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The asymmetric effect of COVID-19 outbreak, commodities prices and policy uncertainty on financial development in China: evidence from QARDL approach

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ABSTRACT

COVID-19 epidemic has brought uncertainty to each sector of the global economy, including the financial sector. The widely spread disease has a drastic effect, which massively created health and financial crisis and virtually pushed the economy to the brink of recession. The study focused on the financial development of China during the COVID-19 pandemic and analyzed the long-term and short-term impact of COVID-19, oil prices, gold prices, and global economic policy uncertainty on the financial development of the country. The QARDL model, Wald test, and Granger causality tests are employed to assess the daily data of variables from January 1, 2020, to March 15, 2021. The study's empirical results revealed that an increase in the number of COVID-19 registered patients has an unprecedented negative effect on financial development, whereas the oil prices co-moved with the financial performance. On the other hand, gold prices and global economic policy uncertainty are negatively correlated with financial development. This study offers various policy recommendations to help the investors, government, and decision-makers to make better decisions for the improvement of the financial development of China.

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1. Introduction

The COVID-19 epidemic caused by the novel virus known as a coronavirus (2019-nCoV) has been experienced for the first time in China (Ali et al., 2020). The unprecedented disease is highly contagious and rapidly spread in the world. The adversity effect of the COVID-19 outbreak has broken the record of the global financial crises of the past few decades. Therefore it is called the *'Great Compression* (Harvey, 2020). The COVID-19 pandemic has hampered financial and economic transactions and sent shock waves to the world through the high volatility in social, economic, and financial activities (Fallahgoul, 2021). Moreover, the increase of the global

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humanitarian crisis reduced the capacity to absorb the massive disruption. The COVID-19 outbreak has primarily depressed the stock market indices (Albulescu, 2021). This is due to the high systematic risk, which made investors reluctant to invest (Sharif et al., 2020; Umar, Su et al., 2021).

Similarly, the pandemic highlighted the substantial effects of the global health emergency and expose the obstructed financial developments in the world (Leach et al., 2021). The COVID-19 pandemic spurs various outcomes to be catastrophic the financial development globally. For instance, the lockdown to curb the disease has reduced the direct income from production, deepened poverty, created negative supply shocks, disrupted the global supply chain, and closed many businesses (Pak et al., 2020). Thus, the pandemic virtually pushed the economies to the brink of recession. The financial sectors of many countries are also experiencing a significant negative effect of the COVID-19 (Ali et al., 2020). The outbreak has taken the financial sector, especially the stock market, in very different directions, ultimately influencing the financial sector's growth and stability. Investors and traders have shaken their trust in financial instruments and markets because they cannot anticipate market disruption and profitability (Mishra, 2020). Moreover, it has already been warned by different monetary international organizations and forums that the recent financial crises due to COVID-19 are more intense and will have severe effects on the global economy in the long run.

The literature on the effect of the COVID-19 outbreak on social, economic-financial, and environmental aspects has grown rapidly during the COVID-19 pandemic (Ali et al., 2020) study the relationship between the global financial market and COVID-19. The study by Apergis and Apergis, (2020) observed the different energy issues triggered by the pandemic. Also, there is several studies carried out by various researchers to analyze the influence of the COVID-19 pandemic on various economic factors such as the aggregate market (Baker et al., 2020), cryptocurrency reliability (Conlon & McGee, 2020; Yarovaya et al., 2021), the insurance industry performance (Babuna et al., 2020; Wang et al., 2020) value of risk in mutual fund (Rizvi et al., 2020), global economy (McKibbin & Fernando, 2020) economic uncertainty and geopolitical risk (Sharif et al., 2020). Corporate solvency (Mirza et al., 2020), and liquidity and volatility of stocks (Albulescu, 2021; Baig et al., 2021; Narayan et al., 2021).

Financial development is a crucial and inextricable part of economic development (Umar et al., 2020; Umar et al., 2021). The country's financial sector development not only accelerates economic growth but also mitigates the risk of crisis (Su et al., 2020; Su et al., 2021; Umar et al., 2021). Additionally, it increases investments, productivity, and income and reduces poverty. COVID-19 has increased the financial uncertainty. There is scant evidence of the COVID-19 impact on financial sector development. However, as per the current knowledge, none of any empirical studies has been conducted to analyze the impact of the COVID-19 outbreak on the financial sector development of China. This study will fill the gap in the existing literature. Generally, financial development represents by two different platforms. One is stock market-based financial development, and another is the financial institutions or bank-based financial development (Su, Qin, Rizvi et al., 2021; Su et al., 2021). This study examines the COVID-19 outbreak and other variable's impact on the stock-based financial

development measures as stock returns of the china stock market. These stock returns reflect the overall progress of the financial sector.

According to the Worldometer Data Tracker (WDT) website's daily update statistics, as of March 15, 2021, the accumulated registered and confirmed patients of COVID-19 in China exceeded 90,000, with 4,636 deaths. The active cases are 169 in mild condition. However, the recovered cases are 85,367, which is 95% of the total accumulated COVID-19 patients. The rise in COVID-19 figures causes more economic uncertainty and a slowdown the investment activities. The present study is carried out to investigate the asymmetric effects of the COVID-19 epidemic on the financial sector development of China from January 1, 2020, to March 15, 2021. This study contributes to the existing literature by sharing the new knowledge, supporting the investor and government authorities to analyze the country's financial development, and making decisions accordingly.

The current study specifically focused on the financial development of China due to various reasons. First, China is the first country hit by the pandemic and transitioned from rescue to recovery among all other countries (Ahmad et al., 2020). The economic and financial downfall has given in-depth knowledge to identify the system's weaknesses and combat the pandemic crisis. Second, China has a state-dominated financial system more depends on investment and less on productivity and innovations. The central bank has taken a series of measures to support the financial sector, reduce the financial cost, and provide necessary liquidity in subsidies (Ba & Bai, 2020). Third, China is the global business hub and the center of the supply chain (Su et al., 2021). During the COVID-19 epidemic, china has suspended most of the productions, experience massive curbs on exports, and lose plenty of investment opportunities. Several other factors and the COVID-9 epidemic can affect China's financial development, such as commodity prices of oil, gold, and global economic policy uncertainty.

Considering the above facts and figures, the study's most challenging task was to provide accurate outcomes through the most appropriate methodology, which explores the reliable and detailed relationship among the selected variables. The selection of the proper analytical method is crucial to serve the study's objective and assist the policymakers for further planning to control the situation and take corrective measures to improve financial development. Many researchers have used traditional and simple methods in previous studies to determine the correlation between the variables. However, none of any studies considered the magnitude, such as quantile, to analyze China's financial sector development during the COVID-19 epidemic. This study has employed the quantile autoregressive distributed lag method (QARDL), one of the few systematic quantitative methodologies with various advantages over the other methods. The QARDL method allows the study to analyze the long-run and short-run relationship across the quantiles, which is more detailed, reliable, and accurate to scrutinize the nexus of concerned variables (Cho et al., 2015).

Moreover, the QARDL also considers the potential asymmetric and nonlinear association between COVID-19, oil prices, gold prices, global economic policy uncertainty, and China's financial development. The study's findings illustrate that the pandemic of COVID-19 negatively affected China's financial development in the long

run. Similarly, gold prices and global policy uncertainty also negatively correlated in the long term specified in the medium-high and high-higher market sentiments. In contrast, oil prices show a positive association with financial development in the normal and bullish market. On the other hand, considering the short-term association among the variables, the COVID-19 and global economic policy uncertainty negatively influence the financial market only in the bearish market; however, the financial development experienced an increase only in the bearish market due to the oil prices. Whereas the gold price does not influence the financial development of China in the short term.

The rest of the paper is organized as follows: section two literature review lays out the study's theoretical dimensions. Section three discusses the data and methodology. Section 4 reports the data Analysis and discussion, whereas the last section is a concludes and policy recommendations.

2. Literature review

Existing literature provides several scholarly works investigating the COVID-19, commodity prices such as oil prices, gold prices, and other factors on the stock market performances, financial institutions, insurance companies, investment companies, and real estate firms. Most of the studies show the negative impact of the COVID-19 outbreak on each economic and financial sector of the world (Dzigbede & Pathak, 2020). The outcomes of the COVID-19 pandemic seem inevitable, they are limited to the healthcare sector and the ailing financial sector, depress the financial market activities by destabilizing investors' confidence (Ibn-Mohammed et al., 2020; Phan & Narayan, 2020; Topcu & Gulal, 2020). Along with the health crisis, the world also experiences a sharp decline in financial development due to the pandemic (Leach et al., 2021). In addition, (Pak et al., 2020) provide detailed insights into how the COVID-19 reduced the direct income and disturbed the microeconomic drivers needed to boost financial development. However, to determine the study gap, the detailed literature reviews considering the conceptual and empirical framework for each study variable are as under:

2.1. Covid-19 and financial development

Within a year, several studies have specifically examined the causes of financial volatility in different economic settings. The stock market's catastrophic downfall is why the increased COVID-19 infected cased, which leads to the humanitarian crisis. Moreover, the oil price fluctuations and currency exchange rates are also the reason for the drastic decline. The financial development ups and downs or the stock market volatility highly observed in emerging markets (Topcu & Gulal, 2020).

Ashraf (2020) study the impact of COVID-19 on the stock by comparing the increase in the COVID-19 daily cases to the market response. The study's outcome revealed that the stock market is highly sensitive to health-related bad news; therefore, they react proactively with the increase of COVID-19 registered patients compared to the casualties figure announce daily. The market initially responds negatively during the early days of the pandemic, but later on, the market stabilized; thus, COVID-19 outbreak intensity varies on financial development over time.

Furthermore, Baker et al., (2020) investigate the COVID-19 pandemic impact on stock volatility compared to the previous infection crisis, including the Spanish Flu. The text-based method results evaluate the high unprecedented stock market response and endorse that this time, the stock market volatility is higher than the previous pandemics. Similarly, the US stock market analysis reveals that the COVID-19 pandemic has an inverse effect on the stock market's performance. This is the main reason for the increase in the capital intensity level and the non-performing loans, which ultimately increase the country's overall unemployment (Alfaro et al., 2020). In addition, studies such as by Yarovaya et al. (2021) and Mirza et al. (2020) evaluate the human capital efficiency on the performance of volat funds during the COVID-19 pandemic. They found that the financial development in the form of high returns during the COVID-19 highly depended on fund managers' performance.

X. Zhang et al., (2020) extended the research and analyzed the stock market returns' possible responses in the highly-risk-oriented market due to the COVID-19 outbreak. The study incorporates the topmost stock indices of 64 countries to determine the country-specific risk and systematic risk, causing investors' losses in the short run. Likewise, Al-Awadhi et al. (2020) find the COVID-19 effects on China stock markets' share prices by incorporating the firm-wise data. The panel study concludes that the share prices are significantly negatively correlated to the number of registered infected cases and deaths across all firms. Mazur et al. (2021) conducted a study to examine the USA stock market during the COVID-19 pandemic. The study's result endorsed that the COVID-19 negatively influences the stock returns of the real estate sector, petroleum-related products sector, entertainment, and other service sectors. These stocks are facing losses due to extreme asymmetric fluctuations. However, the food sector, Information technology, sector, and health care sector stocks give high returns during the COVID-19 epidemic.

Ali et al. (2020) also discussed the global stock market reaction in terms of high volatility and sharp decline against the phase wised spreading of COVID-19. Similarly, Rizvi et al. (2020) use risk-adjusted performance measures to evaluate the performance of various subcategories of mutual funds and found only the positive returns by entrepreneurship. Moreover, Mirza et al. (2020) evaluate the price reaction, time volatility, and performance of different investment funds during the COVID-9 pandemic. The results presented that the entrepreneurship funds performed exceptionally well across all three phases, whereas the social funds remain highly volatile. However, the treasury funds give positive returns in the initial phase, and later on, they give negative returns.

2.2. Oil prices and financial development

China's economy is considered the strongest economy with high rapid growth in all sectors. The financial sector development based on the stock market performance highly correlates with the increased dependency of crude oil on foreign countries. Various studies examined the effects of oil price fluctuation on the economic and financial health of the countries. Moreover, many research analyzed how commodity price-sensitive countries react in crises or recession toward the development of

financial stability and development. In bullish and bearish market sentiments, the USA market tread more influenced those countries' financial performances that are highly sensitive to the commodity price fluctuations (Aloui et al., 2011). Inconsistent, Sharif et al. (2020) identified the crude oil prices spillover effect on the USA stock market performance. Using the Wavelet coherence and transform method and wavelet-based Granger causality method for daily data, the results revealed that oil prices slump strongly affect the US stock market and create more uncertainty during the COVID-19 pandemic.

The relationship between the China stock market and the international crude oil market is the essential driver to measure the country's economic and financial development. Peng et al., (2020) evaluate the multiscale integration and volatility effects of the China stock markets and oil market indices. The study results show a strong and positive trend between crude oil prices and stock market returns. Similarly, Alshubiri et al., (2020) studied the impact of petroleum and non-petroleum indices on the Sultanate of Oman's financial development. The study employed the ARDL regression model for data from 1978 to 2017 and figure out that the oil and the service sector GDP has positive and significant on the domestic credits of the Sultanate of Oman.

Furthermore, another study conducted by Atil et al., (2020) explores the relationship of natural resources such as oil prices with the financial development of Pakistan (finance demand function as an additional determinant of economic growth). The study uses the long-run convertibility method and robust the result with the test of cross-quantilogram. The study's outcomes endorsed that natural resources (oil prices) positively influence Pakistan's financial development. Moreover, (W. Zhang & Hamori, 2021) investigated the connectedness of COVID-19, oil price fluctuations, and the US, Japan, and Germany's stock market performance. The study's outcome illustrates that during the COVID-19, the oil prices plummeting, leading to the extreme decline in stock market performances. Investors bear heavy losses in a very short period of history.

2.3. Gold prices and financial development

Generally, investors seek investment opportunities with minimum risk and likely go for the diversified portfolio consisting of secured financial instruments, gold, or precious stones. The gold investment is considered more secure and attractive in the financial downturn (Ciner et al., 2013). Several studies linked the gold price with financial development, such as Shabbir et al. (2020) state that the hike of inflation reduces the value of money, and gold is the best commodity that not only preserves its value but also provides an additional return. The autoregressive distribution lag (ARDL) test results declare that the gold prices are highly correlated to the stock market performance. Furthermore, to control inflation and its adverse effects, it has been suggested that the gold prices can be used as a tool because the change in the gold prices will significantly affect inflation and other financial factors, which are necessary to control financial development and growth.

Another study examined the gold price impact on the BRIC economies stock market volatility and used the nonlinear autoregressive distribution lag (ARDL) model to

find the short and long-term effects. The results discovered that emerging economies are more sensitive to the bad news, the oil gold prices fluctuations significantly affect the stock market stability (Raza et al., 2016; Umar et al., 2021). Tweneboah et al., (2020) investigates the asymmetric link between Africa's spot gold prices and stock returns. The findings of wavelet and quantile regression demonstrate the mixed effects on Africa's financial market's growth and development. Few countries such as Ghana, Mauritius, and Nigeria, experienced positive effects in the long run, whereas Egypt, Morocco, and other countries show a negative association. Also, Su et al. (2020) study the correlation between bitcoin price and gold price. The empirical study explores the casual relationship and illustrates that the bitcoin price and gold price are inversely correlated. The increase in bitcoin prices decreases the gold price or vice versa. The study suggests that the fluctuations in gold prices determine the bitcoin prices. Thereby, the return on cryptocurrency is sensitive to gold price changes.

2.4. Global economic policy uncertainty and financial development

Phan et al. (2021) has examined the role of economic policy uncertainty on various countries' financial stability and development. The study uses the panel data of 23 countries from 1996 to 2016. The empirical finding states that economic policy uncertainty has a negative and significant impact on financial stability. It has been observed that the countries with weak financial systems and low regulatory capital experienced more uncertainty, leading to the high volatility in their stock prices and instability in other financial determinants. Moreover, Karadima and Louri (2021) investigate the bank's financial and debt crises due to the cohesive policy response delay. The study uses the panel data of 507 banks of the leading euro countries and determines the impact of economic policy uncertainty on the non-performing loans. Li and Zhong (2020) analyzed the effect of global economic policy uncertainty on the China financial condition index (CFCI). The study identifies the sources of financial crises and explores that the economic policy uncertainty (EPU) is the major cause of financial volatility, whereas the EPU has insignificant effects on the stable economic and financial conditions.

Nguyen et al. (2020) study the impact of global economic policy uncertainty on the domestic and international financial institutions' credit levels. The study uses the panel data of 22 countries for the period from 2001 to 2015. A study has applied panel standard correction error and feasible generalized least square tests to measure the unbalanced data. The empirical study gives three main outcomes. The highest economic policy uncertainty has a negative impact on bank credit growth. The decrease in policy uncertainty is favorable for credit growth. Moreover, the emerging economies experience additional negative impacts of the economic policy uncertainty than the developed countries.

3. Data and methodology

3.1. Data

For the current study, the number of COVID-19 infected cases registered in China has been used daily and the daily data of commodities prices such as oil prices and

gold prices. Oil prices are defined as the WTI (West Texas Intermediate) crude oil prices. However, the gold prices are measured as daily gold prices, and the SSE Composite Index data used as a proxy of China's financial development. The oil and gold prices and China stock exchange data are retained from DataStream. The data of global economic policy uncertainty is extracted from the Economic Policy Uncertainty website. The present study utilized the time series daily data from January 1, 2020, to March 15, 2021, yielding 314 Observations. The data of all variables are transformed into a logarithm.

3.2. Qardl approach

The QARDL approach intended by Cho et al. (2015) employs to evaluate the long-run association among the COVID-19 outbreak, oil prices, gold prices, global economic policy uncertainty, and the financial development of China. The QARDL Model is the modified version of the ARDL Model and examines the COVID-19 and Financial Development's nonlinear relationship based on the asymmetric linkage. Further, the dependency of parameters examined the long-run and short-run integration association using the Wald test (Aziz et al., 2020; Godil et al., 2020).

The QARDL approach has privilege over the linear approaches in three ways. Firstly, this approach allows location-based asymmetry because the coefficients may be contingent on the dependent variable (FD) location inside the conditional distribution. Secondly, the approach investigates the long-run equilibrium effects with short-run aspects of the conditional distribution of defined variables overall quantiles. Lastly, many studies use linear ARDL and Johansen cointegration tests to demonstrate only the short-run time-varying cointegration parameters. Simultaneously, the QARDL approach considers it for both the long and short run with respect to different quantiles (Hu et al., 2009). Moreover, the use of the QARDL model has another advantage over the other nonlinear models like 'Nonlinear Autoregressive Distribution Lag (NARDL)', which explains the nonlinearity as an exogenous procedure (Godil et al., 2020; Shahbaz et al., 2018). Based on these motives, the QARDL method seems the most appropriate method to analyze the data because it considers both the asymmetric and nonlinear associations.

The equation of the linear ARDL model is as following

$$\sum_{i=0}^{u} \psi_i GPU_{t-i} + \varepsilon_t \; FD_{2t} = \mu + \sum_{i=1}^{p} \varphi_i FD_{2t-i} + \sum_{i=0}^{q} \gamma_i COVID19_{t-i} + \sum_{i=0}^{r} \omega_i OIL_{t-i} + \sum_{i=0}^{s} \theta_i GP_{t-i} + \sum_{i=0}^{u} \psi_i GPU_{t-i} + \varepsilon_t \tag{1}$$

Thus, ε_t mentioned as an error term which demonstrated as $FD_{2t} - E[\frac{FD_{2t}}{\sigma_{t-1}}]$ where is the smallest σ field of $\{FD_{2t}, COVID19_{2t}, OIL_t, GP_t, GPU_t\}$ and alphabets a, b, c, d, and e illustrate the lag order criterion of Schwarz information (SIC). According to Equation (1), FD, COVID19, OIL, GP, and GPU represent financial

development, COVID19 cases, oil prices, gold prices, and global economic policy uncertainty.

In line with the above equation (1), the quantile estimations present the QARDL model as under:

$$Q_{FD_{2t}} = \mu(\tau) + \sum_{i=1}^{a} \varphi_i(\tau)\ FD_{2t-i} + \sum_{i=0}^{b} \gamma_i(\tau) COVID19_{t-i} + \sum_{i=0}^{c} \omega_i(\tau) OIL_{t-i} + \sum_{i=0}^{d} \theta_i(\tau)\ GP_{t-i} + \sum_{i=0}^{e} \psi_i(\tau) GPU_{t-i} + \ \varepsilon_t(\tau) \tag{2}$$

Where, $\varepsilon_t(\tau) = FD_{2t} - Q_{FD2t}\ (\tau/\upsilon_{t-1})$ and $0 > \tau < 1$ represent quantile (Kim & White, 2003). The equation has been reformulated into Equation (3) mentioned below by considering Equation (2) expected probability of serial correlation.

$$\begin{aligned} Q_{\Delta FD2t} = \ & \mu + \rho FD_{2t-1} + \partial_{COVID19}\mathrm{COVID19}_{t-1} + \partial_{OIL} OIL_{t-1} + \partial_{GP}\mathrm{GP}_{t-1} \\ & + \partial_{GPU}\mathrm{GPU}_{t-1} + \sum_{i=1}^{a-1} \varphi_i \Delta\ FD_{2t-1} + \sum_{i=0}^{b-1} \gamma_i \Delta\ COVID19_{t-1} \\ & + \sum_{i=0}^{c-1} \omega_i \Delta OIL_{t-1} + \sum_{i=0}^{d-1} \theta_i \Delta GP_{t-1} + \sum_{i=0}^{e-1} \psi_i \Delta\ GPU_{t-1} + \ \varepsilon_t(\tau) \end{aligned} \tag{3}$$

However, in the QARL approach, the quantile error correction model defined as under:

$$\begin{aligned} Q_{\Delta FD2t} = \ & \mu\ (\tau) + \rho(\tau)(\ FD_{2t-1} - \beta_{COVID19}(\tau) COVID19_{t-1} - \beta_{OIL}(\tau) OIL_{t-1} \\ & - \beta_{GP}(\tau) GP_{t-1} - \beta_{TTI}(\tau) GPU_{t-1}\Big) + \sum_{i=1}^{a-1} \varphi_i(\tau) \Delta\ FD_{2t-1} + \sum_{i=0}^{b-1} \gamma_i(\tau) \Delta COVID19_{t-1} \\ & + \sum_{i=0}^{c-1} \omega_i(\tau) \Delta OIL_{t-1} + \sum_{i=0}^{d-1} \theta_i(\tau) \Delta\ GP_{t-1} + \sum_{i=0}^{e-1} \psi_i(\tau) \Delta\ GPU_{t-1} + \ \varepsilon_t(\tau) \end{aligned} \tag{4}$$

To test the combined short term effect of preceding and existing FD on the existing FD, the study applied the delta method, which defined as $\varphi_i = \sum_{i=1}^{a-1} \varphi_j$ while the cumulative short-run effect of the preceding and existing levels of COVID19, OIL, GP, and GPU is determined by $\gamma_i = \sum_{i=0}^{b-1} \gamma_J$, $\omega_i = \sum_{i=0}^{c-1} \omega_J$, $\theta_i = \sum_{i=0}^{d-1} \theta_J$, $\psi_i = \sum_{i=0}^{e-1} \psi_J$, respectively. The coefficients related to long-run for COVID19, oil price, gold price, and global economic policy uncertainty are calculated as below:

$$\beta_{COVID19*} = -\frac{\beta_{COVID19}}{\rho},\ \beta_{\ OIL*} = -\frac{\beta_{OIL}}{\rho},\ \beta_{GP*} = -\frac{\beta_{GP}}{\rho},\ \text{and}\ \beta_{GPU*} = -\frac{\beta_{GPU}}{\rho},$$

However, the error correction measure ECM coefficient ρ needs to be negative and significant.

Table 1. Results of descriptive statistics.

Variables	Mean	Min.	Max.	Std. Dev.	J-B Stats
FD	5.001	4.115	6.010	1.101	24.045***
COVID19	3.789	2.101	4.101	0.811	19.668***
OIL	2.157	1.789	3.015	0.618	51.137***
GP	0.987	0.852	1.021	1.112	94.900***
GPU	4.201	3.357	5.037	0.451	33.437***

Note: *** present the 1% significance levels, respectively.
Source: Author Estimation.

3.3. Wald test

The asymmetric impact of COVID19, OIL, GP, and GPU on FD in the short-term and long-term has been examined through the Wald test. The null hypothesis is as under:

$$H_0: \ \rho_* \ (0.05) = \rho_* \ (0.1) = \ \ldots\ldots\ = \rho_* \ (0.95)$$

Against the alternative one

$$H_0: \ \exists \ i \neq j / \rho(i) \neq \rho(j)$$

4. Data analysis and discussion

4.1. Descriptive analysis

Table 1 provides the descriptive statistics of financial development (FD), COVID-19, oil prices (OIL), gold price (GP), and global economic policy uncertainty (GPU). The dependent variable FD shows the mean value as 5.001 with a minimum of 4.115 and a maximum of 6.010. At the same time, the COVID19 demonstrates 3.789 as the mean, which lies between 2.101 and 4.101. Moreover, OIL prices have a mean value of 2.157 with a minimum value of 1.789 and a maximum value of 3.015. Similarly, another control variable, GP, has a mean value of 0.987, representing the minimum and maximum values as 0.852 and 1.021, respectively.

Similarly, the global economic policy uncertainty GPU shows a mean value of 4.210, which fluctuates between 3.357 and 5.037. To examine the normal distribution of the data, the Jarque-Bera test has applied. The outcomes of the test presented in Table 1 state that all the variables are significant. Therefore, the test provides evidence of the nonlinearity associations among variables, i.e., FD, COVID19, OIL, GP, and GPU. Thus the data is not normally distributed, which meets the criteria to use quantile regression analysis (Aziz et al., 2020; Godil et al., 2020; Razzaq et al., 2021; Sharif et al., 2020).

4.2. Unit root rest

In the time series framework, it is essential to figure out the level of coherence of data. Therefore, for unit root, the study employed the Zivot and Andrews (2002) test and the Augmented Dickey-Fuller (ADF) test. The ZA test has primacy because it

Table 2. Results of traditional and structural break unit root test.

Variables	ADF (Level)	ADF (Δ)	ZA (Level)	Break Year	ZA (Δ)	Break Year
FD	−0.554	−6.338***	−0.811	24\03\2020	−9.441***	07\01\2021
COVID19	−1.008	−8.410***	−0.745	16\06\2020	−10.108***	18\10\2020
OIL	−0.761	−5.470***	−0.228	21\09\2020	−7.056***	26\07\2020
GP	0.044	−6.110***	−1.225	14\07\2020	−5.557***	09\08\2020
GPU	−1.359	−4.781***	−0.996	31\12\2020	−8.008***	14\02\2021

Note: *** present the 1% significance levels, respectively.
Source: Author Estimation.

determines the structural break and the stationarity of the time-series data. According to Table 2, the findings retrieved from the ZA and ADF unit root tests suggest that all the variables, i.e., FD, COVID19, OIL, GP, and GPU, are non-stationary at the level. However, they all are stationary at first difference. The empirical results endorsed that all the variables have unique integration order.

4.3. QARDL model estimation

Table 3 present the results of QARDL long run and short run estimations. The results indicate that the estimated coefficient of dependency ρ^{*} is negatively significant at intermediate and high quantiles and insignificant with negative value at lowest to low $(0.05-0.10)$ quantiles. This indicates a reversal to the long-term equilibrium among financial development and COVID-19, oil prices, gold prices, and economic policy uncertainty. Moreover, the beta coefficient result demonstrates a long-term relationship between dependent and independent variables, such as the COVID19 (βCOVID19) has a significant and negative value at all the quantiles. This indicates the long-run decreasing asymmetric movement amid the COVID19 and the financial development (presented as the stock market returns) in all market sentiments.

Simultaneously, the oil prices βOIL show the positive and significant value at the middle to high quantile (0.50-0.95), demonstrating that during the bullish market, when the market returns are already high, an increase in oil prices further enhanced the financial development. Whereas for the lower quantile, we observed no significant influence of oil prices on China's financial development. However, the gold prices β_{GP} value is significant but negative at high to higher (0.7-0.95) quartiles, which implies a decline in financial development in the long run when the stock returns are high concerning the increase in gold prices. Similarly, the value of global economic uncertainty β_{GPU} is significant with negative values at the middle to high (0.30–0.95) quantiles, which indicates that even when the market is experiencing intermediate and bullish sentiments, the financial development decreases with respect to the increase in global economic policy uncertainty.

For the analysis of the short-run dynamics, Table 3 illustrates the results, which imply that the fluctuation in the current stock returns or the financial development is significantly and positively linked with its past performance at all quantile. Moreover, the aggregate existing and preceding changes in COVID19 is negatively and significantly affect the current variations in financial development at low (0.05–0.30) quantiles. In contrast, the middle and upper quantiles show insignificant positive effects. At the same time, combined past and present fluctuations in the oil prices (OIL)

Table 3. Results of quantile autoregressive distributed lag (QARDL).

Quantiles	Constant	ECM	Long-run estimates				Short-run estimates				
(τ)	μ*(τ)	ρ*(τ)	βCOVID19 (τ)	βOIL (τ)	βGP (τ)	βGPU (τ)	φ1 (τ)	γ0 (τ)	ω0 (τ)	θ0 (τ)	ψ0 (τ)
0.05	0.006 (0.010)	−0.121 (−0.007)	−0.351*** (−2.992)	0.254 (0.601)	−0.105 (−0.273)	−0.120 (−0.230)	0.480** (2.979)	−0.040** (−2.250)	0.020* (1.827)	−0.012 (−0.251)	−0.023*** (−3.000)
0.10	0.013 (0.005)	−0.112 (−0.008)	−0.360*** (−3.001)	0.278 (0.718)	−0.113 (−0.362)	−0.127 (−0.259)	0.469** (2.960)	−0.052** (−2.062)	0.027* (1.722)	−0.019 (−0.242)	−0.027*** (−2.999)
0.20	0.015 (0.012)	−0.127* (−1.956)	−0.331*** (−2.992)	0.268 (0.962)	−0.110 (−0.254)	−0.115 (−0.668)	0.378** (2.984)	−0.047* (−1.751)	0.016** (2.128)	−0.024 (−0.253)	−0.031** (−2.990)
0.30	0.010 (0.007)	−0.116** (−1.961)	−0.320** (−2.976)	0.245 (1.107)	−0.118 (−0.469)	−0.192* (−1.650)	0.419** (2.969)	−0.039 (−1.248)	0.026** (2.220)	−0.018 (−0.240)	−0.025* (−1.810)
0.40	0.016 (0.011)	−0.119** (−1.973)	−0.328** (−2.953)	0.226 (1.600)	−0.121 (0.460)	−0.190** (−2.248)	0.391** (2.958)	−0.020 (−1.057)	0.012 (1.330)	−0.023 (−0.228)	−0.018 (−1.289)
0.50	0.022 (0.013)	−0.122** (−1.981)	−0.388** (−2.934)	0.261* (1.704)	−0.130 (−0.658)	−0.221** (−2.361)	0.429** (2.988)	−0.035 (−1.241)	0.020 (1.126)	−0.031 (−0.239)	−0.021 (−1.199)
0.60	0.026 (0.009)	−0.181** (−2.002)	−0.410** (−2.943)	0.242** (1.993)	−0.120 (−1.374)	−0.236** (−2.479)	0.408*** (2.992)	−0.019 (−1.039)	0.016 (1.116)	−0.039 (−0.247)	−0.016 (−0.990)
0.70	0.021 (0.014)	−0.229** (−1.991)	−0.416* (−1.959)	0.230** (2.221)	−0.112** (−2.488)	−0.211** (−2.659)	0.397*** (3.001)	−0.025 (−1.046)	0.028 (1.118)	−0.047 (−0.266)	−0.032 (−0.961)
0.80	0.027 (0.008)	−0.218** (−2.001)	−0.408* (−1.958)	0.247** (2.416)	−0.108*** (−3.067)	−0.228*** (−3.047)	0.426*** (3.002)	−0.013 (−1.053)	0.014 (1.110)	−0.038 (−0.253)	−0.028 (−0.857)
0.90	0.023 (0.019)	−0.230** (−1.992)	−0.419* (−1.942)	0.229** (2.522)	−0.166*** (−3.256)	−0.237*** (−3.152)	0.407*** (2.999)	−0.028 (−1.140)	0.025 (1.214)	−0.030 (−0.273)	−0.011 (−0.748)
0.95	0.028 (0.006)	−0.262** (−2.003)	−0.324* (−1.955)	0.239** (2.215)	−0.219*** (−3.071)	−0.241*** (−3.239)	0.398*** (3.000)	−0.031 (−1.160)	0.021 (1.121)	−0.032 (−0.261)	−0.030 (−0.638)

Note: The table reports the quantile estimation results. The t-statistics are between brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Source: Author Estimations.

significantly and positively impacted the present variations in financial development (FD) in the range of low (0.05–0.30) quantiles.

Furthermore, in the short-run, the preceding and existing variation in the gold price (GP) has a negative but insignificant impact at all quantiles, which states that the change in gold prices do not influence the financial development of china in the short run. Further, the combined preceding and existing variations in global economic policy uncertainty (GPU) negatively and significantly affect the current variation in financial development at low (0.05–0.30) quantiles. In contrast, in the middle and high quantile in the short-run, there is no impact on current financial development changes.

4.4. Wald test

The Walt test examines the asymmetric relationship or the explanatory variables' significance in the short-run and long-run. Table 4 demonstrates the findings of the Walt test for parameters stability. According to the result, parameter ρ has a significant value, which implies that the null hypothesis of the adjustment parameter's speed linearity is rejected—similarly, the results of long-run parameters of the $\beta_{COVID19}$. β_{OIL}, β_{GP}, β_{GPU} also reject the null hypothesis and endorse the existence of a long-run correlation between these variables and the financial development of China.

However, in the short-run dynamics, the null hypothesis of parameter constancy has been rejected by the Wald test for the collective effect of the preceding financial performance on the existing financial development. Similarly, the Wald test result of a significant relationship between COVID19 and financial performance failed to accept the H0 and indicate the asymmetric aggregate short-term influence of COVI19 on financial performance. On the other hand, for OIL, GP, and GPU, the Wald test outcomes accepted the null hypothesis of parameter consistency in the short-run and endorsed the symmetric collective effects of the said variables on china's financial development.

4.5. Granger causality test

This study has employed the Granger causality test to determine the interconnection between the variables. The possible outcomes can be bidirectional, unidirectional, or

Table 4. Results of the Wald test for the constancy of parameters.

Variables	Wald-statistics
P	6.810*** (0.000)
βCOVID19	14.010*** (0.000)
βOIL	34.876*** (0.000)
βGP	5.993*** (0.000)
βGPU	44.956*** (0.000)
φ1	2.919** (0.049)
γ 0	6.838*** (0.000)
ω 0	1.462 (0.246)
θ0	1.004 (0.369)
ψ 0	0.273 (0.999)

Note: *** and ** present the 1% and 5% significance levels, respectively.
Source: Author estimations.

Table 5. Granger causality in quantile test results.

Quantiles	ΔFD_t to $\Delta COVID19_t$	$\Delta COVID19_t$ to ΔFD_t	ΔFD_t to ΔOIL_t	ΔOIL_t to ΔFD_t	ΔFD_t to ΔGP_t	ΔGP_t to ΔFD_t	ΔFD_t to ΔGPU_t	ΔGPU_t to ΔFD_t
[0.05-0.95]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.05	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000
0.10	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000
0.20	0.000	0.000	0.000	0.000	0.012	0.000	0.000	0.000
0.30	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000
0.40	0.000	0.000	0.000	0.000	0.016	0.000	0.000	0.000
0.50	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000
0.60	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.000
0.70	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000
0.80	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000
0.90	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000
0.95	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors Estimation.

no causality, and the null hypothesis is a 'no causality. Table 5 demonstrates the result of the Granger causality test for the current study as quantile base detailed result. The extracted probability values show the QARDL model estimates' reliability and fail to accept the null hypothesis of no-causality across all the quantiles.

The results endorsed the existence of two-way causality between financial development and COVID19 (ΔFD_t to $\Delta COVID19_{t)}$ at all quantiles. It suggests that COVID19 affects financial development, and as a result, financial development affects COVID19. These results are consistent with Gherghina et al. (2020). Similarly, the outcomes also indicate two-way causality at a level of 1% significance between financial development and oil prices (ΔFD_t to $\Delta OIL_{t)}$. This has been endorsed by Torun et al. (2020) and Wu et al. (2020). Furthermore, the significant probability value of financial development and global economic policy uncertainty (ΔFD_t to ΔGPU_t) at all quantiles show the bidirectional causality among these variables. However, the causality run from financial development to gold price (ΔFD_t to $\Delta GP_{t)}$ at 1 to 5% significant level and from gold price to financial development (ΔGP_t $_{to}$ ΔFD_t) at a significance level of 1%. Thus the gold prices negatively influence financial development, and financial development causes fluctuations in gold prices.

5 Conclusion and policy recommendation

The country's financial development is a main concern for the investors, policymakers, and financial sector members who act as active contributors when boom and recession. The crisis phase in history always left long-term adverse effects on growth and development. Similarly, the recent economic, health and financial crisis named the COVID-19 outbreak has also imposed severe effects on the overall health of the financial sectors. This study focuses on the long-term and short-term effects of the COVID-19, commodity prices, and global economic policy uncertainty on China's financial sector development. The study employs the QARDL model, Walt Test, and Granger causality test to evaluate the time series daily data from January 1, 2020, to March 15, 2021. To get unbiased results, the primary step is to determine the stationarity of the time-series data. This study used the Zivot-Andrews (ZA) and Augmented Dickey-Fuller (ADF) unit root test for the stationary examination.

Furthermore, after the normality and nonlinearity test, the study has employed the QARDL, which is the most appropriate method to analyze the asymmetric and nonlinear relationship of the variables (Godil et al., 2020; Shahbaz et al., 2021).

The QARDL method outcomes confirmed that the Error Correction Measurement (ECM) parameter ρ is negatively significant as expected at middle and high (0.20-0.95) quantiles. This has proven a notable reversal to the long-term equilibrium in the correlation between financial development and other focus and control variables. Simultaneously, the beta coefficient values primarily indicate that the COVID19 outbreak negatively affects the financial development in all market conditions in the long run. However, the oil prices support the financial development, and the rise in oil prices in the normal and bullish market improves financial market performance. Furthermore, the gold prices and global economic policy's beta coefficient values are significantly negative at high-higher (0.7–0.95) quantiles and medium-high (0.30–0.95) quantile, respectively. The significant negative association of these variables with financial development illustrates that when the gold prices increase, activates of the financial market or performance of the financial sector decrease. Similarly, the increase in economic policy uncertainty enhances investors' risk, which leads to less development in the financial sector in the long run.

From the short-run perspective, the aggregated previous and current changes in COVID19 registered cases exert a negatively significant influence on the variation of the current financial development only at the lowest-lower (0.05–0.20) quantile whereas, global economic policy uncertainty aggregate fluctuations have an asymmetric effect on the current changes of finical development at low (0.05–0.30) quantiles. However, the oil prices have a significant positive impact at low quantile. The QARDL estimates also reveal that the fluctuations in gold prices do not influence the financial development variation in the short-run. At the same time, the research outcome indicates that the financial development's preceding results are significantly and positively co-moved with the existing financial development.

Subsequently, the Granger causality test exhibits the bidirectional causal association among registered cases of COVID19, oil Prices (OIL), Gold prices (GP), global economic policy uncertainty (GPU), and financial development of China. Therefore, this study's empirical results from the QARDL model, Wald test, and Granger Causality test confirm the cointegration existence between COVID19, oil prices, and economic policy uncertainty. Whereas the results of QARDL also endorse a relationship between the COVID-19, oil prices, gold prices, economic uncertainty, and financial development of China in the short-run, except the gold prices that have no significant impact on the changes of financial sector development.

Like the world, China also experiences a downward trend in financial development due to the exceptional outbreak of COVID-19. The halt to the economy has significantly shortfall the revenue of the financial sector. From the policy perspective, in this unprecedented circumstance, the study results help the investors, policymakers to make decisions for the improvement of financial development in China's recovery phase. As the current study evaluates the stock-based financial development, it has been recommended that the government reconsider the stock and investment market trading restrictions imposed in the initial phase of the COVID-19 pandemic.

Moreover, policymakers and government need to provide different ways for investors to bear the low cost of capital.

The key limitation of the study is the small study duration covering the pandemic period. Extension in a time period gives more choices to select other proxies as a market return to evaluate financial development. Moreover, this study has not incorporated various other factors that potentially influence stock market returns such as trading restrictions for short selling and increased margin requirement. Furthermore, as the pandemic situation is dynamic and evolving, it will be interesting to investigate the policy changing's effects on financial development during and after the third wave of COVID-19.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Ahmad, E., Stern, N., & Xie, C. (2020). *From rescue to recovery: towards a post-pandemic sustainable transition for China*. Beijing: China Development Forum. https://cdrf.org.cn/jjh/pdf/towards%20a%20post-pandemic%20sustainable%20transition%20for%20China.pdf

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

Alfaro, L., Chari, A., Greenland, A. N., & Schott, P. K. (2020). *Aggregate and firm-level stock returns during pandemics, in real time*. National Bureau of Economic Research.

Ali, M., Alam, N., & Rizvi, S. A. R. (2020). Coronavirus (COVID-19)—An epidemic or pandemic for financial markets. *Journal of Behavioral and Experimental Finance*, *27*, 100341. https://doi.org/10.1016/j.jbef.2020.100341

Aloui, R., Aïssa, M. S. B., & Nguyen, D. K. (2011). Global financial crisis, extreme interdependences, and contagion effects: The role of economic structure? *Journal of Banking & Finance*, *35*(1), 130–141. https://doi.org/10.1016/j.jbankfin.2010.07.021

Alshubiri, F. N., Tawfik, O. I., & Jamil, S. A. (2020). Impact of petroleum and non-petroleum indices on financial development in Oman. *Financial Innovation*, *6*(1), 1–22. https://doi.org/10.1186/s40854-020-00180-7

Apergis, N., & Apergis, E. (2020). Can the COVID-19 pandemic and oil prices drive the US partisan conflict index? *Energy Research Letters*, *1*(1), 1–4.

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

Atil, A., Nawaz, K., Lahiani, A., & Roubaud, D. (2020). Are natural resources a blessing or a curse for financial development in Pakistan? The importance of oil prices, economic growth and economic globalization. *Resources Policy*, *67*, 101683. https://doi.org/10.1016/j.resourpol.2020.101683

Aziz, N., Sharif, A., Raza, A., & Rong, K. (2020). Revisiting the role of forestry, agriculture, and renewable energy in testing environment Kuznets curve in Pakistan: Evidence from quantile ARDL approach. *Environmental Science and Pollution Research*, *27*(9), 10115–10128. https://doi.org/10.1007/s11356-020-07798-1

Ba, S., & Bai, H. (2020). Covid-19 pandemic as an accelerator of economic transition and financial innovation in China. *Journal of Chinese Economic and Business Studies*, *18*(4), 341–348. https://doi.org/10.1080/14765284.2020.1855394

Babuna, P., Yang, X., Gyilbag, A., Awudi, D. A., Ngmenbelle, D., & Bian, D. (2020). The impact of Covid-19 on the insurance industry. *International Journal of Environmental Research and Public Health*, *17*(16), 5766. https://doi.org/10.3390/ijerph17165766

Baig, A. S., Butt, H. A., Haroon, O., & Rizvi, S. A. R. (2021). Deaths, panic, lockdowns and US equity markets: The case of COVID-19 pandemic. *Finance Research Letters*, *38*, 101701. https://doi.org/10.1016/j.frl.2020.101701

Baker, S. R., Bloom, N., Davis, S. J., Kost, K., Sammon, M., & Viratyosin, T. (2020). The unprecedented stock market reaction to COVID-19. *The Review of Asset Pricing Studies*, *10*(4), 742–758. https://doi.org/10.1093/rapstu/raaa008

Cho, J. S., Kim, T., & Shin, Y. (2015). Quantile cointegration in the autoregressive distributed-lag modeling framework. *Journal of Econometrics*, *188*(1), 281–300. https://doi.org/10.1016/j.jeconom.2015.05.003

Ciner, C., Gurdgiev, C., & Lucey, B. M. (2013). Hedges and safe havens: An examination of stocks, bonds, gold, oil and exchange rates. *International Review of Financial Analysis*, *29*, 202–211. https://doi.org/10.1016/j.irfa.2012.12.001

Conlon, T., & McGee, R. (2020). Safe haven or risky hazard? Bitcoin during the COVID-19 bear market. *Finance Research Letters*, *35*, 101607. https://doi.org/10.1016/j.frl.2020.101607

Dzigbede, K. D., & Pathak, R. (2020). COVID-19 economic shocks and fiscal policy options for Ghana. *Journal of Public Budgeting, Accounting & Financial Management*, *32*(5), 903–917. https://doi.org/10.1108/JPBAFM-07-2020-0127

Fallahgoul, H. (2021). Inside the mind of investors during the COVID-19 Pandemic: Evidence from the stocktwits data. *The Journal of Financial Data Science*, *3*(2), 134–148. https://doi.org/10.3905/jfds.2021.1.058

Gherghina, Ș. C., Armeanu, D. S., & Joldeș, C. C. (2020). Stock market reactions to Covid-19 pandemic outbreak: Quantitative evidence from ARDL bounds tests and Granger causality analysis. *International Journal of Environmental Research and Public Health*, *17*(18), 6729. https://doi.org/10.3390/ijerph17186729

Godil, D. I., Sharif, A., Agha, H., & Jermsittiparsert, K. (2020). The dynamic nonlinear influence of ICT, financial development, and institutional quality on CO2 emission in Pakistan: New insights from QARDL approach. *Environmental Science and Pollution Research*, *27*(19), 24190–24200. https://doi.org/10.1007/s11356-020-08619-1

Harvey, C. (2020). The economic and financial implications of COVID-19. 3rd April. The Mayo Center for Asset Management at the University of Virginia Darden School of Business and the Financial Management Association International virtual seminars series (2020). https://www.darden.virginia.edu/mayo-center/events/virtualspeaker-series

Hu, Y.-J., Liu, Y., & Xiao, X.-H. (2009). Investigation of the interaction between berberine and human serum albumin. *Biomacromolecules*, *10*(3), 517–521. https://doi.org/10.1021/bm801120k

Ibn-Mohammed, T., Mustapha, K. B., Godsell, J. M., Adamu, Z., Babatunde, K. A., Akintade, D. D., Acquaye, A., Fujii, H., Ndiaye, M. M., & Yamoah, F. A. (2020). A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies. *Resources, Conservation and Recycling*, *164*, 105169

Karadima, M., & Louri, H. (2021). Economic policy uncertainty and non-performing loans: The moderating role of bank concentration. *Finance Research Letters*, *38*, 101458. https://doi.org/10.1016/j.frl.2020.101458

Kim, T.-H., & White, H. (2003). *Estimation, inference, and specification testing for possibly misspecified quantile regression*. Emerald Group Publishing Limited.

Leach, M., MacGregor, H., Scoones, I., & Wilkinson, A. (2021). Post-pandemic transformations: How and why COVID-19 requires us to rethink development. *World Development*, *138*, 105233. https://doi.org/10.1016/j.worlddev.2020.105233

Li, Z., & Zhong, J. (2020). Impact of economic policy uncertainty shocks on China's financial conditions. *Finance Research Letters*, *35*, 101303. https://doi.org/10.1016/j.frl.2019.101303

Mazur, M., Dang, M., & Vega, M. (2021). COVID-19 and the march 2020 stock market crash. Evidence from S&P1500. *Finance Research Letters*, *38*, 101690. https://doi.org/10.1016/j.frl.2020.101690

McKibbin, W., & Fernando, R. (2020). The economic impact of COVID-19. *Economics in the Time of COVID-19*, *45*, 45–51.

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

Mirza, N., Rahat, B., Naqvi, B., & Rizvi, S. K. A. (2020). Impact of Covid-19 on corporate solvency and possible policy responses in the EU. *The Quarterly Review of Economics and Finance*, https://doi.org/10.1016/j.qref.2020.09.002

Mishra, M. K. (2020). The world after COVID-19 and its impact on global economy. ZBW – Leibniz Information Centre for Economics. http://hdl.handle.net/10419/215931

Narayan, P. K., Gong, Q., & Aliahmed, H. J. (2021). Is there a pattern in how COVID-19 has affected Australia's stock returns? *Applied Economics Letters*, 1–4. https://doi.org/10.1080/13504851.2020.1861190

Nguyen, C. P., Le, T.-H., & Su, T. D. (2020). Economic policy uncertainty and credit growth: Evidence from a global sample. *Research in International Business and Finance*, *51*, 101118. https://doi.org/10.1016/j.ribaf.2019.101118

Pak, A., Adegboye, O. A., Adekunle, A. I., Rahman, K. M., McBryde, E. S., & Eisen, D. P. (2020). Economic consequences of the COVID-19 outbreak: The need for epidemic preparedness. *Frontiers in Public Health*, *8* https://doi.org/10.3389/fpubh.2020.00241

Peng, Y., Chen, W., Wei, P., & Yu, G. (2020). Spillover effect and Granger causality investigation between China's stock market and international oil market: A dynamic multiscale approach. *Journal of Computational and Applied Mathematics*, *367*, 112460. https://doi.org/10.1016/j.cam.2019.112460

Phan, D. H. B., Iyke, B. N., Sharma, S. S., & Affandi, Y. (2021). Economic policy uncertainty and financial stability–Is there a relation? *Economic Modelling*, *94*, 1018–1029. https://doi.org/10.1016/j.econmod.2020.02.042

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

Raza, N., Shahzad, S. J. H., Tiwari, A. K., & Shahbaz, M. (2016). Asymmetric impact of gold, oil prices and their volatilities on stock prices of emerging markets. *Resources Policy*, *49*, 290–301. https://doi.org/10.1016/j.resourpol.2016.06.011

Razzaq, A., Sharif, A., Ahmad, P., & Jermsittiparsert, K. (2021). Asymmetric role of tourism development and technology innovation on carbon dioxide emission reduction in the Chinese economy: Fresh insights from QARDL approach. *Sustainable Development*, *29*(1), 176–193. https://doi.org/10.1002/sd.2139

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

Shabbir, A., Kousar, S., & Batool, S. A. (2020). Impact of gold and oil prices on the stock market in Pakistan. *Journal of Economics, Finance and Administrative Science*, *25*(50), 279–294. https://doi.org/10.1108/JEFAS-04-2019-0053

Shahbaz, M., Lahiani, A., Abosedra, S., & Hammoudeh, S. (2018). The role of globalization in energy consumption: A quantile cointegrating regression approach. *Energy Economics*, *71*, 161–170. https://doi.org/10.1016/j.eneco.2018.02.009

Shahbaz, M., Sharma, R., Sinha, A., & Jiao, Z. (2021). Analyzing nonlinear impact of economic growth drivers on CO2 emissions: Designing an SDG framework for India. *Energy Policy*, *148*, 111965. https://doi.org/10.1016/j.enpol.2020.111965

Sharif, A., Aloui, C., & Yarovaya, L. (2020). COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the

wavelet-based approach. *International Review of Financial Analysis*, *70*, 101496. https://doi.org/10.1016/j.irfa.2020.101496

Sharif, A., Baris-Tuzemen, O., Uzuner, G., Ozturk, I., & Sinha, A. (2020). Revisiting the role of renewable and non-renewable energy consumption on Turkey's ecological footprint: Evidence from quantile ARDL approach. *Sustainable Cities and Society*, *57*, 102138. https://doi.org/10.1016/j.scs.2020.102138

Su, C.-W., Huang, S.-W., Qin, M., & Umar, M. (2021). Does crude oil price stimulate economic policy uncertainty in BRICS? *Pacific-Basin Finance Journal*, *66*, 101519. https://doi.org/10.1016/j.pacfin.2021.101519

Su, C.-W., Qin, M., Rizvi, S. K. A., & Umar, M. (2020). Bank competition in China: A blessing or a curse for financial system? *Economic Research—Ekonomska Istraživanja*, 1–21. https://doi.org/10.1080/1331677X.2020.1820361

Su, C.-W., Qin, M., Tao, R., & Umar, M. (2020). Financial implications of fourth industrial revolution: Can bitcoin improve prospects of energy investment? *Technological Forecasting and Social Change*, *158*, 120178. https://doi.org/10.1016/j.techfore.2020.120178

Su, C.-W., Qin, M., Tao, R., & Zhang, X. (2020). Is the status of gold threatened by Bitcoin? *Economic Research—Ekonomska Istraživanja*, *33*(1), 420–437. https://doi.org/10.1080/1331677X.2020.1718524

Su, C.-W., Song, Y., & Umar, M. (2021). Financial aspects of marine economic growth: From the perspective of coastal provinces and regions in China. *Ocean & Coastal Management*, *204*, 105550. https://doi.org/10.1016/j.ocecoaman.2021.105550

Su, C.-W., Sun, T., Ahmad, S., & Mirza, N. (2021). Does institutional quality and remittances inflow crowd-in private investment to avoid Dutch disease? A case for emerging seven (E7) economies. *Resources Policy*, *72*, 102111. https://doi.org/10.1016/j.resourpol.2021.102111

Topcu, M., & Gulal, O. S. (2020). The impact of COVID-19 on emerging stock markets. *Finance Research Letters*, *36*, 101691. https://doi.org/10.1016/j.frl.2020.101691

Torun, E., Chang, T.-P., & Chou, R. Y. (2020). Causal relationship between spot and futures prices with multiple time horizons: A nonparametric wavelet Granger causality test. *Research in International Business and Finance*, *52*, 101115. https://doi.org/10.1016/j.ribaf.2019.101115

Tweneboah, G., Junior, P. O., & Kumah, S. P. (2020). Modelling the asymmetric linkages between spot gold prices and African stocks. *Research in International Business and Finance*, *54*, 101246. https://doi.org/10.1016/j.ribaf.2020.101246

Umar, M., Ji, X., Kirikkaleli, D., & Xu, Q. (2020). COP21 Roadmap: Do innovation, financial development, and transportation infrastructure matter for environmental sustainability in China? *Journal of Environmental Management*, *271*, 111026. https://doi.org/10.1016/j.jenvman.2020.111026

Umar, M., Ji, X., Mirza, N., & Rahat, B. (2021). The impact of resource curse on banking efficiency: Evidence from twelve oil producing countries. *Resources Policy*, *72*, 102080. https://doi.org/10.1016/j.resourpol.2021.102080

Umar, M., Mirza, N., Rizvi, S. K. A., & Furqan, M. (2021). Asymmetric volatility structure of equity returns: Evidence from an emerging market. *The Quarterly Review of Economics and Finance*, https://doi.org/10.1016/j.qref.2021.04.016

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

Umar, M., Su, C.-W., Rizvi, S. K. A., & Shao, X.-F. (2021). Bitcoin: A safe haven asset and a winner amid political and economic uncertainties in the US? *Technological Forecasting and Social Change*, *167*, 120680. https://doi.org/10.1016/j.techfore.2021.120680

Wang, Y., Zhang, D., Wang, X., & Fu, Q. (2020). How does COVID-19 affect China's insurance market? *Emerging Markets Finance and Trade*, *56*(10), 2350–2362. https://doi.org/10.1080/1540496X.2020.1791074

Wu, K., Zhu, J., Xu, M., & Yang, L. (2020). Can crude oil drive the co-movement in the international stock market? Evidence from partial wavelet coherence analysis. *The North American Journal of Economics and Finance*, *53*, 101194. https://doi.org/10.1016/j.najef.2020.101194

Yarovaya, L., Mirza, N., Abaidi, J., & Hasnaoui, A. (2021). Human capital efficiency and equity funds' performance during the COVID-19 pandemic. *International Review of Economics & Finance*, *71*, 584–591. https://doi.org/10.1016/j.iref.2020.09.017

Zhang, W., & Hamori, S. (2021). Crude oil market and stock markets during the COVID-19 pandemic: Evidence from the US, Japan, and Germany. *International Review of Financial Analysis*, *74*, 101702. https://doi.org/10.1016/j.irfa.2021.101702

Zhang, X., Cai, H., Hu, J., Lian, J., Gu, J., Zhang, S., Ye, C., Lu, Y., Jin, C., Yu, G., Jia, H., Zhang, Y., Sheng, J., Li, L., & Yang, Y. (2020). Epidemiological, clinical characteristics of cases of SARS-CoV-2 infection with abnormal imaging findings. *International Journal of Infectious Diseases*, *94*, 81–87. https://doi.org/10.1016/j.ijid.2020.03.040

Zivot, E., & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics*, *20*(1), 25–44. https://doi.org/10.1198/073500102753410372