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Analysing the impacts of unscheduled news events on stock market contagion during the epidemic

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Abstract

This paper investigates the impact of unscheduled news announcements on market contagion during the COVID-19 pandemic. Using coexceedance of stock returns as a metric for market contagion effect, we assess the contribution of news releases from the United States and China on the financial contagion of a representative group of global equity markets through a quantile analysis framework. The empirical results are mixed: news events originating in the United States have a greater impact on market contagion compared with those originating in China, especially at lower quantiles. Stock markets respond asymmetrically to good news versus bad news, and the latter lead to a sharper common fall among the markets than the boost to the market caused by good news. We also find evidence that conditional variance and investor sentiment play some role in the spread of financial market crises, despite differences in extent and direction.

KEYWORDS

coexceedance, financial contagion, quantile regression analysis, unscheduled news events

1 | INTRODUCTION

It has been a hot topic for academics to study the emergence and spread mechanisms of financial crises since the 1997 Asian financial crisis. Financial contagion is widely understood as a phenomenon where a crisis in one country or region in the financial market may spread to other countries or regions through trade, investment, and other channels. This contagion phenomenon can lead to turbulence and instability in financial markets worldwide, with profound impacts on the global economy.

In parallel, the coronavirus (COVID-19) outbreak in the beginning of 2020 has caused substantial turbulence in global financial markets. The major stock markets of the world have witnessed a sharp decline in a very short time. Many people believe that the epidemic has been the most serious challenge facing the world since the 2008 global financial crisis for the world economy. In the field of financial research, the effects of the COVID-19 epidemic are often compared with those of the global financial crisis, which has been extensively studied in the linkage, contagion and spillover effect literature (Akhtaruzzaman et al., 2021; Ando et al., 2022; Croitorov et al., 2020; Dimitriou et al., 2013; Ron et al., 2020; Zorgati et al., 2019). Indeed, these two crises have some similarities, especially in terms of the contagion effect. We can observe apparent joint ups and downs among markets over this time. Therefore, it is beneficial for both market regulators and individual investors to obtain an understanding of the mechanism and effect of market contagion during the epidemic.

In the literature, a considerable number of extant studies link economic news release to financial market behaviours. The fundamental theory lies in the fact that market news, such as financial news, market announcements and government policies, affects investors' expectations of risk–return relationships and might generate high fluctuations in asset prices (Atri & Kouki, 2021; Kamal & Wohar, 2023; Wu & Lin, 2017; Zhang et al., 2022). Birz and LottJr (2011) select headlines of newspaper stories as a measure of news and as evidence that news of GDP or unemployment has no effect on the performance of the US stock market. Huang (2018) shows that market responses depend not just on the surprise component of the news but also on how agents feel about their forecasts. Caporale et al. (2018) use a VAR-GARCH model to analyse the influence of macroeconomic news coverage by newspapers on the spillover effect of yield spread volatility in the Eurozone, finding that news volatility has a significant impact on yield spread volatility. On the other hand, Silva et al. (2022) explore the relationship between the dynamic of Brazil financial market during the GFC periods and the news releases related to monetary policies. The authors note that there are mean spillover effects from news releases on the exchange rate and the Brazilian stock index.

Economic news release is also relevant to market integration, as rational agents attempt to extract information from price fluctuations across various markets (Al-Maadid et al., 2022; Wang, 2022). Alanoud et al. (2020) analyse the effect of business and political news on stock market returns in Gulf Cooperation Council countries, finding that news released in the largest financial markets in the regions has strong spillover effects. Jiang et al. (2012) investigate how news releases from the United States and Europe influence the propagation of volatility between their respective stock markets, finding that unscheduled news announcements significantly increase implied volatility levels. Chevapatrakul and Tee (2014) review the crucial news events that originated in the United States and the United Kingdom in the 2007–2009 global financial crisis. The authors further assess the impact of these news events on market contagion by using the quantile regression technique.

In the early stages of the COVID-19 pandemic in 2020, the global equity markets experienced severe volatility associated with the epidemic. When looking back over this time of market turbulence, we observe that news events were one of the main factors driving fluctuations in the market. For example, when Wuhan, China announced the closure of the city on January 22, the Shanghai Composite Index fell by 5.24 percentage points on the following trading day. A similar situation also appeared in the United States. After the United States CDC issued a warning on February 27, the US stock market fell by more than 1900 points on two trading days and further caused the global stock markets to plummet simultaneously. These phenomena motivate us to examine how news events influence market performance in periods of market turmoil. When news announcements bring new information to the market, what is the impact of these announcements on the international financial market? Will it lead to a contagion effect? Additionally, will the market's response vary based on the country of origin of the news event? The answers to these questions are not only of theoretical interest, such as verifying whether the efficient market hypothesis theory holds in reality but also have important practical implications.

We address the above concerns by quantitatively assessing the effect of unscheduled news announcements on financial market contagion through a quantile regression framework. Our study is closely linked to and extends the existing literature in three aspects: financial contagion across international equity markets, the effect of news announcements on extreme risk spillover, and the role of the COVID-19 crisis in market interdependence. To the best of our knowledge, our study is among the first to investigate the impact of news events announcements on the stock market during the epidemic. We focus mainly on news originating from the United States and China for the reason that: the former is the world's most influential financial market and has been significantly affected by the pandemic, while the latter is one of the world's major economies and was the outbreak site of the COVID-19 pandemic. We provides insights on the asymmetric response of stock markets to good and bad news, as well as the role of conditional variance and investor sentiment in financial market crises.

Numerous studies have shown that the empirical results of market contagion research heavily rely on the testing methodology (Davidson, 2020; Dimitriou et al., 2020; Forbes & Rigobon, 2002; Luo et al., 2021; Yunus, 2013; Zorgati & Garfatta, 2021). This paper uses the concept of coexceedances in the extreme value theory framework proposed by Baur and Schulze (2005). Coexceedance refers to the extreme return (positive or negative) shared by markets on a particular trading day. For example, the 5th (95th) percentile of the overall return distribution can be used as the threshold, and the joint returns that exceed this threshold are characterized as coexceedances. We choose coexceedances as the measure for contagion effect for two reasons: First, compared with other commonly used methods for measuring contagion, coexceedances are a more direct statistical method that does not rely on the assumption of a contagion model. Second, as financial risk is usually understood as the potential losses of assets under extreme market circumstances, the coexceedances measurement can effectively avoid mistaking normal interdependence for contagion phenomena by measuring extreme values occurring simultaneously (Christiansen & Ranaldo, 2009; Handika et al., 2019).

The results of the empirical analysis suggest that the impact of news events originating from the United States on market dependency is greater than those originating from China, particularly at lower quantiles. In addition, it is observed that stock markets react differently to positive and negative news, with the latter causing a more intense market downturn than the boost provided by the former. The analysis also suggests that market contagion can be influenced by conditional variance and investor sentiment, although the extent and direction of these effects may vary.

The rest of the paper is organized as follows: the methodology is outlined in Section 2, Section 3 provides the description of the data and the discussion of the empirical research. The conclusions are given in Section 4.

2 | METHODOLOGIES

We employ a two-phase quantile regression analysis to model the process of stock market contagion. Two-stage estimation is a statistical method that involves using two separate regression models to estimate the relationship between a dependent variable and a set of independent variables. In the first stage, a model is estimated to predict the independent variables, which are then used as inputs in the second stage to estimate the relationship between the dependent variable and the predicted independent variables. This approach is often used when the independent variables are endogenous or correlated with the error term in the regression model. Two-stage estimation can help to reduce bias and improve the efficiency of the estimates, but it requires careful consideration of the choice of first-stage and second-stage models and the potential for bias transmission between the two stages. In our analysis setting, the spillover effect of conditional volatilities between the original market and the infected market are estimated via a BEKK-GARCH technique in the first phase. Then, we examine the effect of market news on market contagion by establishing a quantile regression model in the second phase. To address the problem of bias errors, we employ bootstrapping to estimate the standard errors in the second stage. We follow the method described in Efron (1987) to ensure accurate standard errors. Specifically, we perform 2500 bootstrap replications for each estimation. The coexceedance between the markets, as a measure of market contagion, is assessed as the interpreted variable of the regression model. The key interpreting factor is news events proxied by a dummy variable. We also add the conditional volatility obtained in Phase 1 and the VIX index into our model as two control variables.

2.1 | Coexceedance as a metric of market linkage

We adopt the concept of coexceedance, which was presented by Bae et al. (2003), as a measurement of financial contagion. According to Bae et al. (2003), an exceedance is defined as a return that lies below (above) the specific low (high) quantile of the marginal return distribution. This way, the occurrences of extreme returns can be separated from the non-extreme returns. Bae et al. (2003) further define coexceedances as the joint occurrences of large or small returns on a particular day. They set up an econometric model of the joint occurrences of large absolute value returns using multinomial logistic regression to assess the extent to which coexceedances can be used to assess contagions.

Baur and Schulze (2005) follow the idea of Bae et al. (2003) when assessing common occurrences of extreme returns and accommodate the measure of coexceedances into the quantile regression framework. The quantile processes allow the evolution of coexceedances to be shown over the distribution of coexceedance. The authors investigate how market announcement events affect the extent of contagion during the 1997 Asian financial crisis. Following Baur and Schulze's definition, we express coexceedance in the case of a bivariate market setting as follows:

$$Coex_t(r_1,r_2)=\begin{cases}\min(r_{1t},r_{2t}) & if \quad r_{1t}>0, r_{2t}>0\\ \max(r_{1t},r_{2t}) & if \quad r_{1t}<0, r_{2t}<0\\ 0 & \text{others}\end{cases}, \tag{1}$$

where r_{1t} and r_{2t} are the return rates of the two markets at time t, respectively. As formula (1) shows, the smaller value of the two return pairs is chosen as the coexceedance when both returns are positive, while the greater value of the two return pairs is chosen when both returns are negative; otherwise, it is equal to 0. This is a rather conservative definition because it tends to be biased towards the market that is less impacted, regardless of the change in market direction.

2.2 | Estimating volatility using the BEKK-GARCH model

The BEKK-GARCH model is an extended form of the GARCH model under multivariable conditions. By representing the conditional variance–covariance matrix among multivariate variables as a function of volatility and covariance lag values, the BEKK-GARCH model can effectively detect the dynamic time-varying correlation of multiple time series and further test the volatility spillover effect among markets. A typical BEKK-GARCH model is specified as

$$H_t = C^{'}C + \sum_{i=1}^{q} A_i^{'}\varepsilon_{t-i}\varepsilon_{t-i}^{'}A_i + \sum_{j=1}^{p} B_j^{'}H_{t-j}B_j, \tag{2}$$

where $r_t = \varepsilon_t$, $\varepsilon_t = H_t^{1/2}Z_t$. A, B, and C are $n \times n$-order matrices. $C^{'}C$ is the upper (or lower) triangle matrix, and n is the number of markets to be investigated. Here, n is equal to 2, as we examine the bivariate markets. Therefore, the BEKK-GARCH (1, 1) model can be written as

$$\begin{bmatrix} \sigma_{i,t}^2 & \sigma_{im,t} \\ \sigma_{mi,t} & \sigma_{m,t}^2 \end{bmatrix} = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{i,t-1}\varepsilon_{m,t-1} \\ \varepsilon_{m,t-1}\varepsilon_{i,t-1} & \varepsilon_{\mathrm{m},t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{21} \\ b_{12} & b_{22} \end{bmatrix} \begin{bmatrix} \sigma_{i,t-1}^2 & \sigma_{im,t-1} \\ \sigma_{mi,t-1} & \sigma_{\mathrm{m},t-1}^2 \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}. \tag{3}$$

The conditional variance $\sigma_{i,t}^2$ can be estimated by the maximum likelihood, and $\sigma_{i,t}^2$ will be further used as a control variable in the regression model we establish later.

2.3 | Modelling market contagion in a quantile regression framework

In the second stage of our analysis, we utilize the quantile regression approach to examine the connection between our explanatory variables and coexceedances across various percentiles of the coexceedance's distribution. In our quantile model, the variable that we are explaining is the coexceedance, as defined in Equation (1). As for the explanatory variables, we introduce a dummy variable to proxy for the news event factor. Additionally, we include two control variables, namely the VIX and conditional variance $\widehat{\sigma}_t$, into our analysis to account for the potential increase in coexceedance due to volatility spillover during crisis periods. The VIX index serves as an indicator of how investors perceive market uncertainty, and previous literature on financial contagion suggests that market sentiment, as captured by the VIX, plays a crucial role in the amplification of crisis effects (Ismailescu & Kazemi, 2011; Remolona et al., 2007). An increase in the VIX is typically viewed as a signal of heightened volatility due to increased uncertainty. Therefore, we anticipate a positive (negative) correlation between VIX and negative (positive) coexceedances in our specification. We also incorporate the conditional volatility estimated from the BEKK-GARCH model to account for the spillover effects between the country where the news originated and the international market on the coexceedances during the pandemic period. Based on the above analysis, we set up the following quantile regression model to reveal the effect news announcements on market contagion:

$$q_\tau(Coex_t|\Omega_t) = \alpha_\tau + \beta_\tau D_t + \gamma_\tau VIX_t + \delta_\tau \widehat{\sigma}_t, \tag{4}$$

where $q_\tau(\cdot)$ is the conditional quantile regression equation on the τth quantile; $Coex_t$ is the coexceedance calculated using the criteria in Equation (1); Ω_t is the information set at time t; and α_τ, β_τ, γ_τ, and δ_τ are parameters to be estimated. D_t denotes the dummy variable, which is equal to 1 when a news event related to the financial market takes place during the period; otherwise, $D_t = 0$. VIX_t is the implied volatility derived from the S&P 500 options contracts, which is considered a proxy of investor sentiment. Conditional volatility $\widehat{\sigma}_t$ is calculated using Equation (2), which measures the effect of volatility spillover between markets. It should be noted that coefficient β_τ measures the sensitivity of the dummy variable to the distribution of the coexceedances. If the estimation result of β_τ is significantly below zero in the low quantile of the coexceedances, it suggests that news events have brought a common negative impact to the markets and exacerbate the contagion effect. Parameter γ_τ measures the extent to which investor sentiment contributes to market correlation. If the estimated result of γ_τ is significantly negative, it suggests that the contagion effect is aggravated by investors' pessimistic sentiments.

TABLE 1 Descriptive statistics.

	United States	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
Mean	0.0023	0.0125	0.0036	0.0045	−0.0132	−0.0052	0.0042	0.0131	0.0048
SD	1.0541	0.9548	0.9541	1.2354	0.9874	2.0321	1.3654	0.6587	0.4987
Skewness	0.3054***	0.2314***	0.3154***	0.3698***	−0.1254***	−0.5145***	−0.3654***	−0.2987***	−0.2154***
t-Statistic	3.6847	8.9874	11.5847	−32.5478	−11.68	8.8748	7.5487	6.5897	5.6587
Kurtosis	6.5845***	5.9874***	5.3658***	7.5415***	6.5487***	9.8456***	11.5241***	4.9875***	3.9874***
t-Statistic	33.65	105.65	65.84	84.39	62.57	−58.54	−94.57	−60.85	59.81
Jarque-Bera	2365.54***	3541.15***	8994.58***	7541.25***	3987.56***	2987.54***	1000.58***	2543.68***	6987.54***
p-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t-Statistic	39.5414	26.5874	11.5478	22.6354	29.8475	12.3654	11.2358	9.5841	

Note: The table presents the statistic characteristics of each market's daily returns over the January 2016–June 2021 period. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

Parameter δ_τ reflects the impact of the effect of volatility spillovers on coexceedances. A significant and positive estimated result of δ_τ indicates that the intensity of market contagion is positively correlated with the current market volatility risk.

For a specified level of τ, the parameters α_τ, β_τ, γ_τ, and δ_τ can be estimated by minimizing the following linear function:

$$\min_{\alpha_\tau,\beta_\tau,\gamma_\tau,\delta_\tau} \sum_{t=1}^{T} \rho_\tau [Coex_t - q_\tau(Coex_t|\Omega_t)]$$

in which $\rho_\tau(z)$ is the check function defined as $\rho_\tau(z) = z(\tau - 1_{[z \leq 0]})$.

3 | EMPIRICAL RESEARCH

3.1 | Data description

We collect and sort out the prominent events related to the COVID-19 pandemic from the United States and China along the timeline of the epidemic's development. These events include those directly related to the epidemic, such as the death toll, urban containment measures, and the latest progress in vaccine research. It also includes the corresponding economic events, such as the newly released unemployment rate data, fiscal or monetary stimulus plans, and the government bailout program. The data are all sourced from the Centers for Disease Control and Prevention, the Ministry of Finance, the Central Bank, and other authoritative institutions in both countries. We collect a total of 77 records, 43 of which are from the United States and 34 from China. These events are scattered throughout the observation period.

We employ daily data on stock market indices for nine countries: the United States, the United Kingdom, Germany, France, Japan, China, Brazil, India, and Russia. The sample interval is from 1 January 2016 to 30 June 2021, for a total of 1347 observations; the sample incorporates the main phase of the epidemic. All data come from Datastream.

Table 1 reports the summary of statistics from the data series. All stock market returns, except for those in Japan and China, have positive mean returns. Additionally, all market returns have skewed distributions and exhibit excess kurtosis characteristics, where the United States and four European markets are skewed to the right, with the others skewed to the left. This implies a high probability of occurrence of extreme values.

To examine the variation in market interdependence during different market stages, we roughly divide the correlations into tranquillity (from 1 January 2016 to 30 November 2019) and turmoil (from 1 December 2019 to 30 June 2021) phases and show the results in Table 2. Regardless of whether China or the United States is considered the origin of the market turmoil, an apparent shift in correlation structure can be observed before and during the pandemic. For example, the unconditional correlation metric for the United States and China increased from 0.133 to 0.487.

Tables 3 and 4 present the statistical properties of the coexceedances between pairwise markets. We take the United States and China as the origin of the crisis and count the coexceedances between the United States (China) as well as the other eight markets. Table 3 shows that when the United States is served as the news source, the proportion of coexceedances to data for the whole sample is generally high at a level of ~75%. Among these coexceedances, the observed positive coexceedances are apparently more than negative coexceedances. Take the United States–United Kingdom pair as an example; the proportion of the coexceedances in the total sample data reaches 75.9%, in which the positive coexceedances account for 42.3% compared with 33.6% for negative coexceedances. Similar appearances can be observed for the remaining market pairs. When turning to China, we find that the tail-dependencies structure between Chinese markets and the other eight markets is relatively weaker, manifested as a lower proportion of coexceedances of ~60%. Moreover, the proportion of positive and negative coexceedances is very close, indicating that the performance of the Chinese stock market is relatively independent from that of the global market.

Table 4 presents the computational results for the skewness of the coexceedances. We can see that the distribution of coexceedances are all asymmetrical and left-skewed, suggesting that the markets tend to decline more sharply in response to a negative shock than they rise in response to an equivalent positive shock. These results strongly support that the utilization of a quantile

TABLE 2 Comparison of the correlation during the stable and turmoil period for the United States and China as sources of the crisis.

	United States	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States (Stable)	1	0.562	0.498	0.485	0.384	0.133	0.487	0.354	0.254
United States (turmoil)	1	0.795	0.841	0.789	0.664	0.487	0.735	0.687	0.587
China (Stable)	0.133	0.338	0.425	0.435	0.587	1	0.382	0.478	0.414
China (turmoil)	0.487	0.514	0.625	0.714	0.669	1	0.687	0.687	0.715

Note: This table reports market correlations during different market stage. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

TABLE 3 Statistical results of the coexceedances.

	United States	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States (−)	-	33.6	35.1	35.4	26.4	19.8	36.8	35.4	28.1
United States (+)	-	42.3	40.2	39.8	49.5	58.5	38.8	37.5	47.5
China (−)		28.3	28.6	28.8	30.5	-	20.5	29.8	28.5
China (+)		31.5	32.0	31.2	31.5	-	39.5	31.2	33.3

Note: The table presents the statistical properties of the coexceedances between pairwise markets. United States (−) and United States (+) refer to the negative and positive news source from the United States market, respectively, while China (−) and China (+) denote the negative and positive news source from the Chinese market, respectively.

TABLE 4 Skewness of the coexceedances.

	United States	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States	-	−1.43	−1.65	−2.23	−2.64	−1.98	−1.08	−1.58	−2.14
China	−1.98	−2.04	−2.11	−1.68	−1.59	-	−2.54	−2.36	−2.05

Note: The table presents the computing results of the skewness of the coexceedance.

regression technique for the issue of financial contagion is convenient.

3.2 | Estimation results and discussion

3.2.1 | Estimation results of the BEKK-GARCH model

We first estimate the conditional volatility via the BEKK-GARCH technique, as discussed in Section 2.2. The results suggest that the return series of U.S. and Chinese markets follow BEKK-GARCH (1, 1) and BEKK-GARCH (1, 2) specifications, respectively. The Ljung-Box statistic test also shows that this model specification fits the data well.

3.2.2 | The impact of news events on market contagion

Table 5 reports the effect of dummy variable D_t on the coexceedance during the pandemic. We find that when a news event takes place in the United States, it intensifies the contagion effect between the domestic market and the foreign market, especially in the cases of low quantiles. For example, the estimated results for the coefficient of the dummy variable are all significant at the 1% level at the 0.05th quantile except those for Russia, suggesting that markets are more inclined to fall simultaneously and sharply in a down market in response to a news release. However, these observations are not that obvious for the upper quantile cases. We can conclude that markets are asymmetrically reacting to news and more vulnerable to bad news in a down market during the pandemic, which aggravates financial crisis contagion. When turning to China as the source of news, it is rare to see a joint rise or fall between the Chinese stock market and other markets. We find evidence of contagion only for France, Japan, and India at several lower quantiles. In addition, the dummy variables have almost no impact on coexceedances at any of the upper quantiles for all the market pairs, among which Russia is an exception. The distribution of coexceedances between China and Russia is significantly affected by news events at the 95th quantile. All this evidence suggests that the linkage effect of China market on other markets is weaker than that of the US market.

3.2.3 | The impact of market sentiment on market contagion

Now, we turn our attention to the impact of market sentiment on the contagion effect. We use the Chicago Board Options Exchange volatility index as a proxy for market sentiment and report the estimation results in Table 6. The implied volatility index, also known as the fear index, reflects investors' risk attitude towards future market uncertainty. An increase in the VIX always implies that market participants are becoming pessimistic about the future of the market, which will further intensify the

TABLE 5 Regression results of the dummy variable.

Markets	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States as original								
0.05	−1.625***	−1.025***	−0.987***	−1.125***	−0.321***	−0.415***	−1.214***	−1.625
0.1	−1.213***	−1.187**	−1.412***	−1.012*	−0.456*	−0.368***	−0.412	−1.213
0.5	−1.325***	−0.987*	−1.124**	−1.041**	−0.354	−1.214**	−0.847	−1.325*
0.9	−0.324	−0.264	−0.158	−0.265	−0.415	−0.354	−0.265	−0.324
0.95	−1.123**	−0.365	−1.101*	−0.365	−0.456	0.535**	−1.021*	−1.123
China as original								
0.05	−1.306	−1.235	−0.101	−1.845**	−1.741	−1.645	−1.954**	−1.524
0.1	−1.254	−1.354-	−1.451*	−1.125	−0.987	−1.325	−1.151	−1.202
0.5	−1.354	−1.514	−1.451	−1.089	−0.987	−0.867	−0.748	−1.471
0.9	−1.234	−1.145	−1.054	−1.354	−1.415	−1.204	−1.104	−1.214
0.95	−1.025	−1.452	−2.02	−1.358	−1.451	−1.368	−1.262	−1.145**

Note: The table reports the effect of the dummy variable on the coexceedance during the pandemic. We show the regression results by considering the news events arise from the United States and China, respectively. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

TABLE 6 Regression results of the VIX variable.

Markets	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States as original								
0.05	−0.012	−0.002*	−0.022*	−0.015	−0.016	−0.002*	−0.007	−0.031
0.1	−0.002	−0.003	−0.024	−0.026	−0.027	−0.026	−0.004	−0.006
0.5	−0.002	−0.007*	−0.071	−0.069	−0.055	−0.043*	−0.047	−0.042
0.9	−0.003	−0.031	−0.029	−0.005	−0.041*	−0.039	−0.035	−0.004
0.95	−0.006***	−0.005**	−0.052*	−0.049**	−0.048**	−0.005	−0.055	−0.013
China as original								
0.05	−0.023	−0.014	−0.021	−0.027	−0.028*	−0.031	−0.002	−0.001
0.1	−0.021	−0.022	−0.003	−0.013	−0.015	−0.016	−0.002	−0.003
0.5	−0.046***	−0.051	−0.036	−0.004	−0.051	−0.015*	−0.013	−0.023
0.9	−0.042	−0.036	−0.024	−0.002	−0.005	−0.004	−0.003	−0.035
0.95	−0.009*	−0.016***	−0.015***	−0.041	−0.003	−0.002***	−0.001***	−0.003**

Note: The table reports the effect of market sentiment on the coexceedance during the pandemic. The market sentiment is proxied by the Chicago Board Options Exchange volatility index. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

spread of crises. In line with our expectation, the estimation results indicate that the VIX variable is negatively correlated with the coexceedance for both US and Chinese markets, and this correlation is more prominent at the upper quantiles. We also find that at several upper quantiles, the impact of the VIX on the coexceedance of China is stronger than that of the US Combined with the results yielded in the last section, we can summarize that the US market is more susceptible to specific risk perceptions originating from news events, while the Chinese market is commonly affected by general market sentiment.

3.2.4 | The conditional volatility during the pandemic

Table 7 shows the estimation results of conditional volatility parameter δ_τ, which assesses the impact of volatility spillover on the market contagion effect. It can be seen that conditional volatility significantly affects the coexceedance at upper quantiles for both United States and China with their respective paired markets. This finding suggests that in an 'up' market, investors react more actively to good news and that the propagation of a shock across markets is more rapid than they would be normally. However, there is little evidence to show that market contagion is affected by volatility spillover at the lower quantiles. The term δ_τ is only significant for Brazil and India at a few lower quantiles when the news has originated from the United States.

3.3 | Evaluating the performance of the model

We apply the approach proposed by Koenker and Bassett (1978) to appraise how the model fits the actual data. The results for goodness of fit (R^2) are reported in Table 8.

Generally, the model acquires a remarkably high goodness of fit in extreme quantiles for both the United States and China. For the United States, the maximum value of R^2 appears in the United States–Brazil pair, which is equal to 0.53 located at the 5th quantile. When China is considered the source of crisis, the greatest value of R^2 is equal to 0.48 and obtained at the 95th quantile between China and Russia. The remaining values of R^2 are all above the level of 0.3, suggesting that the model we established fits the data at the tails of the coexceedance distributions to a satisfactory level.

We also conduct an examination to test the discrepancy of the values of the parameters at different quantiles by using the method proposed by Koenker and Bassett. We take the 10th and 90th quantiles as typical cases and report the results in Table 9. For China, the test results for the dummy variable are significant for France, Japan, India, and Russia at the level of 5%, suggesting that the null hypothesis that there is no difference in the value of the parameters between the 10th and 90th quantiles should be rejected. For the United States, except for China, Germany, and Russia, the test results for the dummy variable for the remaining countries are all significant, which suggests that the coefficients differ at the upper and lower quantiles. The conditional volatility parameters are significantly different between the 10th

TABLE 7 Regression results of the conditional volatility variable.

Markets	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States as original								
0.05	−1.354	−2.021	−0.158	−0.192	−0.222	−2.987*	−3.021*	−0.512
0.1	−1.113	−1.635	−1.524	−1.449	−1.397	−1.687	−1.741	−0.998
0.5	−0.003	−0.125	0.325	0.458	−0.223	−0.369	−0.645	0.364
0.9	−1.326	−1.625	−1.594	−2.011	−1.658	−1.584	−2.514	−0.584
0.95	1.065***	0.996**	1.101**	2.031**	0.987	1.021	0.999**	0.978
China as original								
0.05	−0.616	−0.721	−0.687	−2.01	−1.854	−1.684	−1.234	−1.616
0.1	−0.715	−1.315	−1.287	−2.014	−0.354	−0.298	−0.958	−0.887
0.5	−0.259	−0.564	0.684	0.369	−0.351	0.414	0.264	−0.351
0.9	−1.645	−1.594	−1.445	−1.698	−1.546	−1.449	−1.369	−1.297
0.95	0.878**	0.974	0.697**	0.787	0.759**	0.818**	0.824	0.934***

Note: The table reports the results of the impact of volatility spillover on market contagion effect. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

TABLE 8 Results of goodness-of-fit of the model.

Markets	United Kingdom	Germany	France	Japan	China	Brazil	India	Russia
United States as original								
0.05	0.41	0.51	0.42	0.42	0.41	0.53	0.48	0.4
0.1	0.45	0.5	0.41	0.41	0.42	0.43	0.41	0.4
0.5	0.46	0.49	0.45	0.4	0.41	0.4	0.42	0.43
0.9	0.48	0.51	0.48	0.48	0.42	0.44	0.43	0.41
0.95	0.42	0.46	0.42	0.51	0.49	0.48	0.52	0.51
China as original								
0.05	0.45	0.47	0.47	0.46	0.45	0.46	0.47	0.44
0.1	0.35	0.32	0.33	0.34	0.37	0.36	0.31	0.33
0.5	0.33	0.33	0.35	0.36	0.31	0.3	0.32	0.35
0.9	0.32	0.35	0.34	0.36	0.31	0.38	0.4	0.33
0.95	0.45	0.44	0.42	0.43	0.39	0.35	0.41	0.48

Note: The table reports the results of goodness-of-fit of the quantile regression model at different percentiles of the return distribution.

and 90th quantiles for most cases. This confirms the convenience of including conditional volatility as a control variable in our model. Finally, we note that there is little evidence to support the assumption that there are significant differences in the estimation results for VIX variables at different quantiles. The calculation results of the test statistics are not statistically significant except for quite a few countries, suggesting the consistency of the impact of market sentiment on contagion across the extreme quantiles.

In summary, the results of the quantile regression model show that it performs well in fitting the data and has good robustness, especially at extreme quantiles. We find that the release of unexpected news events significantly intensifies the risk of down-tail contagion between markets in a falling market, despite differing in extent. Aside from news events, market sentiment and conditional volatility also exhibit some power in explaining market contagion.

3.4 | Discussion and implications

The empirical results support the hypothesis that news announcements in major countries have a significant effect on market contagion across global equity markets during the COVID-19 pandemic crisis, suggesting that investors attempt to extract information from market

TABLE 9 Test of equality of parameters at different quantiles.

	China Dummy	Conditional volatility	Volatility implied index	United States Dummy	Conditional volatility	Volatility implied index
United States	−0.954	0.027**	−2.013*			
China				−0.97	0.121*	1.213
United Kingdom	1.332	0.031**	−1.245	−1.365**	0.091**	1.336
Germany	0.874	0.022*	−1.848*	−0.798	0.134**	3.984*
France	2.346**	0.034**	−0.987	−1.598**	0.144**	1.984
Japan	2.854**	0.113**	−1.526	−1.451**	0.156**	2.031
Brazil	1.031	0.198**	−1.451	−1.745**	0.166**	1.968
India	3.123**	0.154	−1.638	−1.689**	0.173**	2.103
Russia	2.984**	0.166**	−1.345	−1.264	0.003	2.451

Note: The table reports the test result of equality of parameters at different quantiles. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

fluctuations in various markets, especially in extreme market conditions. It should be noted that extreme return linkages subject to news event releases are observed after accounting for volatility spillovers in our contagion testing specification. This, to some extent, indicates the presence of a pure contagion effect taking place in a market condition when news is released. We also observed some interesting findings regarding the heterogeneous impact of United States and China news events on market contagion. Specifically, despite China being the country where the COVID-19 outbreak first occurred, both market reactions were more sensitive to US news events compared to China news events during the pandemic, whether they were positive or negative. On one hand, negative news events from the US had a more significant drag on both the US and China markets, indicating that the US stock market remains the most critical indicator in the global financial system and exerts a tremendous impact on other markets. On the other hand, since most positive news events from the US related to the Fed's monetary easing or fiscal stimulus plans, such news events were considered as promising policy measures to resolve the crisis for market investors.

Our study can be highly linked to existing studies by Jiang et al. (2012) and Chevapatrakul and Tee (2014). These previous studies have shed light on the relationship between news events (both scheduled and unscheduled) and market integration. However, our study is among the first to investigate the effect of unscheduled news announcements from major countries in the world on market contagion during the COVID-19 pandemic. Consistent with the findings of these studies, we find evidence that information impacts market behaviour and, to some extent, test the efficient market hypothesis. However, our study provides more details on the asymmetric effect of tailed contagions in the face of news event took place.

The results of this study have useful implications for market regulators in terms of preventing financial risks and promoting market stability. Since this study provides evidence that stock markets become more integrated when new market information emerges in related countries, regulators need to address the negative effects of such news events on domestic markets in a timely manner to maintain financial market stability. On the other hand, diverse market relationships during times of frequent information releases can potentially be used as a guide for investors regarding asset allocation during market turmoil.

4 | CONCLUSION

Since the outbreak of the epidemic in January 2020, global financial markets have fallen into continuous turbulence, with frequent sharp rises and falls. During this period, an obvious market contagion effect was characterized by an increase in price comovement. In addition to being driven by the common sentiment of investors, stock market performance is affected largely by a series of news events. These events include the latest developments in the epidemic, government regulatory measures, and adjustments of monetary or fiscal policy. Therefore, it is useful for both individual investors and market regulators to obtain an understanding of the impact of news events on market performance to aid in their decision-making.

Taking coexceedance as the metric for market contagion, this paper investigates the extent to which news events contribute to financial contagion by using the quantile regression technique. We introduce the dummy variable as a proxy for news events, together with the conditional variance and implied volatility index as control variables, and regress these factors on different quantiles of coexceedance. We collect the news events released in the United States and China from 1 January 2016 to 30 June 2021, which covers the epidemic period, for empirical research, which yields some mixed results. In brief, news events that originated in the United States have a greater impact on market dependency than those that originated in China, especially at the lower quantiles. Moreover, stock markets respond asymmetrically to good news and bad news, and the latter will lead to a common drove among markets that is sharper than the boost that good news provides to the market. This suggests that fund managers and investors should consider the asymmetric responses of stock markets to news events when making investment decisions in a negative market environment, as well as be aware of the potential for market contagion and take steps to mitigate its impact on their portfolios. We also find evidence that conditional variance and investor sentiment play some role in market contagion, despite differences in extent and direction. Our study also has some limitations. For example, the analysis is based on daily data, which may not capture the dynamics of intraday trading. Additionally, the use of the BEKK-GARCH model may be subject to structural breaks. Future research could address these limitations by using more robust models and higher-frequency data.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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