RESEARCH ARTICLE

Assessing Financial Risk Spillover and Panic Impact of Covid-19 on European and Vietnam Stock market

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Abstract

This study examined the influence of tail risks on global financial markets, which aids in better understanding of the emergence of COVID-19. This study looks at the global and Vietnamese stock markets impacted by the COVID-19 pandemic to identify systemic emergencies. Risk dependent value (CoVaR) and Delta link VaR are two important tail-related risk indicators used in Conditional Bivariate Dynamic Correlation (DCC) (CoVaR). The empirical findings demonstrate that when COVID-19's worldwide spread widens, the volatility transmission of systemic risks across the global stock market and multiple exchanges shifts and becomes more relevant over time. At the time of COVID-19, the world industrial market was larger than the Vietnamese stock market, and the Vietnamese stock market posed a lesser danger to the global market. A closer examination of the link between the Vietnam value-at-risk (VaR) range index sample and the world stock index indicates a significant degree of downside risk integration in key monetary systems, particularly during the COVID-19 era. Our study findings may help regulators, politicians, and portfolio risk managers in Vietnam and worldwide during the unique moment of uncertainty created by the COVID-19 epidemic.

Keywords COVID-19 · Vietnam and global · Stock · Markets · Systemic · Risk · CoVaR · ΔCoVaR · Connectedness

Introduction

When the securities market is highly uncertain, the risk distribution widens dramatically, jeopardizing the system's overall stability. Adverse events, in particular, can cause chain reactions and pessimistic expectations (Chesbrough, 2020), (such as the 1997–98 Asian financial crisis, the 2007–2008 global financial crisis, and the 2010–2013 European debt). The new coronavirus (formally known as COVID- 19, classified as the most severe infectious disease epidemic) is putting pressure on the stock market. COVID-19 was first discovered at the end of 2019 in Wuhan, Hubei

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Province, central China (Sadiq et al., 2021a; Hale et al., 2020). A health emergency of international concern was declared on January 30, 2020. The virus has spread in all over the world since late February 2020. COVID-19 cases have been confirmed in over 12 million people around the world. By the beginning of July 2020, the budget for more than 500,000 victims has been released. The spread of COVID-19 has piqued the public's interest. In terms of the global economy's prospective, the most economic activities have been reawakened and frozen. As a result of the sudden drop, the financial market became unstable. Vietnam have experienced the most significant one-day declines in history, daily price increases indicate increased volatility (Hale et al., 2020). It is difficult to assess the economic and financial impact if the epidemic continues. Investors and portfolio managers faced unprecedented challenges because of this catastrophic event. As a result, they're forced to embark on a perilous journey to adopt new investment strategies that could boost profits while lowering risk (Mohsin et al., 2021) and (Agyekum et al., 2021).

Stock return will be hit by high volatility at the same time. COVID-19's unprecedented health crisis examines extreme parallel movements among global markets, evaluates their interdependence and infection, and impacts financial stability. It highlights the importance of making a choice. Several studies in the financial literature have looked into the financial market transmission or spillover and compared the results before and after a negative situation (Atalan, 2020; Chang et al., 2021; Crane et al., 2020; Farsalinos et al., n.d.; Lawal, 2021; Li et al., 2021; Sadiq et al., 2021b). Most of these studies use the GARCH (Multivariate Conditional Autoregressive Heterogeneous Variance) method to deal with conditional volatility and correlation. Various studies overlook the most important systemic risks in global financial markets while underestimating the potential for risk spillovers (Conlon and McGee, 2020)(Coibion et al., 2020; del Rio-Chanona et al., 2020; Id, 2021a; Prem et al., 2020; Sabat et al., 2020; Sadiq et al., 2021c; Chien et al., 2021). This has a significant impact on the stock market's stability.

The pattern created by the pandemic has led to increased risk aversion and the consequent "jumping" of liquid stocks, leading to high volatility in many risky asset classes (Sebhatu et al., 2020; Li et al., 2021; Liu et al., 2021). COVID-19 has had a fatal impact on health, but it is characterized by a global blockade of Vietnam and dark prospects in many areas (Tunio et al., 2021) and (Cavallino and De Fiore, 2020). It is also in an unprecedented dangerous economic situation.

Furthermore, according to (Lindsey et al., 2020; Xiang et al., 2021), dynamic reasoning will almost certainly play an important role at this stage of the pandemic. In response to the epidemic, the fiscal system exaggerated market panic and promoted commercial activities, resulting in sharp price

fluctuations (Yarovaya et al., 2021b)(Chen et al., 2020) As a result, rational investors liquidate high-risk assets such as stocks and replace them with safe assets such as currencies and government bonds to restructure their investment portfolios (Hepburn et al., 2020). The rapid withdrawal of the investment portfolio increases the highest risk exposure. This behavior of investors will lead to market consolidation, which will lead to financial pollution of the entire system and increase the risk of financial market turmoil (Elsheikh et al., 2021; Tropea and De Rango, 2020). The interdependence of Girardi is used in the tail in this regard (Y. Zhang et al., 2020a, b). The study also used Adrian and Brunnermeier's Delta-CoVaR (CoVaR), whose conditional hazard (CoVaR) is used for "contribution" and "exposure." These indicators exceed a certain level of reliability and the sum of value at risk (VaR), which calculates the maximum damage a country can suffer in a given period of time (Morgan et al., 2020), but VaR does not recognize that the country is part of a system that may experience instability, especially during crises and constitute a new source of systemic risk (Mukanjari and Sterner, 2020). The "contribution" of CoVaR depends on the economic difficulties of individual countries as defined in the global market VaR. (Furceri et al., 2020). The "contribution" of any country's CoVaR is the difference between the CoVaR that depends on the world market of the difficult country and the CoVaR that depends on the world market of the country in a stable state (Taherzadeh, 2021).

In this study, in order to generate CoVaR and CoVaR estimates, we first use the univariate GARCH model to calculate the VaR of global and Vietnamese exchanges and each target country market. The following uses a conditional correlation (DCC) model of two dynamic variables to estimate the global pair of each country in Vietnam (Davidsson et al., 2021).

The impact of COVID-19 on financial markets has recently become the focus of various research (Baker et al., 2020; Coccia, 2020; Goodell and Huynh, 2020; Hanke et al., 2020; Kapata et al., 2020; Kraus et al., 2020; Roser et al., 2020).

There is a lack of evidence, on whether the deadly COVID-19 epidemic has produced a major link between infectious disease, and whether this has a significant influence on stock return. In two ways, we contribute to the scientific literature. It backs up prior studies by disregarding the influence of sad occurrences on global stock markets' severe parallel movement. According to recent research, market losses under elastic situations are higher than market losses in neutral conditions (i.e. Chang et al., 2021; De Vito and Gomez, 2020). As a result, examining the distribution of tail risks in global financial markets will aid in a better understanding of communication during tough market periods like the COVID-19 era. The

14 economies most affected by COVID-191 (the United States, Spain, Italy, China, Germany, Turkey, France, the United Kingdom, Belgium, Switzerland, Netherlands, Austria, Canada, and South Korea) are included in the sample. Our findings focus on portfolio rebalancing and hedging techniques used by global portfolio managers to offset the additional systemic risks of current economic and financial developments connected to the COVID-19 pandemic. The combined results reveal a strong link between the chance of a severe stock market fall, particularly in COVID-19. This work consists of the following sections: Section 2 contains our data and descriptive analysis, whereas Section 3 describes our technique. The empirical findings are presented in Section 4. In part 5, the article contains the conclusion.

Data analysis and descriptive statistics

The Morgan Stanley Capital International (MSCI) index is used to analyze the global and Vietnamese stock markets and the stock markets of 14 other countries on daily basis. All indexes are presented in US $ and derived using the Thomson Reuters database. The target nations for the study were the United States, Italy, Spain, Germany, China, France, the United Kingdom, Turkey, Switzerland, Belgium, the Netherlands, Canada, Austria, and South Korea. There were 1,170 observations each day throughout the sample period, which ran from January 7, 2016, to July 1, 2020. It also covers COVID-19's length in order to analyze the influence of this unpredictably long period on global dynamic risk interactions: each country's stock index. According to sources, as of February 20, 2020, major financial institutions (Bloomberg, Yahoo Finance, Wall Street Journal, Financial Times, etc.) have begun to pay serious attention to the COVID-19 threat. The first phase (COVID-19 and below) runs from January 7, 2016 to February 19, 2020, and ends on December 31, 2019. Subperiod 2 (of COVID-19) will end on February 20, 2020. Our goal is to define the return of a stock as the difference between the number of the first unit in each price index, expressed as a percentage. Table 1 shows the collection of technical performance data.

In addition, all kurtosis scores indicate that all income series greater than 3 have longer sides and higher peaks than the normal distribution. Except for the conditions, all performance sets below the 1% threshold passed the Jarque–Bera test. Extensive Dickey-Fuller test results at the 1% level demonstrate the smoothness of all performance series. The null hypothesis that successive rows and their squares are not autocorrelated is rejected by the Box-Pierce Q statistic (estimated to 20 lags), showing that the sample contains substantial linear and nonlinear correlations. All performance series show volatility clusters, according to the Lagrangian ARCH multiplier statistics with ten delays.

Table 1 Basic statistics (Descriptive)

Global Countries and Vietnam	Avg	Std.Dev	Skew	Kurt.- 3	JQBR	Ag.Dflr	Q(20)	Q²(20)	ARCH
USA	0.038	0.751	− 1.415	14.932	11,242**	− 13.449**	306.266**	1289.470**	68.781**
Italy	− 0.007	1.104	− 2.110	18.474	17,476**	− 13.340**	335.818**	403.832**	27.165**
Spain	− 0.012	1.023	− 1.742	16.68	13,155**	− 13.724**	370.457**	507.126**	37.165**
Germany	0.008	0.931	− 1.137	13.889	9640**	− 13.725**	412.957**	1028.270**	63.348**
China	0.040	0.877	− 0.306	1.244	93.685**	− 14.522**	370.151**	437.271**	21.253**
France	0.014	0.927	− 1.287	14.706	10,848**	− 14.220**	430.956**	1094.170**	61.321**
UK	− 0.014	0.926	− 1.311	20.382	20,551**	− 14.104**	364.798**	755.668**	41.894**
Turkey	− 0.041	1.458	− 1.200	9.862	5014**	− 14.319**	327.436**	222.813**	23.308**
Switz	0.021	0.678	− 1.334	13.506	9225**	− 14.318**	328.490**	871.519**	62.821**
Belgium	− 0.032	0.996	− 1.365	12.771	8300**	− 13.430**	420.673**	1060.400**	75.194**
Nether	0.034	0.812	− 1.295	11.929	7252**	− 13.945**	405.591**	940.335**	50.378**
Canada	0.017	0.880	− 1.143	24.185	28,719**	− 12.516**	387.156**	1113.220**	60.921**
Austria	− 0.005	1.155	− 0.807	9.532	4549**	− 14.254**	461.637**	1805.170**	84.333**
Korea	0.022	0.989	− 0.462	9.577	4505**	− 14.221**	395.491**	453.575**	45.985**
Vietnam	0.029	0.688	− 1.349	17.666	15,543**	− 13.214**	430.821**	1208.370**	73.041**

JB is the abbreviation for the Jarque–Bera regularity test. The identification of the extension of the return series Bib Enhanced Black is abbreviated to ADF. Q (20) and Q2 (20) are drilling statistics, and trailing returns and secondary returns can have up to 20 consecutive correlations. ** The 1% threshold is used to calculate statistical significance

Methodology

Our strategy is organized in three steps. We begin by calculating the VaR of global and national stock indexes using extreme risk (VaR), and calculate the CoVaR and CoVaR of some nations based on the VaR (systemic risk exposure) of global stock markets. This enables to think about massive disasters like COVID-19. Third, it investigates the linkage system between the VaR series of 14 stock indexes and worldwide stock indexes.

Step one — VaR

Assume that the first-order AR (1) autoregressive model represents each income group in the following way: (1) It denotes a country's global market or rate of return. For potential serial correlations, consider the autoregressive rate of return. It is a constant, and the autoregressive feedback parameter is a one-time error term (T1) determined by the above-mentioned data.

$$r_{it} = c_i + v_i r_{it} - 1 + \varepsilon_{it}$$
$$\varepsilon_{it} \big| \Omega_{t-1} \approx N\big(0 H_t\big) \tag{1}$$

The conditional variance from the GARCH (1, 1) univariate model is as follows: (2) Each performance series' conditional variance is listed below. Unconditional volatility is measured by a constant. Examine ARCH's and GARCH's effects separately.

$$h_{it} = \omega_i + a_i \varepsilon_{it-1}^2 + \beta_i h_{it-1} \tag{2}$$

$$P\left(r_r^i \le V_a R_t^{i,q}\right) = q \tag{3}$$

Generate the following world or national VaR using the parameter estimate of the modified GARCH(1,1) model:

$$V_a R_{q,t}^i = \phi^{-1}(q)\sigma_t^i \tag{4}$$

The DCC-GARCH model

To estimate the correlation of variables across time, the second step is to compute the DCC-GARCH CoVaR and CoVaR specifications (Bretscher et al., 2020). As an example, consider the following conditional variance–covariance matrix: (5)

$$H_t = D_t^{\frac{1}{2}} R_t D_t^{\frac{1}{2}} \tag{5}$$

The diagonal matrix in the univariate GARCH model is the conditional standard deviation diagonal matrix. The conditional correlation matrix is created by multiplying the following numbers together:

$$R_t = \left[diag\big(Q_t\big) - 1/2\right] Q_t \left[diag(Q_t)^{-1/2}\right] \tag{6}$$

where q denotes the DCC-GARCH model's standardized residual conditional covariance matrix.

$$Q_T = \big(1 - \theta_1 - \theta_2\big)Q' + \theta_1\big(Z_t Z'_{t-1}\big) + \theta_2 Q_{t-1} \tag{7}$$

Below is the standardized residuals unconditional covariance matrix. This parameter is a non-negative scalar coefficient whose total is smaller than 1 when considering the effect of the initial shock and (Ferreira et al., 2020). (Sharif et al., 2020), quasi-maximum likelihood estimators are used to estimate the DCC-GARCH model's parameters. This is typically correct and accounts for the non-normal multivariate distribution of financial time series in general. (D. Zhang et al., 2020a, b) and (Holter et al., 2020) CoVaR is also computed as the quantile q of the conditional distribution of the world market g, depending on the national stock index I. t As follows is the definition of the indicator: (da Cruz Perez et al., 2020).

$$P(r_t^g \le CoVaR_t^{g/i,q}/r_t^i \le VaR_t^{i,q}) = q \tag{8}$$

Calculate the "contribution" of CoVaR or CoVaR to evaluate the global condition VaR of a specific nation, Vietnam, as it transitions from normal to problematic (median) (Ishak et al., 2020). This image depicts the United States. In collaboration with Girardi and (Tarrataca et al., 2021).

$$CoVaR_t^{g/i,q} = \phi^{-1}(q)\sigma_t^g \sqrt{1 - \rho_{gi,t}^2} + \Phi^{-1}(q)\rho_{gi,t}\sigma_t^g \tag{9}$$

(10) Relationships between countries that are conditional. The overall condition's standard deviation is q, and the confidence level is 5%. It also computes the total CoVaR to understand how a particular marginal risk influences the overall unconditional risk. The data may be computed particular nation has difficulties (or none) (Cox et al., 2020). To lower CoVaR, apply the following formula: (50 percent)=0.

$$\Delta CoVaR_t^{g/i,q} = CoVaR_t^{g/i,q} - CoVaR_t^{g/b,q} \tag{10}$$

It also employs procedures that are comparable to those used in equations. 9)-Eq. (10) Calculate CoVaR's exposure in domestic and international emergencies (12).

Measures of connectedness in step three / Measures to improve connection in the third phase

Zidouemba et al. (2020) suggested the vector autoregressive (VAR) process-based connecting technique. This approach employs extended VAR for predictive analysis of variance

error (FEVD). The VAR classification approach is defined as follows in this study: a vector of average i.i.d.s and a vector of matrices comprising 14 risk values and calculated parameters. The covariance matrix represents the error term. If the system's covariance is stable, the coefficient matrix's moving average is utilized, and the representation is derived recursively concerning the matrix of appearance identities. (Štreimikienė and Kaftan, 2021; Wicaksono, 2020). Where can I find the error vector's variance matrix, the standard deviation error component, and the equation's vector?

The elements of the decomposition matrix are normalized as follows: (15) The connection between VaR has no measuring range. Each VaR series' system range compatibility is determined as follows. (12) The point-to-point network connection is (13), and the VaR omnidirectional connection is the direction information in the opposite direction of VaR transmission. Greetings, VaR. For each VaR series represented by TO. To find the omnidirectional connection between all VaR series and the VaR provided in FROM, apply the equations below.

$$\Delta CoVaR_t^{g/i,q} = CoVaR_t^{g/i,q} - CoVaR_t^{g/i,50\%} \tag{11}$$

$$\Delta CoVaR_t^{g/i,q} = \phi - 1(q)\rho_{gi,t}\sigma_t^g \tag{12}$$

$$VaR_I = \sum_{i=1}^{p} \Phi VaR_{t-i} + \varepsilon_t \tag{13}$$

$$\theta_{ij}^g(H) = \frac{\sigma_{jj}^{-1}\sum_{h=0}^{H-1}(e_i^! h_h \sum ej)^2}{\sum_{h=0}^{H}(e_i^! h_h \sum ej)} \tag{14}$$

Empirical findings

We give our conclusions in this section based on the steps mentioned above for estimating CoVaR and CoVaR. The results of the third stage, which involves connectivity measurements among VaR series, are also presented.

VaR Analysis

We use the univariate GARCH model to calculate the VaR for each country stock index's global stock index.

CoVaR, ΔCoVaR and GARCH analysis

When the ARCH() coefficients are more than 0, they are all meaningful, Table 2 indicates that earlier shocks have had a beneficial influence on present changes. When > 0, all GARCH() computed percentages are likewise valid.

This indicates that historical changes in conditions in each country have a beneficial influence on current situations. Furthermore, the GARCH process has come to a halt (Li et al., 2020).

Risk analysis of global and Vietnam

The worldwide average unconditional VaR was 0.619 before the COVID-19 epidemic (that is, the sub-period before COVID-19) (see Table 3 below). This number climbed considerably to 2,182 when the COVID-19 epidemic began. As a result, the danger of global stock markets collapsing has increased, with volatility jumping from 0.472 to 1.714.

Furthermore, our findings demonstrate that, to various degrees, all markets had comparable patterns are considered within the range of (2,597–3,082) and (2,597–3,082), respectively (1,985–2,433). The incident demonstrated that global markets face negative risks in each country's stock market threats (Yao et al., 2020). According to all statistical data collected during the sample period, the stock markets of Austria, China, South Korea, and Turkey contributed the most to the CoVaR of exchanges in 14 countries.

Table 3 shows world's average CoVaR value. The sample period and the average VaR value of each of the two sub-periods are always less relevant than the market value (i.e., the average CoVaR value is more negative than the expressed VaR value). As a result, the systemic risk of stock indexes collapsing in several nations has triggered a chain reaction in the global stock market. The 14 separate stock markets are having problems, and VaR appears to be increasing. These nations contributed 0.446 percent, 0.417 percent, 324 percent, and 0.306 percent The Netherlands, Germany, Spain, and France have CoVaR ratios of 0.220 percent, 0.209 percent, 0.208 percent, and 0.207 percent, respectively, making them the world's top systemic risk suppliers. With CoVaR levels of 0.095 percent, 0.102 percent, 0.166 percent, and 0.170 percent, respectively, Vietnam, Canada, Switzerland, and Italy provided the least marginal systemic risk.

Because Cumulative Systemic Risk (CoVaR) is linked to big global financial markets, the U.S. stock market is the primary risk communication instrument during COVID-19, according to this study. These findings suggest that the adjustment of the US stock market has had a substantial influence on the VaR of global stock markets. In the worldwide market, VaRs grew by 1,821 percent, 1,579 percent, 1,551 percent, and 1,543 percent in Canada, the United Kingdom, Spain, France, and Germany, respectively. The countries that contribute the least to systemic risk are Turkey, South Korea, Switzerland, and China, with 0.996 percent, 1010 percent, 1289 percent, and 1310 percent of the global VaR market, respectively. As a result, the elasticity

Table 2 DCC-GARCH Analysis

Country	C_i	N_i	ω_i	α_i	β_i	θ_1	θ_2
USA	0.080*** (0.018)	0.467*** (0.030)	0.012*** (0.003)	0.317*** (0.056)	0.683*** (0.0370)	0.067*** (0.008)	0.932*** (0.008)
Italy	0.052 (0.037)	0.498** (0.027)	0.026* 0.015	0.199*** 0.064	0.778*** (0.072)	0.016*** (0.006)	0.984*** (0.008)
Spain	0.023 (0.037)	0.522*** (0.027)	0.041** (0.020)	0.215*** (0.076)	0.727*** (0.092)	0.029*** (0.011)	0.964*** (0.018)
Germany	0.041 (0.032)	0.0514*** (0.027)	0.022* (0.009)	0.165*** (0.044)	0.792*** (0.052)	0.023** (0.011)	0.972*** (0.022)
China	0.076 (0.042)	0.560*** (0.025)	0.032** (0.015)	0.123*** (0.035)	0.817*** (0.058)	0.085*** (0.026)	0.608*** (0.051)
France	0.046 (0.029)	0.515*** (0.027)	0.021*** (0.006)	0.210*** (0.039)	0.752*** (0.038)	0.016** (0.008)	0.983*** (0.010)
UK	0.028 (0.026)	0.490*** (0.029)	0.018*** (0.0005)	0.227*** (0.039)	0.745*** (0.034)	0.027*** (0.007)	0.969*** (0.012)
Turkey	0.078*** (0.011)	0.456*** (0.023)	0.022*** (0.002)	0.117*** (0.023)	0.953*** (0.037)	0.034*** (0.004)	0.564*** (0.013)
Switzerland	0.043 (0.023)	0.498** (0.027)	0.026* 0.015	0.167***0.054	0.778*** (0.072)	0.016*** (0.006)	0.564*** (0.007)
Belgium	0.056 (0.065)	0.522*** (0.027)	0.041** (0.020)	0.345*** (0.0744)	0.727*** (0.092)	0.054*** (0.012)	0.543*** (0.013)
Netherlands	0.023 (0.066)	0.0514*** (0.027)	0.054* (0.007)	0.143*** (0.033)	0.792*** (0.052)	0.053** (0.015)	0.543*** (0.022)
Canada	0.023 (0.067)	0.560*** (0.025)	0.076** (0.013)	0.167*** (0.035)	0.817*** (0.058)	0.032*** (0.024)	0.454*** (0.051)
Austria	0.064 (0.012)	0.515*** (0.027)	0.056*** (0.007)	0.210*** (0.039)	0.752*** (0.038)	0.014** (0.005)	0.954*** (0.010)
Korea	0.033 (0.021)	0.490*** (0.029)	0.016*** (0.015)	0.227*** (0.039)	0.745*** (0.034)	0.031*** (0.006)	0.643*** (0.013)
Vietnam	0.045*** (0.015)	0.467*** (0.030)	0.0125*** (0.003)	0.317*** (0.017)	0.683*** (0.0370)	0.043 (0.006)	0.954*** (0.022)

In parenthesis, SEs with high calculation coefficients are displayed. *** Indicates statistical significance at the 1% significance level; ** indicates statistical significance at the 5% significance level. Enter a ten percent significance criterion for statistical significance

Table 3 Vietnam and Global stock market analysis

		CoVaR			ΔCoVaR		
		Before COVID-19	During COVID-19	Whole sample	Before COVID-19	During COVID-19	Wholesample
Vietnam/USA	MeanSD	− 0.500 0.443	− 2.597 1.985	− 0.671 0.910	− 0.084 0.207	− 2.130 1.690	− 0.095 0.798
Vietnam /Italy	Mean SD	− 0.673 0.524	− 3.072 2.051	− 0.868 1.075	− 0.060 0.087	− 1.412 1.109	− 0.170 0.493
Vietnam /Spain	Mean SD	− 0.696 0.550	− 3.080 2.419	− 0.890 1.085	− 0.089 0.132	− 1.551 1.300	− 0.208 0.559
Vietnam /Germany	Mean SD	− 0.700 0.565	− 3.082 2.422	− 0.894 − 1.093	− 0.092 0.133	− 1.524 1.245	− 0.209 0.543
Vietnam /China	Mean SD	− 0.852 0.655	− 3.041 2.413	− 1.030 1.107	− 0.337 0.290	− 1.310 1.227	− 0.417 0.520
Vietnam /France	Mean SD	− 0.697 0.553	− 3.081 2.423	− 0.891 1.088	− 0.088 0.121	− 1.543 1.223	− 0.207 0.541
Vietnam /UK	Mean SD	− 0.682 0.556	− 3.081 2.419	− 0.877 1.091	− 0.073 0.131	− 1.579 1.282	− 0.195 0.564
Vietnam /Turkey	Mean SD	− 0.808 0.636	− 2.921 2.383	− 0.980 1.080	− 0.245 0.240	− 0.996 1.010	− 0.306 0.422
Vietnam /Switzerland	Mean SD	− 0.678 0.547	− 3.031 2.433	− 0.869 1.082	− 0.066 0.114	− 1.289 1.218	− 0.166 0.494
Vietnam /Belgium	Mean SD	− 0.689 0.550	− 3.066 3.074	− 0.883 1.084	− 0.078 0.110	− 1.386 1.121	− 0.185 0.490
Vietnam /Netherland	Mean SD	− 0.713 0.572	− 3.074 2.422	− 0.905 1.092	− 0.107 0.138	− 1.489 1.295	− 0.220 0.544
Vietnam /Canada	Mean SD	− 0.552 0.481	− 3.019 2.380	− 0.752 1.062	− 0.050 0.148	− 1.821 1.420	− 0.102 0.666
Vietnam /Austria	Mean SD	− 0.856 0.656	− 3.040 2.373	− 1.034 1.100	− 0.359 0.328	− 1.417 1.336	− 0.446 0.572
Vietnam /Korea	Mean SD	− 0.821 0.640	− 2.933 2.374	− 0.993 1.080	− 0.262 0.240	− 1.010 0.978	− 0.324 0.415
		Global VaR					
Vietnam	Mean SD	Pre-COVID-19		During COVID-19		Full sample	
		− 0.619 0.472		− 2.182 1.714		− 0.746 0.791	

In parenthesis, SEs with high calculation coefficients are displayed. *** Indicates statistical significance at the 1% significance level; ** indicates statistical significance at the 5% significance level. Enter a ten percent significance criterion for statistical significance

of such markets' market circumstances may extend to other areas of the world.

During the research period, Fig. 1 depicts the general trend of VaR and CoVaR in each nation (2016–2020). The values of Universal VaR and CoVaR change over time on various scales in response to comparable patterns, as illustrated in the figure. Before the occurrence of COVID-19, none of the VaR or CoVaR values had changed significantly. These figures, on the other hand, have altered dramatically during COVID-19. Table 3's technical data supports this conclusion even more.

The world and Vietnam face systemic risks

Table 4 contains descriptive statistics of the average values of VaR, CoVaR, and ΔCoVaR for all In the sub-period before COVID-19 (1.875), Turkey had the highest level of value at risk (absolute value), while the United States had the lowest risk (0.759). So, in the sample, Turkey is the country with the highest risk, and the United States is the safest country.

According to the CoVaR statistics in Table 4, severe total losses will be transferred to the national stock market as a result of global market benefits. Seconds before a pandemic All stock markets have risen rapidly as a result of severe losses. This figure gives no indication of the future economic and financial climate. Global stock markets will have a significant negative influence on local stock markets throughout the COVID-19 era, damaging investors' stock values. Furthermore, based on our experience and estimations, Belgium,

Austria, the United Kingdom, and Canada have CoVaR values of 4,446, 4,348, and 4,168, respectively. The most exposed markets for CoVaR are France, Italy, Germany, and Spain, with a price of 3,841,3,749,3,714,3680. China, Switzerland, Turkey, and Vietnam, on the other hand, are low-risk markets, with a CoVaR price of 2215,2668,2834,2947. The average and standard deviation of a single daily CoVaR value is shown in the final three columns of Table 4.

The 5 percent VaR of global stock markets has been realized in average by 0.792 percent, 0.742 percent, 0.655 percent, and 0.536 percent. CoVaR values in Spain, Belgium, the United Kingdom, Germany, France, and the worldwide market are 0.309 percent, 0.288 percent, 0.286 percent. With the lowest marginal risk, the United States, Canada, Switzerland, and CoVaR had values of 0.104 percent, 0.111 percent, and 0.164 percent, respectively. The study found that the marginal systemic risk of global stock markets in specific economies is higher than the risk of the Vietnamese stock market. It can be compared to the amount of money spent on systemic risk (Table 4).

In the COVID-19 sub-period (see the last three columns of Table 4), the relevant results of the indicate that the US stock market is the primary beneficiary. Risky market. For example, the global market increased the US VaR by 2.516%. These data suggest that the North American and British stock markets were less susceptible to the severe side effects of global stock market systemic risks during the COVID-19 sub-period.

Throughout the sample period, Fig. 2 depicts the VaR and CoVaR series derived in various nations from global
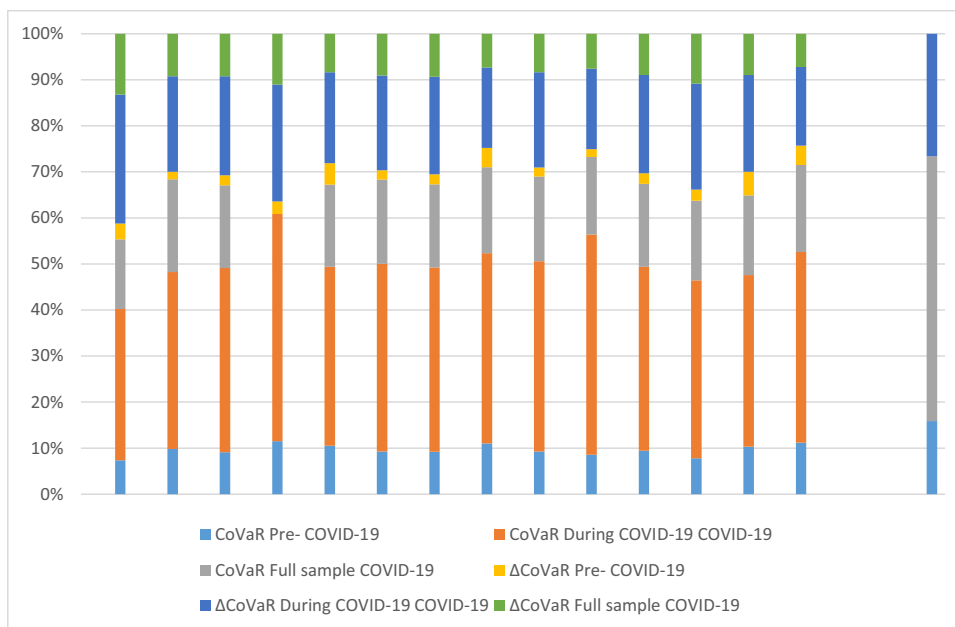
Fig. 1 ΔCoVaR/Global and Vietnam

Table 4 VaR, CoVaR, and ΔCoVaR of the world and Vietnam stock exchanges

Country		VaR (Mean SD)			CoVaR (Mean SD)			ΔCoVaR (Mean SD)		
		Pre-COVID-19	During COVID-19	Full sample	Pre-COVID-19	During COVID-19	Full sample	Pre-COVID-19	During COVID-19	Full sample
USA	Mean SD	−0.759 0.5546	−2.579 1.895	−0.907 0.907						
USA/Vietnam	Mean SD				−0.608 0.492	−3.071 2.193	−0.809 1.033	−0.109 0.260	−2.516 1.870	−0.104 0.928
Italy	Mean SD	−1.226 0.816	−2.664 2.053	−1.343 1.053						
Italy/Vietnam	Mean SD				−1.329 0.902	−3.749 2.892	−1.526 1.366	−0.112 0.153	−1.720 1.319	−0.243 0.597
Spain	Mean SD	−1.186 0.752	−2.608 1.747	−1.302 0.958						
Spain/Vietnam	Mean SD				−1.339 0.896	−3.680 2.466	−1.529 1.281	−0.174 0.228	−1.839 1.334	−0.309 0.632
Germany	Mean SD	−1.036 0.552	−2.630 1.617	−1.165 0.826						
Germany/Vietnam	Mean SD				−1.164 0.654	−3.714 2.286	−1.372 1.142	−0.145 0.166	−1.833 1.193	−0.282 0.595
China	Mean SD	−1.168 0.566	−1.592 0.891	−1.203 0.610						
China/Vietnam	Mean SD				−1.608 0.783	−2.215 1.256	−1.657 0.848	−0.630 0.342	−0.936 0.630	−0.655 0.383
France	Mean SD	−0.984 0.617	−2.720 1.753	−1.126 0.908						
France/Vietnam	Mean SD				−1.104 0.714	−3.841 2.481	−1.327 1.236	−0.134 0.157	−1.928 1.254	−0.280 0.625
UK	Mean SD	−1.023 0.724	−2.951 1.783	−1.180 1.009						
UK/Vietnam	Mean SD				−1.130 0.878	−4.168 2.518	−1.377 1.383	−0.122 0.217	−2.133 1.344	−0.286 0.702
Turkey	Mean SD	−1.875 1.031	−2.120 1.277	−1.895 1.055						
Turkey/Vietnam	Mean SD				−2.440 1.394	−2.834 1.778	−2.472 1.433	−0.724 0.591	−0.953 0.735	−0.742 0.607
Switzerland	Mean SD	−0.796 0.415	−1.925 1.303	−0.888 0.626						
Switzerland/Vietnam	Mean SD				−0.868 0.480	−2.668 1.860	−1.014 0.858	−0.079 0.113	−1.122 0.958	−0.164 0.409
Belgium	Mean SD	−1.146 0.519	−3.165 1.789	−1.310 0.901						
Belgium/Vietnam	Mean SD				−1.269 0.956	−4.446 2.525	−1.527 1.264	−0.136 0.135	−2.009 1.180	−0.288 0.626
Netherland	Mean SD	−0.898 0.541	−2.099 1.427	−0.995 0.736						
Netherland/Vietnam	Mean SD				−1.033 0.661	−2.956 2.019	−1.190 1.004	−0.154 0.174	−1.421 1.095	−0.257 0.495
Canada	Mean SD	−0.830 0.524	−2.914 2.361	−0.999 1.015						
Canada/Vietnam	Mean SD				−0.713 0.713	−4.031 3.282	−0.983 1.384	−0.094 0.175	−2.435 1.954	−0.111 0.904
Austria	Mean SD	−1.192 0.598	−3.115 1.844	−1.349 0.939						
Austria/Vietnam	Mean SD				−1.651 0.836	−4.348 2.572	−1.870 1.313	−0.685 0.426	−1.999 1.426	−0.792 0.679
Korea	Mean SD	−1.188 0.486	−2.204 1.384	−1.270 0.671						
Korea/Vietnam	Mean SD				−1.573 0.655	−2.947 1.878	−1.685 0.906	−0.497 0.240	−0.987 0.717	−0.536 0.336

For the whole time and two periods of the model, this table provides the average price and standard deviation of the domestic stock market VAR, CoVaR, and ΔCoVaR. (Both before too and during COVID-19)

stock markets. At the start of COVID-19, however, all VaRs and CoVaRs had aberrant severity. Table 4 shows the data, which support this conclusion.

Analysis of VaR connectivity measurements

The correlation system between the VaR series of 14 stock indexes and global stock indexes is discussed in this section. This suggests that there are dangers on the downside. Let's have a look at the VaR series correlation matrix first in Table 5. The pairs United Kingdom-Switzerland, United Kingdom-Netherlands, United Kingdom-Nether except for China and Turkey, Vietnam's VaR is closely linked to the VaR of all nations.

Static analysis

First, let's look into static testing. (Brands and Gavin, 2020) proposed using VaR series to create a generic VAR connection network with a 10-step delay and lead time. The VAR model is used to generate the decomposition matrix, and the lag and prediction time are advanced ten steps, as shown in Table 6. This high number denotes the global stock market system's high-risk integration. In particular, Turkey, China, and South Korea have minor contributions to the VaR system's risk, with values of 21.20 percent, 40.44 percent, and 45.04 percent, respectively. With a score of 179.79 percent, the worldwide index's VaR system risk is the greatest however, the major beneficiary of the net risk is (percentage).

Time-varying analysis / Changes over time analysis

The time variations of the downside risk spillover of 14 stock indexes and global stock indexes shows that the dynamic integration of the VaR series trading system based on a 200-day trading window is shown in Fig. 3. There are various values for the global spillover index. The steep drop in the first half of 2017, and a further drop to 59 percent in February 2018, was owing to trade tensions between the United States and China and the United Kingdom's concern about the EU's prospects.

    After that, it stabilized in the range of about 70%. In particular, risk connectivity has steadily increased since February 2020, reaching a peak of approximately 93% at the end of March 2020. 5 The outbreak of COVID-19 is the cause of the significant increase in the global leak rate within the VaR system. The latter caused severe foreclosures, leading to global economic recession and financial market turmoil (Estrada et al., 2020). This is consistent with previous studies, which show that the risk of recurrence rates for all indicators has increased. The 2007–2008 global financial crisis, etc.(Dupor and Guerrero, 2017; Dutta, 2018; Gurara and Ncube, 2013; Yarovaya et al., 2021a).

    Figure 4 depicts the VaR system's net downside risk findings, which comprise 14 stock indexes and worldwide stock indexes. Based on the produced patterns, three distinct groups may be identified. Pure VaR receivers from the United States, Italy, Spain, Germany, the United Kingdom, group (except from late February to early February). The deadline is July 2020. (It's sub-period 19 in this case.) Countries that are net emitters of value-at-risk outflows, such
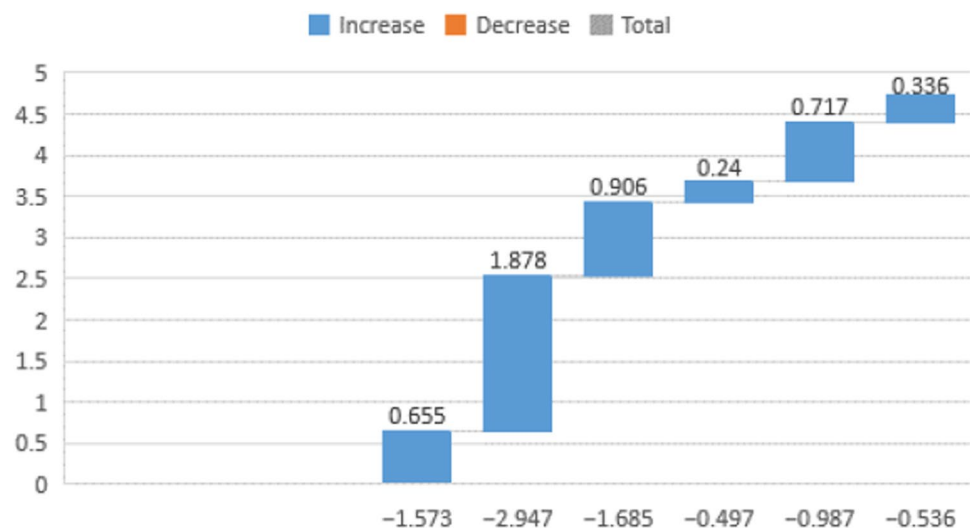
Fig. 2 ΔCoVaR/Country

Table 5 VaR series correlation

	USA	Italy	Spain	Germany	China	France	UK	Turkey	Switzerland	Belgium	Netherlands	Canada	Austria	Korea	Vietnam
USA	1.000														
Italy	0.653	1.000													
Spain	0.646	0.941	1.000												
Germany	0.768	0.906	0.904	1.000											
China	0.458	0.430	0.424	0.507	1.000										
France	0.770	0.922	0.930	0.973	0.487	1.000									
UK	0.745	0.893	0.905	0.929	0.446	0.949	1.000								
Turkey	0.197	0.298	0.285	0.289	0.274	0.283	0.253	1.000							
Switzerland	0.796	0.835	0.829	0.895	0.503	0.901	0.884	0.248	1.000						
Belgium	0.776	0.801	0.813	0.889	0.478	0.886	0.845	0.281	0.852	1.000					
Netherlands	0.753	0.908	0.907	0.950	0.528	0.961	0.923	0.292	0.898	0.870	1.000				
Canada	0.858	0.736	0.722	0.807	0.455	0.818	0.796	0.225	0.828	0.800	0.773	1.000			
Austria	0.697	0.735	0.753	0.797	0.499	0.797	0.787	0.319	0.738	0.800	0.754	0.760	1.000		
Korea	0.612	0.571	0.569	0.662	0.665	0.651	0.604	0.307	0.630	0.643	0.650	0.617	0.626	1.000	
Vitnam	0.849	0.733	0.735	0.823	0.589	0.830	0.803	0.304	0.816	0.806	0.805	0.804	0.829	0.718	1.000

as the globe. The latter two, on the other hand, apply to COVID-19 pandemic net beneficiaries. The securities markets in the third category (France and South Korea) may be the net beneficiaries of the VaR pandemic or the VaR pandemic's net issuers. Net transmitters at other times and net receivers at different times make up the remaining sample periods. The predicted period of 5 days and the window of days will remain unchanged.

Robustness tests

The robustness test of the paper results shows that the model analyses were conducted repeatedly with dependent and independent variables. The VaR, $CoVaR$, and $\Delta CoVaR$ averages Throughout the whole sample period as well as the two sub-periods, all of the countries that were picked across countries demonstrated a continuous upward trend around the pandemic's beginning. All samples of study applied the model tests. When the Table 7 rows and columns data is verified, it can be observed that the model tests results support our results of the study.

Conclusions

The substantial impact of systemic risk between Vietnam and global stock indexes in 14 nations badly impacted by the COVID-19 pandemic which is examined in this study. To develop the two greatest risk certainty metrics, CoVaR and CoVaR, we first utilize bivariate and multivariate DCC-GARCH models. According to empirical findings, the transmission of systemic risks between global stock markets and individual exchanges surged during the COVID-19 epidemic. The North American stock market and established European markets have communicated and displayed a generally high market index risk during this pressure stage, which is primarily lower than the Vietnamese stock market.

This is similar to the overflow method used by contemporary guitarists. Overall, the findings suggest that the inventory system is in jeopardy, particularly during the COVID-19 epidemic. This is in line with prior research conducted under stressful conditions such as strong economic depression episodes. This episode demonstrates that systemic risk is transferred in both directions between people and the global stock market. This enables foreign investment and portfolio managers to efficiently assess, monitor, and manage portfolio risk using the findings of this study. Second, the substantial reliance on domestic and global stock markets, particularly on global problems like COVID-19, must be taken into account when calculating systemic risk. Ignoring the component of systemic risk may lead to an underestimation of the amount of diversification tolerance as well as the influence of systemic risk on risk management.

Table 6 Var Analysis (spillover)

	USA	Italy	Spain	Germany	China	France	UK	Turkey	Switzerland	Belgium	Netherlands	Canada	Austria	Korea	Global	FROM
USA	16.47	3.94	4.00	5.60	2.73	6.85	6.00	0.58	5.55	5.64	5.39	9.78	8.45	3.10	15.94	83.53
Italy	3.17	12.15	9.28	6.76	1.92	8.81	8.95	1.77	5.03	5.13	7.11	4.48	11.33	2.24	11.87	87.85
Spain	2.95	9.06	11.65	6.77	1.86	8.95	9.32	1.70	4.88	5.37	6.97	4.42	11.85	2.35	11.90	88.35
Germany	4.80	7.05	6.77	8.81	2.55	9.08	8.61	1.50	5.55	6.07	7.13	5.58	11.05	2.48	12.99	91.19
China	3.96	2.22	1.94	3.17	32.25	3.43	2.98	2.67	3.17	3.12	3.81	4.51	8.23	10.60	13.94	67.75
France	4.76	7.13	7.38	7.32	2.36	9.86	9.03	1.53	5.38	5.84	7.07	5.66	10.93	2.57	13.18	90.14
UK	4.84	7.06	7.55	6.83	1.92	8.91	12.64	1.16	5.72	5.35	6.86	5.40	10.50	2.33	12.94	87.37
Turkey	2.36	2.34	1.67	1.64	1.88	1.83	1.72	63.61	1.28	2.27	1.75	2.20	6.28	2.63	6.56	36.39
Switzerland	6.22	6.22	6.08	6.66	2.72	8.18	8.18	1.07	10.53	5.92	6.88	6.54	8.47	3.06	13.29	89.47
Belgium	6.23	5.83	6.12	6.87	2.06	8.14	7.61	1.29	6.08	11.89	6.78	6.83	9.57	2.12	12.59	88.11
Netherlands	4.43	6.89	6.84	7.11	3.08	8.98	8.59	1.76	5.72	5.75	9.19	4.73	10.20	2.89	13.85	90.81
Canada	8.96	5.59	5.24	6.01	2.40	7.64	7.26	0.91	6.45	6.00	5.63	13.72	9.28	2.80	12.13	86.28
Austria	6.52	4.95	5.37	5.38	2.37	6.58	7.63	1.49	4.67	6.69	4.76	8.18	19.46	2.14	13.82	80.55
Korea	6.04	3.01	2.54	4.35	8.95	4.67	4.03	2.45	3.29	4.57	4.06	6.75	9.05	21.45	14.80	78.55
Global	9.54	4.55	4.59	5.55	3.64	6.90	6.61	1.32	5.02	5.29	5.11	7.86	10.51	3.74	19.76	80.24
Contribution to others	74.80	75.82	75.35	80.00	40.44	98.94	96.52	21.20	67.79	72.99	79.30	82.89	135.70	45.04	179.79	1226.57
Contribution including own	91.26	87.97	87.00	88.81	72.69	108.81	109.16	84.80	78.32	84.88	88.49	96.61	155.16	66.49	199.55	TCI=81.7%
Net spillovers	−8.74	−12.03	−13.00	−11.19	−27.31	8.81	9.16	−15.20	−21.68	−15.12	−11.51	−3.39	55.16	−33.51	99.55	

This table depicts the value at risk (VaR) spillover impact on several equity markets

Fig. 3 Dynamic interconnection of VaR intervals in the market system
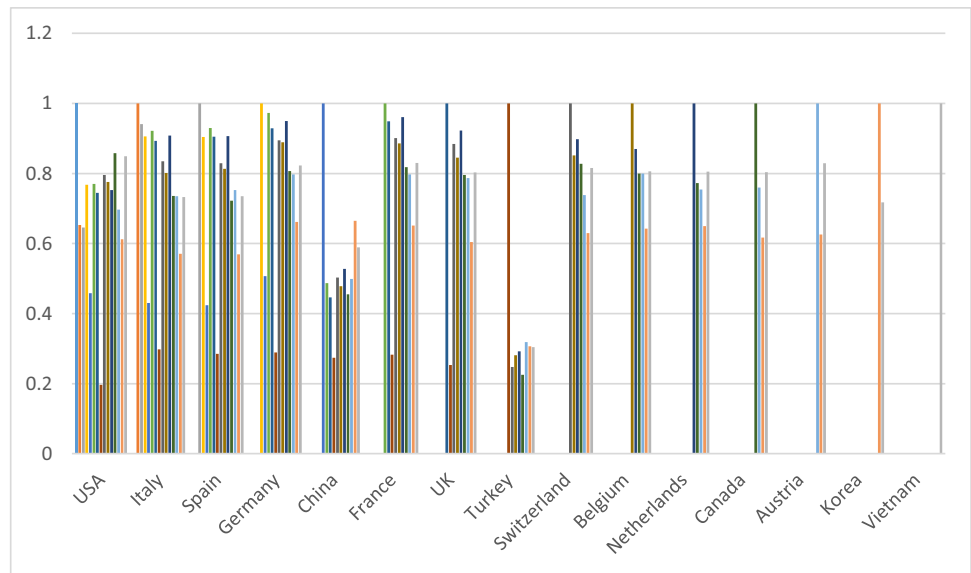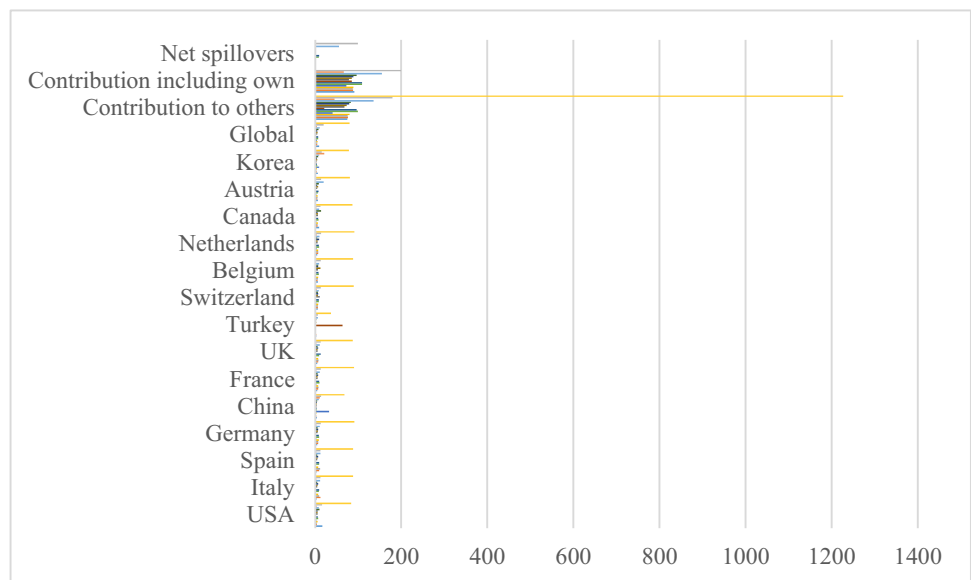

Fig. 4 All spillover model results

The United States has the world's largest stock market, and it may be considered a significant stock market if it has received or has received the greatest marginal risk in the global market during COVID-19. This indicates the need to diversify the capital portfolio while it is under stress. Third, COVID-19 was first listed in China, but as the pandemic spreads throughout the world.

As a result, any developments in China pertaining to the likelihood of a second COVID-19 wave should be closely observed. This is especially significant for North American and European investors. Global regulators and policymakers must evaluate the substantial interdependencies across financial markets, as well as probable changes during stressful moments, when assessing, quantifying, or categorizing systemic financial risks. Our connection metrics are relevant to building financial stability solutions with a low-risk appetite. Given the scope of the COVID-19 epidemic, systemic risks will skyrocket, as will global financial market resistance to difficulties. As a result, taking proactive steps to mitigate systemic risks is critical. Because different economic systems have different degrees of effect on systemic risks in the global market, the findings of our study can be utilized as a guide. As a result, sensible steps must be taken to reduce the excessive risk of global stock markets while maintaining the stability of local stock markets, particularly in the case of the COVID-19 outbreak's second wave. Further study may look at the systemic risk spillovers induced by COVID-19 in the global and domestic stock markets at the sectoral level as well.

Table 7 The model *VaR*, *CoVaR* and *ΔCoVaR* of global and Vietnam stock market

Country		VaR			CoVaR			ΔCoVaR		
		Pre- COVID-19	During COVID-19	Full sample	Pre- COVID-19	During COVID-19	Full sample	Pre- COVID-19	During COVID-19	Full sample
USA	Mean SD	−0.758 0.5547	−3.578 2.896	−0.908 0.908						
USA/Vietnam	Mean SD				−0.609 0.493	−3.072 2.194	−0.808 1.035	−0.108 0.370	−3.516 2.880	−0.105 0.929
Italy	Mean SD	−2.227 0.817	−3.665 3.054	−1.344 2.054						
Italy/ Vietnam	Mean SD				−2.328 0.904	−4.748 4.894	−2.527 3.368	−0.114 0.155	−3.740 3.319	−0.245 0.599
Spain	Mean SD	−3.189 0.754	−4.608 4.748	−2.303 0.958						
Spain/ Vietnam	Mean SD				−3.339 0.897	−5.680 3.467	−2.529 2.282	−0.175 0.229	−2.838 2.335	−0.308 0.633
Germany	Mean SD	−2.037 0.553	−3.640 2.618	−3.167 0.827						
Germany/ Vietnam	Mean SD				−2.165 0.654	−4.715 2.286	−1.37 1.142	−0.145 0.166	−1.833 1.193	−0.282 0.595
China	Mean SD	−1.168 0.566	−1.592 0.891	−1.203 0.610						
China/ Vietnam	Mean SD				−1.608 0.783	−2.215 1.256	−1.657 0.848	−0.630 0.342	−0.936 0.630	−0.655 0.383
France	Mean SD	−0.984 0.617	−2.720 1.753	−1.126 0.908						
France/ Vietnam	Mean SD				−1.104 0.715	−3.841 3.482	−3.32 2.238	−0.135 0.158	−2.929 2.255	−0.290 0.626
UK	Mean SD	−1.023 0.725	−3.952 2.784	−2.190 2.008						
UK/ Vietnam	Mean SD				−2.140 0.879	−5.169 3.519	−2.378 2.384	−0.123 0.218	−3.134 2.345	−0.287 0.703
Turkey	Mean SD	−2.877 2.033	−3.130 3.278	−2.88 2.056						
Turkey/ Vietnam	Mean SD				−3.450 3.395	−3.835 2.779	−4.474 2.436	−0.73 0.593	−0.954 0.736	−0.743 0.608
Switzerland	Mean SD	−0.797 0.416	−2.926 2.304	−0.889 0.627						
Switzerland/ Vietnam	Mean SD				−0.869 0.490	−3.669 2.870	−2.015 0.859	−0.078 0.114	−2.123 0.959	−0.165 0.408
Belgium	Mean SD	−1.146 0.519	−3.165 1.789	−1.310 0.901						
Belgium/ Vietnam	Mean SD				−1.269 0.956	−4.446 2.525	−1.527 1.264	−0.136 0.135	−2.009 1.180	−0.288 0.626
Netherland	Mean SD	−0.898 0.541	−2.099 1.427	−0.995 0.736						
Netherland/ Vietnam	Mean SD				−1.033 0.661	−2.956 2.019	−1.190 1.004	−0.154 0.174	−1.421 1.095	−0.257 0.495
Canada	Mean SD	−0.830 0.524	−2.914 2.361	−0.999 1.015						
Canada/ Vietnam	Mean SD				−0.713 0.723	−4.031 3.282	−0.983 1.384	−0.094 0.175	−2.435 1.954	−0.111 0.904
Austria	Mean SD	−1.192 0.598	−3.115 1.844	−1.349 0.939						
Austria/ Vietnam	Mean SD				−1.652 0.836	−4.344 2.572	−1.890 1.313	−0.685 0.426	−1.999 1.426	−0.792 0.688
Korea	Mean SD	−1.189 0.486	−2.204 1.384	−1.270 0.671						
Korea/ Vietnam	Mean SD				−1.574 0.656	−2.948 1.878	−1.695 0.906	−0.499 0.240	−0.988 0.719	−0.546 0.337

above table using these models *VAR, CoVaR, and ΔCoVaR* for robustness test

Declarations

Ethical Approval and Consent to Participate It is declared that the authors have no known competing financial interests or personal relationships that seem to affect the work reported in this article. We declare that we have no human participants, human data, or human tissues.

Consent for Publication Not Applicable.

Conflict of interest It is declared that there is no conflict of interest.

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