stock market movements is essential meant for effective portfolio diversification and a likely preparatory position to explore the performance of the worldwide financial system amid crises Iqbal et al. (2021a, b).

Therefore, discussing stock markets with the consequences of crises like COVID-19 outbreak has become much important to reveal the potential solutions and it is extremely relevant to discuss the movement of crises fear with financial variables (Okorie and Lin 2020). As it is argued that "The co-movement of world equity markets is often used as a barometer of economic globalization and financial integration." Several studies tested co-movement within the international stock markets (Corbet et al. 2020), (Zaremba et al. 2020) and (Straif-Bourgeois and Robinson 2020) revealing significant effect on international stock returns, volatility, portfolio diversification, and inter-temporal stability. Studies also revealed that financial crises significantly affect international stock market performance. Studying the co-movement of Global fear index of COVID-19 crises with study topicality is still a missing link. More recently, empirical measurement of Global fear index of COVID-19 outbreak is developed that holds the capacity to assess with different financial settings and variables (Iqbal et al. 2021a, b; Anh Tu et al. 2021). However, these studies explain the concept theoretically that co-movement of crises like COVID-19 outbreak explains the relationship with financial variables (Topcu and Gulal 2020) (e.g., stock volatility) of international stock markets. Thus, the study hypothesized that there is significant co-movement between *global Fear Index of COVID-19 outbreak and stock market volatility index.*

The empirical literature on volatility applications and pandemics, though, engaged on silver (Dutta 2018), gold (Klein et al. 2018; Demirer et al. 2019; Abounoori and Zabol 2020), and electricity (Mayer et al. 2015; Borovkova and Schmeck 2017; Rintamäki et al. 2017). According to Allahrakha et al. 2019, cycles of economic instability have a high predictive capacity for commodity future returns volatility (Nenna et al. 2018), (Chuliá et al. 2010), (Abounoori and Zabol 2020; Baker et al. 2020; Cheema et al. 2020; Daniel 2020; Doidge et al. 2020): SARS (Papagiakoumou et al. 2010; Andersen et al. 2020); the bird flu (H5N1) (Pipper et al. 2007; Thapa et al. 2020); the swine flu (H1N1) (Jilani et al. 2020); and (Kapata et al. 2020) infectious as well as the effect of globalization on the spread of infectious diseases (Pastor-Satorras and Vespignani 2001; Saker et al. 2004; Pastor-Satorras et al. 2015).

In comparison to previous crises, financial institutions were better capitalized and had more liquidity; a variety of regulatory steps were implemented to avoid pro-cyclical consequences, such as a relaxation of capital standards and more flexibility in the classification of defaulted loans due to the Covid-19 (Cavallino and De Fiore 2020). As a result, we expect business sectors such as health care, consumer goods/services, and technology to receive increased attention compared to the financial sector during the 2008 globall financial crises (Alemzero et al. 2021). As a result, we argue that a sectorial review is needed better to evaluate the impact of the Covid-19 financial crisis. Our study fills this research gap by investigating the sectorial impact of the Covid-19 financial crisis. It will cost almost $900 billion in lost in productivity by a percentage drop-in growth rate. Forecast for a 1.7% growth rate because of pandemic virus will cost approximately $2 trillion. The pandemic virus disrupts economic scenario by three channels.

Data and methodology

Study data

Daily data for stock volatility of ASEAN markets, reported corona cases, and reported corona death cases were used. The value of volatility was figured into the local currency unit. The data on reported corona cases and death cases to measure global fear index for COVID-19 outbreak was taken from worldometer database. The data comes from datastream, which spans April 27, 2018, and April 28, 2020. We calculate the continuously compounded percentage return for each index using the formula$rt = log\ (pt/pt — 1) — \times 100$, where pt is the day's closing price. Covid-19 data on confirmed cases are retrieved regularly for each country from the Johns Hopkins University Coronavirus Research Centre(Muhareb and Giacaman 2020) and the data about stock markets is taken from relevant websites of each stock market. Even though there are exceptions since the data during January is exceptionally scarce, we begin our study on 1/2/2020 and aggregate the number of reported Covid-19 cases worldwide. The study data was further purified to version only for the days when stock markets were operational and doing trading activities by using 5522 numerical observations (see Fig. 1).

Empirical estimation

To outline our research design, consider a T × 1 vector of demeaned asset returns, where the variance is estimated as a GARCH(1,1) process:

$$r_t|\mathrm{F}_t{-}1{\sim}N\left(0, \mathrm{h}_t^2\right) \tag{1}$$

$$\mathrm{h}_t^2 = \omega + au_{t-i}^2 + br_{t-j}^2 \tag{2}$$

The heterogeneous autoregressive model is used in subsequent conditional variance modeling (H.A.R.) and (Wen et al. 2016). That takes advantage because short-memory models' summation will produce the hyperbolic decay patterns seen in volatility estimates' autocorrelation function (Li et al. 2021a), (Chien et al. 2021) and (Iqbal et al. 2021b). The H.A.R.'s outstanding success in modeling and the ability to predict realized volatility is well-established (Andersen et al. 2007). Estimation is superior to ARFIMA, and H.A.R. models are more conveniently obtained for forecasting. After that, the H.A.R. model is described by (Anser et al. 2020d), (Anser et al. 2020c), (Anser et al. 2020e), (Anser et al. 2020a), and (Anser et al. 2020b) as:

$$h_t = \mathrm{c} + \beta^{(d)}\, h_{t-1} + \beta^{(w)}\, h_t^{(w)} + \beta^{\mathrm{m}} h_t^{(m)} + e_t \tag{3}$$

Where e_t~iid(0, σ^2 with $h_t^{(w)}$ and $h_t^{(m)}$ defined as follows:

$$h_t^{(w)} = \frac{1}{5}\left(h_{t-1} + h_{t-2} + h_{t-3} + h_{t-4} + h_{t-5}\right) \tag{4}$$

$$h_t^m = \frac{1}{22}\left(h_{t-1} + h_{t-2} + \ldots + h_{t-21} + h_{t-22}\right) \tag{5}$$

The smooth transition model family is used to account for non-linear dynamics in the volatility method (Asif et al. 2020), (Sarker et al. 2020), (Iram et al. 2020), and (Tehreem et al. 2020). These allow observed variables to influence the transition between regimes, despite the presence of unobservable variables.

$$yt = x_{ta} + \mathrm{G}(s_t;\gamma,\psi)Z_t\ \beta + (1{-}\mathrm{G}(s_t;\gamma,\psi))Z_t\ \ \delta + \varepsilon_t \tag{6}$$

Where G denotes a continuous transition function that returns values (i.e., threshold weights) between 0 and 1; st is an observable threshold variable with the unknown threshold

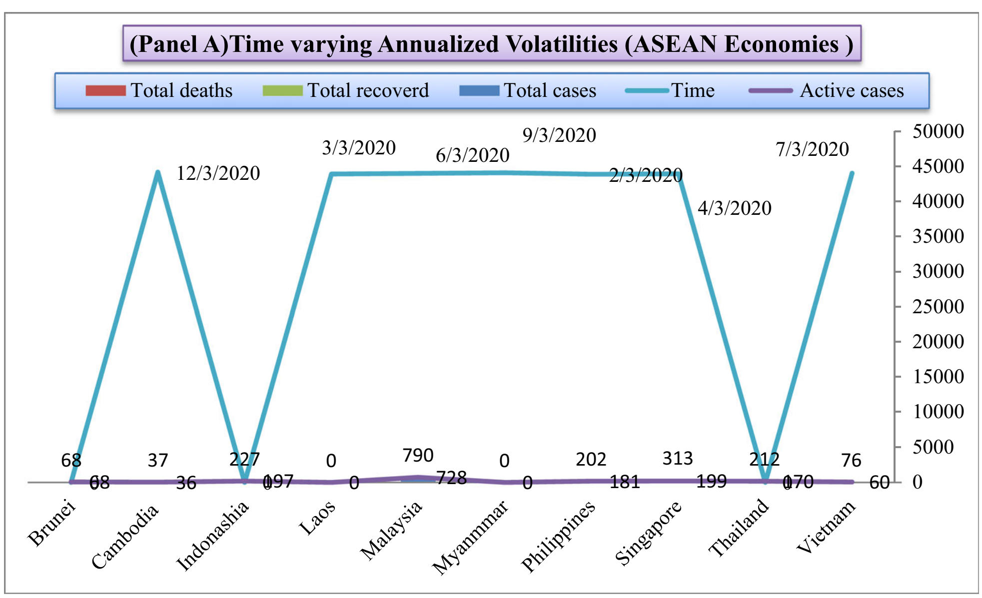

Fig. 1 Time evolution of volatilities and Covid-19 cases

(ψ) and slope (γ) values; Z_t denotes a vector containing regime dependent variables (i.e., slope coefficients that vary across regimes); X_t Denotes a vector containing regime invariant variables, and t denotes the stochastic error term.

$$G(s_t;\gamma,\psi) = 1-\exp\left(-\gamma/\sigma^2_{s_t}\ (s_t-\psi)\ 2\ \right) \tag{7}$$

We use an ST-HAR model in our specification, which allows for a smooth transition between two E STAR-controlled regimes (Agyekum et al. 2021) and (Zhang et al. 2021). We assume H.A.R. parameters related to weekly and monthly volatility allow for more rational dynamics during the turmoil phase (Sun et al. 2020b) and (Sun et al. 2020a) invariant regime. The following equation is calculated using the nonlinear least-squares method. Newey-West stable standard error techniques and square techniques limiting factors. Furthermore, they allow a more practical and analog transition between the regimes. 9 A smooth transition between two regimes is achieved using a two-regime model.

$$h_t = \beta_0 + \beta_{10} h_t-1 + \alpha_1 h_t^{(w)} + \alpha_2 h_t^{(m)}\ + (\ \delta_0 + \delta_1\ h_t-1)\times \left(1-\exp\left(-\frac{\gamma}{\sigma^2_{s_t}}\ (s_t-\psi)2\right)\right) + et \tag{8}$$

COVID-19 fear index measurement

The stock market volatility is calculated by using square root of the variance is directly obtained from all the indexes of stock markets. While the global fear index of COVID-19 outbreak is measured using daily reported cases index, daily death cases reported index and daily fear index (Salisu and Akanni 2020). Reported cases index (RCI) measures that what is the probability of the corona positive cases from today to next 14 days. According to WHO (2020), most of the corona positive cases incubate in incubation centers for 14 days approximately. Endorsing WHO verdict, this time period of 14 days shows maximum number of days for corona virus positive cases in incubation centers. Thus, is measured as follows, where, RCI shows reported cases index at t time period $\sum_i^N C\ i, t$ is the net numbers of corona (e.g., COVID-19 virus) positive reported cases at t time for international stock markets in the countries $i = 1, 2, 3, \ldots. N$ and the N shows net figure of cross sections taken in $C\ i,\ t-14$, and, 100 show the scale multiplication from 0 to 100 representing the lower to higher number of fear through this index.

$$RCI\ t = \left(\frac{\sum_i^N C\ i, t}{\sum_i^N C\ i, t + C\ i, t-14}\right)*100 \tag{9}$$

Reported death index (RDI) measures the probability of conversion of corona positive cases into death in 14 days and reported as death case due to COVID-19 virus. The time period of 14 days is cited by following WHO directions on COVID-19 cases conversion from incubation to report as death cases (Alemzero et al. 2020b), (Sun et al. 2020c) and (Alemzero et al. 2020a). RDI is measured as, where, RDI means reported death cases, $\sum_i^N D\ i, t$ means total reported death cases in t time period for in i international stock markets in different countries, like, $i = 1, 2, 3, \ldots. N$ and the N means figure of cross sections taken from $D\ i,\ t-14$, with multiplication of 100 showing the intensity of fear among stock market stakeholders from 0 to 100.

$$RDI\ t = \left(\frac{\sum_i^N D\ i, t}{\sum_i^N D\ i, t + D\ i, t-14}\right)*100 \tag{10}$$

The measurement of global fear index of COVID-19 outbreak (GFI) is calculated by using and assigning the equal weights to RCI and RDI. Thus the composite index of GFI is calculated as follows,

$$GFI\ t = [0.5(RCI\ t + RDI\ t)] \tag{11}$$

Study model

To estimate the research models of recent study marginal distributions showing AR (1) – GARCH (1, 1) were used and the results outcome for interconnected distribution estimation was used. The AR (1) – GARCH (1, 1) model is already discussed and operationalized in Glosten, Jagannathan, and Runkle, (1993). The AR (1) – GARCH (1, 1) model is explained as follows, where the,

$$\mathrm{Vi,t} = \beta 0 + \beta 1\ \mathrm{Vi,t} + \beta 2\ \mathrm{Vi,t-1} + \beta 3\ \mathrm{Green\ Inv}\ \varepsilon\mathrm{i,t} \tag{12}$$

$$\mathrm{MCi,t} = \beta 0 + \beta 1\ \mathrm{MCi,t} + \beta 1\ \mathrm{MCi,t-1} + \varepsilon\mathrm{i,t} \tag{13}$$

Each model holds eights constructs showing the parameters of estimation, two parameters (β0, β1, β2) in Eq. (1), four parameters (ω, α, β, γ) are in further equations with two parameters of distributions (υ, λ) representing AR (1) – GARCH (1, 1) model. Moreover, ω shows GARCH coefficient, β indicates past volatility of the time series and γ measures past volatility if error term is negative and public attention to environment in Eq. (4). Using Log Likelihood (LL), Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), model vigorous of the recent study is analyzed.

Empirical analysis

The estimated results through the ST-HAR model's

The shrill rise of fear of COVID-19 outbreak drastically affected international stock markets. Stereotypically, persistence of uncertainties about future raised the fear of COVID-19 pandemic among potential stakeholders. By the fact, such fear of COVID-19 pandemic led imbalance in investment decisions, steeped investment motives of individual and institutional investors. Previous studies shown that structural imposed crises (e.g., COVID-19 outbreak) reduced the real interest rates and have significant positive impact of stock market volatility (Singh 2020). Notably, these findings are not generalized for the larger set of population and the study holds this limitation. Thus, considering this limitation recent study initiated to inquire the nature of co-movement between stock market volatility and global fear index of COVID-19. Seven international well-reputed stock markets were selected to draw an inference among the construct and to set a clear econometric verdict that either ASEAN equity stock market's volatility significantly co-moved (see Table 1). Table 2 represents the sector-by-sector estimation performance, including median values across the ASEAN seven (07) countries and regular goodness-of-fit statistics using ST-HAR models. The linearity test, in particular, demonstrates the superiority of a non-linear H.A.R. specification over its linear counterpart.

The COVID-19 pandemic has the large potential to reach a greater proportion of global population. As this pandemic has already infected almost 3,110,702 with 215,231 casualties in more than 190 countries up to 28-04-2020 (Webmeter 2020). Because of its huge spread, it is forecasted that 40 to 70% of world's population could be infected. This health crisis would negatively affect both supply (production of goods and services) and demand side (consumption and investment). Already the supply chain is affected because of constrained production. This pandemic has adversely affected business regardless of their size. Businesses are facing serious challenges especially in tourism industries, with a real threat of decline in revenue and job security. Small and Medium Enterprises (SME) are at risk as they are unable to sustain their business operation . (ILO 2020). Borders are sealed, travelling is banned, and lockdown and curfew, and many other quarantine measures restrict the movement of people from place to another place. Leading to contagion effect on incomes of casually-employed workers.

During the Covid-19 period the quantity and quality of employment is badly deteriorated due to corona virus outbreak. Putting it in a nut shell, the virus outbreak has a significant negative impact on the global economy and it is unpredictable how long and how much it will affect the world market. A coordinated policy response can moderate the indirect economic fallout all over the world. Strong multilateral leadership can help to perimeter the direct health effect of Covid-19 on workers causing hygienic and nutrition deficiency problems. Among all other priorities, it needs to be top priority to protect the workers and their families from the contagious risk of infection. Labor productivity may fall along with income loss due to infectious disease and reduced economic activities. All the economic disincentives associated with virus outbreak can be mitigated through various rapid income protection programs for especially disadvantaged labor class and low-income groups (see Table 3).

This pandemic has drastic impacts on workers and enterprises. There is rapid increase in mandatory and recommended closure (Global Behaviors and Perceptions in the COVID-19 Pandemic). ILO estimates reveals 81% of the global workforce is at mandatory or recommended workplace closure (ILO 2020). Developing countries are also badly affected by this pandemic as resources are severely scarce (Loayza, N. V., & Pennings, S. (2020). Macroeconomic policy in the time of covid-19: A primer for developing countries). About 3.3 billion global workforces is facing mandatory or recommended closures which is one of the massive economic disruption. Reduction in economic activities worldwide had dramatically decline employment. The number of jobs is declined and aggregate hours of work are reduced. So partial or total lockdowns are making it impossible for workforce to work. Service sector like accommodation and food service and retail trade are severely affected sector of the economy. Supply chain is experiencing a huge disruption due to low mobility of transport.

Threshold sectors variables

According to comparable metrics, oil & gas values − 5.527 negative significance level and financials − 2.990 were negatively affected (see Table 4, Figs. 2 and 3) first and last in the bottom row (estimated slope thresholds (ψ)) (Table 5).

Table 6 shows crucial position and dispersion statistics for the transition function's slope and threshold. These characteristics characterize Covid-19's strength and timeliness across industries and countries. As demonstrated by the low mean threshold values, the Oil & Gas 3.581 and Telecommunications industries 5.063 were the first to impact transition timeliness. Compared to the Telecommunications case, the lower Q.C.V. in the Oil & Gas case indicates the Covid-19 crises' homogeneous effect on the former market. People found diversion and entertainment elsewhere online due to the Covid-19 lockdown steps, which has accelerated the adoption of remote working platforms and accelerated the adoption of remote working platforms. Singapore and Vietnam have the most severe crisis transitions. Both Myanmar and the Philippines were among the last to implement containment measures, often met with civil unrest. As opposed to the 2008 G.F.C. policy response in Singapore, this

Table 1 Descriptive statistics for the ASEAN-7 member countries

		Panel A: Covid (01/04/2020–26/4/2020)							Panel B: pre-Covid (26/4/2018-30/1/2020)						
		Indonesia	Myanmar	Malaysia	Philippines	Singapore	Thailand	Vietnam	Indonesia	Myanmar	Malaysia	Philippines	Singapore	Thailand	Vietnam
Aggregate	Return	0.014	− 0.049	− 0.014	− 0.041	− 0.037	− 0.068	− 0.028	0.044	− 0.002	0.024	0.014	0.007	− 0.007	0.009
	Volatility	17.845	15.095	13.511	17.401	18.401	21.289	17.835	13.398	12.144	8.768	14.093	15.297	17.689	15.897
Oil & Gas	Return	− 0.136	− 0.117	− 0.094	− 0.104	− 0.245	− 0.095	− 0.128	− 0.061	− 0.048	− 0.005	− 0.043	− 0.143	− 0.025	− 0.085
	Volatility	27.966	27.202	26.984	25.736	42.653	23.318	30.604	21.578	21.487	20.3	20.371	39.145	18.36	29.988
Materials	Return	− 0.036	− 0.053	0.049	0.013	− 0.082	− 0.186	− 0.079	− 0.011	− 0.015	0.026	0.043	− 0.039	− 0.111	− 0.039
	Volatility	22.178	28.015	21.686	19.56	23.493	34.927	21.255	18.138	24.547	18.703	17.045	20.888	32.93	19.703
Industrials	Return	− 0.010	− 0.030	0.042	− 0.044	− 0.058	− 0.089	− 0.049	0.036	0.021	0.08	0.043	− 0.001	− 0.026	− 0.007
	Volatility	20.307	19.229	21.265	20.827	21.686	27.558	20.002	15.931	16.058	18.075	16.184	18.497	23.641	18.347
Consumer Goods	Return	0.01	− 0.013	− 0.088	− 0.008	− 0.086	− 0.038	− 0.043	0.039	0.016	− 0.029	0.021	− 0.031	0.003	− 0.017
	Volatility	15.27	15.829	25.948	18.404	22.197	24.95	16.684	11.846	14.123	22.698	16.097	18.41	22.161	15.146
Health Care	Return	0.043	0.055	− 0.100	0.042	− 0.056	0.078	0.025	0.044	0.06	− 0.027	0.052	− 0.034	0.078	0.042
	Volatility	17.777	18.281	43.023	16.872	22.696	23.32	19.545	14.376	16.774	40.812	15.3	21.27	20.934	18.166
Consumer Services	Return	0.031	− 0.041	0.014	− 0.038	− 0.063	− 0.107	− 0.026	0.048	0.012	0.046	0.014	− 0.037	− 0.068	0.001
	Volatility	18.072	15.705	15.783	19.137	21.548	30.567	15.665	14.646	12.939	12.149	16.47	19.433	27.923	14.051
Telecommunications	Return	0	− 0.128	− 0.018	− 0.041	− 0.031	− 0.141	0.013	0.025	− 0.076	0.02	− 0.023	− 0.004	− 0.106	0.022
	Volatility	19.319	24.155	17.379	18.088	17.596	31.122	22.507	17.091	21.944	13.526	16.227	15.209	28.769	20.863
Utilities	Return	0.027	0.004	0.027	− 0.062	0.013	0.023	− 0.035	0.067	0.035	0.063	0.027	0.056	0.083	− 0.041
	Volatility	17.998	20.411	15.471	19.361	18.351	21.35	19.577	13.704	18.188	10.941	16.252	16.127	18.319	18.631
Financials	Return	− 0.024	− 0.099	− 0.061	− 0.135	− 0.031	− 0.128	− 0.084	0.034	− 0.028	0.01	− 0.033	0.021	− 0.049	− 0.034
	Volatility	19.213	19.802	17.018	21.64	16.935	27.458	16.811	14.097	16.423	11.686	17.311	13.575	24.065	15.001
Technology	Return	0.061	− 0.039	0.085	0.002	0.016	0.052	− 0.006	0.082	0.027	0.071	0.039	0.041	0.082	0.026
	Volatility	24.147	27.551	22.595	26.702	25.472	40.441	18.844	19.896	25.365	19.124	23.486	23.856	37.27	16.945

For the stock indexes in the respective countries and industries, the table displays average percentage daily returns and annualized volatility

Table 2 GARCHX assessment SMVI movement

	Average	Variance
C	0.029 (0.19)	–
SMVI-COVID-19	− 0.548* (0.001)	–
GFI Index	− 1.432* (0.001)	–
Constant	–	0.0021* (0.000)
Heterogeneity (-1)	–	0.2135* (0.000)
η 2 (−1)	–	0.114* (0.0001
Assessment		
LM test for heteroscedasticity	(0.59)	(0.63)

SMVI stands for Stock Market Volatility Index while FGI stands for global fear volatility index

may have been a catalyst for a quicker and more robust response. The unparalleled size, reach, and response pace have helped the financial markets' quick recovery in part (see Table 7, Fig. 2). Vietnam adopted a similar policy, directing funds directly to business sectors (Chick et al. 2020).

Robustness checks

We replace the GARCH conditional volatility used in the study's central part with realized measures as a first robustness check. The realized variance (R.V.) and the robust to microstructure noise realized kernel variation are used in particular (R.K.V.). The sum of squared intraday returns is used to measure the realized variance (R.V.) (Andersen et al. 2001, 2003; Barndorff-Nielsen and Shephard 2002) as:

$$RV_T = \sum_{J=1}^{M} r^2 t, j \tag{9}$$

Each of the M evenly spaced 5-min subintervals in each day is denoted by the letter j. The realized kernel variance is determined as follows:

$$RKV_T = \sum_{h=-H}^{H} k\left(\frac{h}{H+1}\right)\gamma_h$$

Where

$\gamma_h = \sum_{j=h+1}^{H} r_{j,t} r_{j-h}$,t

Using the R.V. and the R.K.V., Table 7 shows estimated slope (γ) and threshold (ψ) coefficients for the G7 countries (see Table 9 and Fig. 3).

The table reports estimated slope (γ) and threshold (ψ) coefficients and t-statistics in parenthesis from Eq. (8)

A glance at Table 6 and Table 8 reveals that the slope and threshold figures derived from the realized measurements are very similar to those derived from the paper's key findings. The Covid-19 has had the most significant impact on the Singapore markets in particular. As a result, the use of alternative volatility proxies has no impact on the paper's key conclusions (Mohsin et al. 2020), (Mohsin et al. 2018) and (Mohsin et al. 2021) (Table 9).

Discussion

Covid-19 is a global shock which needs international coordination, integrated economic policy, sound health care, and science infrastructure. Different countries opted different strategies in order to cope this epidemic crisis. The policy interest rate has been reduced twice by combined 125 points this year by the Central Bank of UAE (CBUAE). CBUAE announced one of huge package of AED 256 billion dollar (20% of GDP) to deal with coronavirus. Quarantine, lockdown, shutdown, and self-isolation strategies imply reducing economic activity. These strategies have both economic and human cost likely to higher in developing countries. developing countries are already surviving on lower health care capacity, less fiscal space, shallower financial markets, mostly economic activities based on large informal sector and poor governance. In order to avoid unintended consequences, a vigilant response to epidemiological evidence of virus spread is inevitable, policy makers will need to weigh carefully the effectiveness and socioeconomic consequences to containment and mitigation policies. Short-term economic policy necessitates the provision of emergency relief to vulnerable population and affected businesses. Short-term economic policy during this epidemic does not stimulate the economy—which is impossible, but mass layoffs and bankruptcies can be avoided rather. Ease of lockdown restriction and retaining restriction on movement on massive gathering (Yang et al. 2021), (He et al. 2020b) and (Mohsin et al. 2020).

Almost countries of the world are adversely affected by COVID-19 in the production and consumption. As the wave of the COVID-19 varies from country to country and the intensity of the pandemic is different in different countries, but it has not been ceased to exist completely. However, COVID-19 has exposed gaps in the forms of challenges, experiences, and learnings regarding the sustainability of production and consumption (Tiep et al. 2021). However, there is possibility to boost the production and consumption of the sustainable, healthy, locally sourced articles. Simultaneously, the priorities of the consumers are inclined towards such products (EY, 2020; Accenture, 2020). Recent studies have endorsed and highlighted the sustainable consumption behavior, perform of circular economy and emerging technologies for the sustainable production (Azzurra et al., 2019). By the breakthrough of the COVID-19 offered not only threats in the different forms, but also lessons by experiencing it. The ongoing studies are insufficient to furnish the concerned knowledge,

Table 3 Estimation results

	Aggregate	Oil & Gas	Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecommunications	Utilities	Financials	Technology
β0	6.066**	− 5.527	16.376**	− 2.407	15.737**	50.920***	20.833**	− 2.485	10.583***	− 2.990	23.345***
	− 1.651	− 2.11	− 1.043	(− 1.904)	− 1.149	− 2.037	− 3.218	− 2.172	− 0.263	(− 4.344)	− 1.005
β1	0.426*	0.888**	0.109	0.650*	0.088	− 1.199*	− 0.032	− 0.029	0.028	0.517*	− 0.322
	− 0.304	− 1.369	− 2.213	− 0.304	− 1.619	(− 0.228)	(− 1.576)	(− 0.131)	− 0.109	− 0.106	(− 1.271)
δ0	− 6.388**	38.440**	− 17.203**	10.915**	− 16.039**	− 50.959***	− 22.062**	1.988	− 17.780***	11.621	− 21.505***
	(− 1.622)	− 2.174	(− 1.874)	− 2.212	(− 1.748)	(− 1.988)	(− 3.009)	− 2.171	(− 0.215)	− 4.369	(− 1.039)
δ1	0.933**	− 0.551	0.998***	0.437	1.118***	1.870***	1.138	0.927*	1.413***	0.677	1.299***
	− 1.835	(− 1.633)	− 0.946	− 2.684	− 1.161	− 2.432	− 3.418	− 1.016	− 1.438	− 2.698	− 0.526
α1	0.341*	0.488**	0.309	0.403**	− 0.177	− 0.027	0.075	0.577	− 0.060**	0.015	0.248
	− 0.825	− 1.334	− 1.741	− 0.825	(− 2.091)	(− 0.736)	− 0.171	− 0.621	(−1.100)	− 1.722	− 0.058
α2	− 0.462**	− 0.511**	− 0.584**	− 0.337*	− 0.483*	− 0.070	0.011	− 0.434**	0.005	− 0.219*	− 0.811**
	(− 1.455)	(− 1.766)	(− 1.667)	(− 1.962)	(− 1.384)	(− 1.395)	− 1.186	(− 0.171)	− 1.941	(− 0.375)	(− 1.259)
Γ	3.914***	3.277**	2.950***	3.368**	3.487***	35.775***	4.354***	3.057**	5.851***	4.242**	1.884***
	− 2.998	− 2.998	− 1.754	− 3.828	− 2.226	− 4.123	− 4.257	− 3.95	− 1.934	− 4.831	− 2.277
Ψ	5.555***	4.734***	5.977***	5.373***	5.968***	5.670***	5.382***	5.910***	5.684***	5.539***	6.159***
	− 100.891	− 103.877	− 120.973	− 47.227	− 93.006	− 81.434	− 307.775	− 116.207	− 95.155	− 89.256	− 93.965
Adj-R2	0.833	0.785	0.901	0.844	0.849	0.949	0.9	0.81	0.885	0.843	0.88
BIC	6.167	8.542	5.305	6.561	5.825	4.472	5.184	5.422	3.481	6.545	5.94
Q(8)	11.759	10.197	11.119	12.142	12.87	8.274	15.346*	14.212*	17.607**	10.115	12.876
Linearity test	2.410*	2.583**	2.739**	3.072**	3.033**	2.248*	3.083**	3.067**	2.486**	2.603**	4.276***
EJ test	3.027*	3.688**	2.462*	3.176**	3.666**	3.774**	3.390**	3.738**	3.247*	3.467**	3.241**

In parenthesis, the table records median approximate coefficients and t-statistics from Eq. (8). The Schwarz knowledge criteria are abbreviated as B.I.C. The Ljung-Box test for serial correlation up to lag eight is known as Q(8). The F-statistic known as the linearity test compares the null hypothesis of linearity to a non-linear model's alternative. The Escribano-Jorda test determines if an exponential transformation function in a non-linear specification is sufficient. The symbols ***, **, and * represent statistical significance at the 1%, 5%, and 10% rate, respectively

Table 4 Impact of Covid-19 on stock market volatility

	(1) Levine 2002	(2)	(2)	(3) Cuadro-Sáez & García-Herrero 2007	(4)	(5)
CF	0.123			0.145		
CFI	(0.142)			(0.184)		
∅		− 0.131***			− 1.321***	
∩		(0.211)			(0.783)	
β			− 0.215**			− 1.11**
∂			(0.117)			(0.321)
Dp	− 0.211**	− 0.135***	− 0.066	− 0.265**	− 0.236***	− 0.011
CF	(0.021)	(0.184)	(0.052)	(0.052)	(0.032)	(0.031)
CFI	− 0.254***	− 0.233	− 0.021***	− 0.144***	− 0.144***	− 0.022***
∅	(0.332)	(0.166)	(0.184)	(0.111)	(0.133)	(0.243)
∩	− 0.165***	− 0.189***	− 0.485*	− 0.231***	− 0.222***	− 0.133*
β	(0.421)	(0.343)	(0.278)	(0.166)	(0.233)	(0.255)
∂	− 1.569***	− 1.568***	− 0.321*	− 2.267***	− 0.422*	− 0.11*
	(0.189)	(0.353)	(0.376)	(0.3122)	(0.188)	(0.276)
Constant	2.154	2.167	3.376**	3.522	3.133*	3.212**
	(1.222)	(3.538)	(1.367)	(2.052)	(8.4654)	(1.421)
AR(2) p-value	0.521	0.766	0.5432	0.820	0.344	0.122
Hansen p-value	0.112	0.454	0.8674	0.423	0.322	0.775

but this study pours into the literature for the actors and institutions involved in the policy making and implementation. Hence, this study demonstrates the lessons learned from the COVID-19 concerned with the financial systems (Bradley et al., 2020; Khan & Zhang 2020).

Several events and activities are disrupted globally due to the pandemic COVID-19 and has dragged all the transformations occurring in the production of the goods and their supply. This has designed new actions and course to go through the process of stock market business. Resultantly, transition in the sustainability has become mandatory (Kumar, et al., 2020). COVID-19 signals for the change in new behavior for the suitable actions for the business managers, and policy makers who are more concerned with the sustainable production and supply as well as the transition in the prospects of the sustainability. Recent studies have indicated novel changes in the behavior for sustainable production like cleaning and sanitizing the workplace, implementing social distance, and minimize travel and reduce the transportation. However, the novel changes about the supply chains, social innovations, and technology have been observed in the consequence of the coronavirus outbreak (Sarker et al. 2020). The production and supply

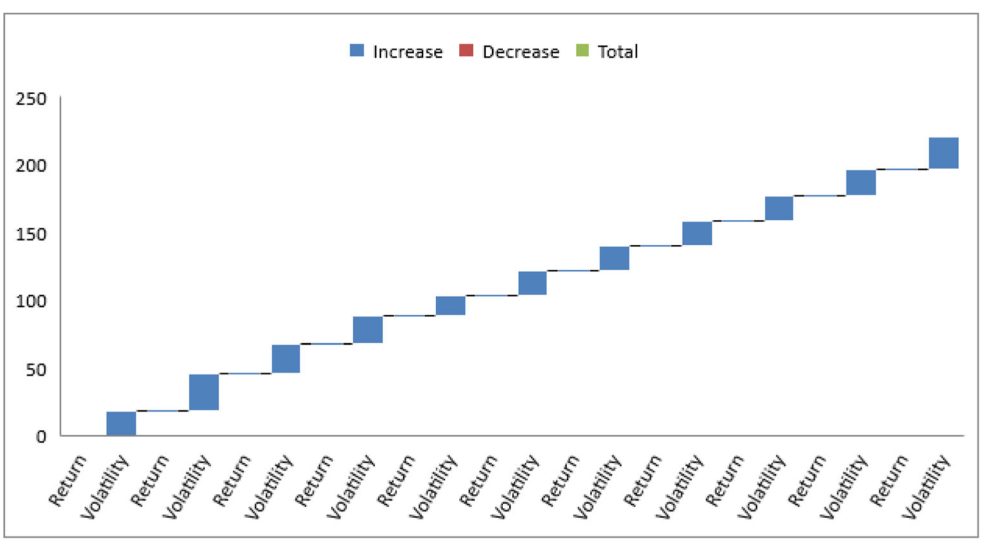

Fig. 2 Threshold weights for selected countries

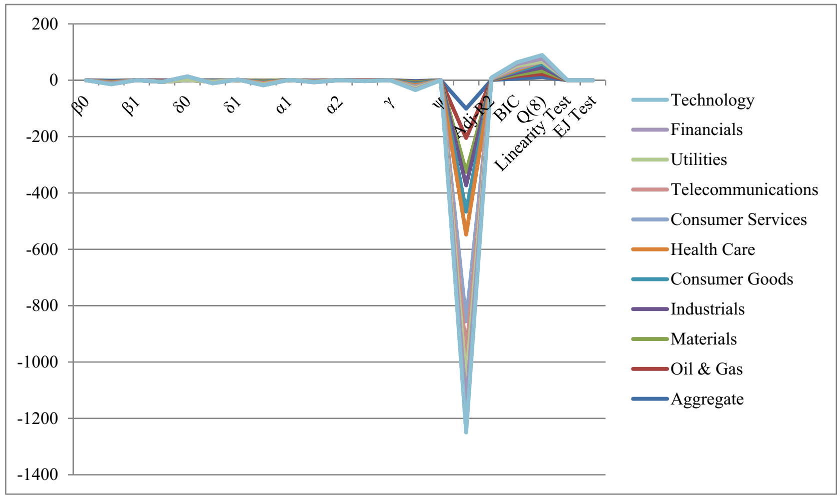

Fig. 3 Empirical estimation indicate sectors

system is interrupted from the outbreak of the COVID-19 and strategies and policies are set to design new patterns and deal with the demand of consumer for production. It is vivid that raw products and raw materials were supplied from the China and Asian countries in the entire world, but the pandemic situation gave a break to the transportation and supply was shortened (Ikram et al. 2019a), (Sun H et al. 2019) and (Ikram et al. 2019b). Thus, priorities were given to the demand for the basic and mandatory products and services (Sun et al. 2020d) *and* (Baloch et al. 2020). Therefore, policy strategies are set to improve the resilience and sustainability of the system (Ivanov, 2020).

The economic and market fluctuations have contributed to the transition in the sustainability and enabled to remain pro-active to respond to the challenges. Besides the consumption of the mass products, integration of social, economic,

Table 5 The results of posterior estimates (inference) of COVID-19's causal effect on stock market performance

	Actual (-1)	Prediction (-2)	Absolute Effect (-3)	Relative Effect (-4)
Panel A (average)				
Indonesia	2053	2196 (46) [2104, 2284]	− 143 (46) [− 231, − 51]	− 6.5%** (2.1 %)[− 11 %, − 2.3 %] p = 0.003
Singapore	23745	27284 (1396) [24444, 30024]	− 3539 (1396) [− 6280, − 699]	− 13%** (5.1 %)[− 23 %, − 2.6 %] p = 0.009
Thailand	1982	2345 (138) [2065, 2613]	− 363 (138) [− 631, − 83]	− 15%** (5.9 %)[− 27 %, − 3.5 %] p = 0.008
Vietnam	1806	2035 (64) [1900, 2159]	− 229 (64) [− 353, − 94]	− 11%** (3.2 %)[− 17 %, − 4.6 %] p = 0.0007
		[7509, 7685]	[− 296, − 120]	%] p = 0.0001
Panel B (average)				
Myanmar	45118	47923 (2215) [43379, 52155]	− 2804 (2215) [− 7036, 1739]	− 5.9% (4.6 %)[− 15 %, 3.6 %]
Malaysia	1639	1879 (126) [1622, 2112]	− 240 (126) [− 473, 17]	− 13% (6.7 %)[− 25 %, 0.9 %]
Philippines	967	1088 (79) [921, 1235]	− 121 (79) [− 268, 46]	− 11% (7.3 %)[− 25 %, 4.3 %]

The brackets' values represent the 95 percent confidence interval, while parentheses' values represent standard deviations. ** denotes a 5% degree of importance, and p denotes posterior tail-area likelihood

Table 6 Slope and threshold by sectors and countries

Slope coefficient (γ)			Threshold coefficient (ψ)			
	Mean	Median	Q.C.V.	Mean	Median	Q.C.V.
Panel A: Business Sectors						
Aggregate	4.794 [7]	3.910 [5]	2.871 [7]	5.413 [3]	5.550 [5]	1.157 [7]
Oil & Gas	3.581 [10]	3.280 [8]	1.598 [10]	4.737 [1]	4.730 [1]	0.021 [1]
Materials	3.033 [11]	2.950 [10]	1.993 [8]	5.757 [9]	5.980 [10]	1.199 [9]
Industrials	9.303 [4]	3.370 [7]	5.078 [6]	5.477 [4]	5.370 [2]	1.311 [11]
Consumer Goods	4.626 [8]	3.490 [6]	1.572 [11]	6.023 [10]	5.970 [9]	0.258 [2]
Health Care	147.7 [1]	35.78 [1]	9.382 [1]	5.644 [6]	5.670 [6]	0.469 [4]
Consumer Services	126.9 [3]	4.350 [3]	9.236 [2]	5.711 [8]	5.380 [3]	1.132 [6]
Telecommunications	5.063 [6]	3.060 [9]	6.184 [4]	5.710 [7]	5.910 [8]	1.276 [10
Utilities	141.4 [2]	5.850 [2]	6.699 [3]	5.580 [5]	5.680 [7]	0.444 [3]
Financials	5.927 [5]	4.240 [4]	1.667 [9]	5.399 [2]	5.540 [4]	1.103 [5]
Technology	4.361 [9]	1.880 [11]	5.574 [5]	6.221 [11]	6.160 [11]	1.187 [8]
Panel B: Countries						
Indonesia	13.73 [4]	4.080 [2]	3.402 [6]	5.446 [2]	5.370 [1]	1.252 [6]
Singapore	8.600 [6]	3.800 [4]	5.758 [3]	5.464 [4]	5.650 [4]	1.103 [3]
Vietnam	5.644 [7]	3.490 [6]	5.077 [4]	5.666 [6]	5.680 [5]	1.300 [7]
Malaysia	88.08 [2]	2.870 [7]	3.507 [5]	5.456 [3]	5.860 [6]	1.167 [4]
Thailand	30.39 [3]	3.610 [5]	3.053 [7]	6.166 [7]	6.170 [7]	0.381 [1]
Philippine	132.1 [1]	3.910 [3]	6.324 [2]	5.653 [5]	5.530 [2]	1.224 [5]
Myanmar	12.10 [5]	4.210 [1]	7.090 [1]	5.395 [1]	5.540 [3]	0.743 [2]

For each sector and region, the table shows the mean, median, and quartile coefficients of dispersion of the slope and threshold estimates from Eq. (11). The number in square brackets represents the transition's relative rank, ranging from 1 to 11, reflecting the speed (slope) and timeliness (threshold) of the transition. In the Q.C.V. scales, a rank of 1 (10) indicates homogeneous (heterogeneous) strength and timeliness

environmental, and institutional opportunities offr opportunities (Spangenberg, 2010). The strong reaction of the stock market to the COVID-19 has endorsed in the reflection of fiscal and monetary policy actions at the time of a pandemic. Government restrictions and volunteer social distancing created room for the investigation, which is filled with this study (Baker, et a., 2020).

Stock market is a great tool for the society therefore, several people belong their sympathy with the stock market. In the financial market, different institutions and individuals adjust with the incertainity and changing conditions. Through different drivers and dynamics, stock produces the concret information about the economy. Outbreak of the COVID-19 enhanced uncertainity to extreme level than any other traditional risks. Such events affected the investors psychology and human behavior towards maket (Wagner, 2020). However, in the market fluctuation and unstability, the crude oil industry where crude oil prices have fallen the most has the highest volatility. For example, the Gulf Harbor Energy Company showed the largest daily price fluctuations. The entertainment and hotel industries are also very unstable, and undergo frequent fluctuations. It is worth noting that, under normal circumstances, the daily fluctuation range is one order of magnitude lower. Our results are supported by the work done by (Harjoto et al. 2020), (Anh and Gan 2020) and (Baek et al. 2020).

By the way, this study uses a simple GARCHX conditional volatility model to test the impact of Covid-19 on the average return and conditional volatility of Chinese stock markets for the first time. The analysis uses two alternative proxies for the Covid-19 factor: (i) the total number of confirmed cases, and (ii) the total number of deaths per day. The survey results

Table 7 Unit root test

Constructs	RCI	RDI	GFI	SMVI
First-order differences	− 1.22(3)	− 1.29(3)	− 1.28(3)	− 1.24(3)
	− 6.66(2)*	− 6.70(1) *	− 6.55(2) *	− 6.59(2) *

Table 8 AR (1) – GJR (1, 1) model estimates

	Brunei	Indonesia	Malaysia	Singapore	Thailand	Vietnam
CF	− 0.0115*	− 0.0221*	− 0.0144*	− 0.021*	− 0.0122*	− 0.0323*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
CFI	0.0011*	0.01231*	0.0034*	0.0422*	0.0031*	0.0022*
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
∅	0.0002*	0.0011*	0.0021*	0.0023*	0.0028*	0.0001*
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
∩	0.0252*	0.0231*	0.0188*	0.0546*	0.0321*	0.0342*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
β	0.4322*	0.112*	0.1889*	0.22*	0.432*	0.532*
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
∂	0.1124*	0.116*	0.234*	0.385*	0.2231*	0.542*
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
Dp	1.321*	1.98*	2.11*	2.32*	2.88*	2.652*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Λ	− 0.2131*	− 0.0121*	0.1887*	− 0.4456*	0.122*	0.0324*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LL	***2116.21***	***583.11***	***972.00***	***556.11***	***235.34***	***116.56***
AIC	***− 4211.1***	***− 331.66***	***− 22.34***	***− 221.43***	***− 234.24***	***− 99.11***
BIC	***− 2991.21***	***− 667.24***	***− 211.32***	***− 335.121***	***− 212.22***	***− 985.21***

C_F shows constant factor, CF1 shows COVID-19 fear index, Dp shows dependent variable, β characterized the coefficient of the variance in volatility index, Λ shows the level of autonomy parameter, ∂ is the AR (1) estimation parameter, ∩ and ∅ are the GJR (1, 1) estimation parameters. Significance level (*p*-value < 0.01, 0.05 and 0.10)

show that, of the two Covid-19 alternative measures, Covid-19 has a significant negative impact on stock returns and related volatility. Simultanous results show that Covid-19 has a positive and statistically significant impact on the volatility of stock returns. When the total number of pandemic deaths is used as a pandemic countermeasure, the negative impact of Covid-19 on stock returns is even very clear and confirm. In addition, models that include Covid-19 factors emphasize better out-of-sample prediction performance.

Table 9 Estimated slop and threshold (ψ) coefficients for the ASEAN-7 countries

Slope coefficient (γ)				Threshold coefficient (ψ)		
	GARCH	RV	RKV	GARCH	RV	R.K.V.
Indonesia	4.080**	3.316**	4.746***	4.754***	4.593***	4.642***
	− 1.833	− 2.302	− 3.353	− 84.706	− 42.427	− 78.136
Vietnam	2.129***	2.518***	4.287***	5.932***	6.278***	4.711***
	− 2.998	− 3.103	− 4.013	− 66.601	− 114.599	− 80.587
Thailand	3.999	2.316***	3.882***	4.739***	5.939***	4.720***
	− 1.94	− 4.942	− 2.946	− 117.727	− 101.668	− 52.67
Myanmar	2.261***	2.787***	2.176	5.977***	6.243***	5.139***
	− 4.979	− 6.432	− 2.128	− 103.877	− 154.393	− 46.646
Malaysia	2.807***	2.921***	1.922***	6.240***	6.332***	5.809***
	− 4.842	− 3.979	− 3.848	− 102.444	− 104.598	− 102.922
Thailand	3.914*	6.100*	3.967***	4.695***	4.681***	4.636***
	− 1.51	− 1.619	− 3.178	− 109.45	− 103.267	− 46.218
Philippines	14.374***	20.649***	7.248**	5.555***	5.321***	4.685***
	− 3.194	− 2.824	− 1.995	− 193.381	− 120.638	− 103.777
ρ	–	0.979	0.845	–	0.778	0.708

Empirical findings show that although China's Covid-19 experience is not the worst in the international context, the impact of the Covid-19 pandemic has made the Chinese market "crazy". However, the reflection of death cases provides market participants with a wealth of "opportunities" so that they can learn about investor psychology and human behavior. Borrowing Keynes's metaphor for this kind of behavior "beauty contest," we can clearly realize that the financial market is driven by humans and therefore has a high degree of behavior, ignoring fundamental trends. The Covid-19 incident represents a terrible novel risk. Therefore, it aroused the enthusiasm of investors. For all stakeholders related to the stock market, namely individual investors, fund and portfolio managers, companies, policy makers and regulators, it is important to understand the nature of the challenges they face in the current stressful era. This stock price reaction suggests that a wide range of actions are needed, including fiscal policy or central bank intervention, to avoid further negative outcomes and the spread of Covid-19 shocks. Our findings support the studies conducted by (Albulescu 2020), (Goutte et al. 2020) and (Salisu et al. 2020b).

The changes behind this event may bring potentially huge social and political unrest, especially if billions of dollars of wealth are lost through the stock market, which requires policymakers to respond. In addition, the results suggest that the news content of the pandemic event is richer and spread faster in the entire market environment. Therefore, the impact of the Covid-19 pandemic on the stock market is very likely to trigger daily stock market jumps and stock market volatility (events that deserve formal research in future empirical attempts). As discussed by (He et al. 2020a) and (Lee et al. 2020), the negative impact of pandemic events on the stock market has been fairly modest in the past, even within a few months. However, today, an explanation that emphasizes the availability of more information and faster dissemination clearly illustrates that the huge stock market impact since the Covid-19 pandemic is justified. In summary, the way this (unfavorable) news is reflected in stock prices is an early and visible way of more losses (through various sectors of the real economy, namely the health market, the labor market, the tourism industry, and the transportation market), reflection. Finally, future research venues may explore how the Covid-19 incident affects different areas of China, individual companies and their corresponding listed stocks. In addition, the impact of the Covid-19 facts (Salisu et al. 2020a), (Shehzad et al. 2020) and (Mishra et al. 2020).

COVID-19 has fragile human suffering, destabilized the economy, turned the lives of billions of citizens around the globe upside down, and significantly affected the health, economic, environmental, and social domains (Majumdar, et al., 2020). The assessment of COVID-19 impacts in the context of socio-economic emergency events and the global reactions to alleviate the effects of these events have been provided. COVID-19 is a global pandemic that sets a pause to financial doings and poses a severe risk to generally wellbeing. The global socio-economic impact of COVID-19 includes higher unemployment and poverty rates, lower oil prices, altered education sectors, transform in the nature of work, poorer GDPs, and heightened risks to health care workers. The influence of the COVID-19 is regarding the COVID-19 on the social and economic mechanism and reaction of the world countries. The world countries received economic shocks which resulted in the increase of the poverty, unemployment, decline the oil prices, and change in the education system (Sun et al. 2020e), (Sun et al. 2020c) and (Sun et al. 2020d).

Conclusion and policy implications

The rapid flow of the coronavirus has disturbed the production as well as supply equally globally. The impact of the COVID-19 has triggered the new plannings and strategies for the future. It is found that interplay between production and consumption has been devastated and this outburst has triggered new stream. However, this study harbors new information based on the lesions learned from the COVID-19 pandemic situation (Queiroz, et al., 2020).

We have tested the shock of the official announcement of COVID-19 on economic volatility, focusing on the COVID-19 pandemic phase of the crisis 2019–2020. To this end, we used the volatility achieved by the S&P 500 Index as a proxy for the volatility of the US financial market, and compared the impact of data reported globally and in the USA. Our empirical survey results emphasize the following facts:

(1) New cases of infection reported globally and in the USA have exacerbated financial turmoil. For example, due to the impact of this pandemic, the total market value of the global stock market reached about US$6 trillion (Ozili and Arun, 2020). Since the outbreak of Covid-19, the market value of the Standard & Poor's (S&P) 500 index has fallen to 30%. According to Azimili (2020), the increase in uncertainty affects the required rate of return and thus the current market value of the stock.
(2) The mortality rate has a significant and positive impact on the volatility. Compared with the impact caused by the data reported in the USA, the impact of the COVID-19 data reported at the global level is stronger; (iv) The impact of EPU is in COVID-19 during the pandemic phase, financial volatility has little effect. All in all, our reliable results show that the persistence of the COVID-19 crisis and its associated uncertainties have exacerbated the turbulence in the US financial market, thereby affecting the global financial cycle.
(3) We investigated the impact of multiple aspects of the COVID-19 pandemic on the liquidity and volatility of

the US stock market. The CBOE VIX index in April rose by nearly 580% from January's level, and the drop in liquidity in the market (caused by the rapid spread of the coronavirus) (Adrian and Natalucci, 2020) encouraged us. Our results show that the increase in confirmed cases and deaths caused by the coronavirus are related to a significant decline in market liquidity and stability. Likewise, public fears and imposing restrictions and blockades seem to exacerbate the lack of liquidity and instability in the market. The policy recommendations for the main stakeholders are as follows:

Throughout the global financial history, periods of abnormally high capital market volatility have occurred. The uncertainties that trigger such events range from epidemics to the collapse of the financial system to geopolitical risks. Although the reasons are diverse, the level of response measures largely depends on the degree of harm and the spread of risks. In some cases, no matter what the triggering event is, the risks accumulated in the expected way and the results under pressure are not surprising. In other cases, increased pressure shows unexpected vulnerabilities and therefore requires unprecedented policy solutions. As far as the capital market sell-off caused by COVID-19 is concerned, people generally feel that the market is dislocated. Policy countermeasures include some anticipated actions and the use of existing tools, as well as new developments and new policy solutions. Although there are signs that these policy measures have the potential to stabilized the market to a certain extent, the uncertainty surrounding this pandemic is still threatening the capital market. Considering the challenge of controlling the pandemic, how and when the COVID-19 crisis will end will determine the parameters for further policy responses. On these questions, the study suggests to conduct upcoming research to add more in the body of knowledge and practice.

Author contribution Conceptualization, methodology: Muhammad Sadiq; review, visualization: Ching-Chi Hsu; data curation, supervision, visualization, editing: YunQian Zhang; writing of draft, software and editing: Fengsheng Chien.

Data availability The data that support the findings of this study are openly available on request.

Declarations

Ethics approval and consent to participate

We declare that we have no human participants, human data, or human issues.

Consent for publication We do not have any individual person's data in any form.

Competing interests The authors declare no competing interests.

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