ISSN: 2783-2678

International journal of Innovation in Management Economics and Social Sciences

Journal homepage: www.ijimes.ir

Int. J. Inn. Man. Eco. Soc. Sci. Vol. 2, No 3, 82-102. (2022)

China Real Estate Price and Stock Market Volatility during COVID-19

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ARTICLE INFO	ABSTRACT
Received: 24 April 2022 *Reviewed: 25 June 2022* *Revised:27 June 2022* *Accept: 05 July 2022* ***Keywords: Volatility Spillover Effect, COVID-19, GHARCH, Real Estate, Stock Market***	**Purpose:** This study examined the response of stock prices on the China Stock Exchange (SSE) and Real Estate prices to COVID-19 using an event study approach and the GARCH model. **Methodology:** In this study, the dimensions and key components of the use of large data obtained from the Internet of Things (IoT) in an industry's supply chain are investigated as a case study. Finally, a model for implementing an agile and lean supply chain based on IoT data analysis to improve the supply chain performance of these industries during emergency drug distribution during critical conditions is presented. **Findings:** We measure volatility spillovers by defining the volatility of each sector in the SSE index. In this study, we investigate the volatility of China stock market. Furthermore, we analyze the dynamic connectedness during COVID-19 pandemic periods to identify the changes in their relationship following the two categories. These empirical findings have several important implications for portfolio managers, policymakers, and investors. **Originality/Value:** This paper focuses on investigating the impacts of the novel coronavirus (COVID-19) on the China stock market volatility from a GHARCH and VAR model point of view. The GHARCH model used proves that during the COVID-19 pandemic, stock price volatility and real estate price volatility increases and lead to a decrease in abnormal returns. The empirical findings also validate the efficient market hypothesis theory related to the study of events and the theory of financial behavior related to uncertainty.

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https://doi.org/10.52547/ijimes.2.3.82

1. Introduction

The COVID-19 pandemic not only infected many people, but also plunged the world economy into recession. The new coronavirus (COVID19) is known to be transmitted from person to person. In fact, such viruses "transmit" from humans to all human-related activities. COVID-19 is actively "invading" almost everywhere in the world. We can never expect financial markets to escape such a serious pandemic. (China real estate and stock market volatility based on COVID-19). Epidemic coronavirus disease has devastating effects around the world. The virus causes a series of chain reactions, including rising unemployment, falling oil prices, and falling stock markets. In particular, based on empirical results, they have shown that government (non-pharmaceutical) interventions can significantly increase stock market volatility [1]. We compared the non-uniformity of corporate-level equity returns caused by COVID-19 with certain risks such as: Global supply chain, demand, and various regulatory and policy uncertainties. A cross-sectional analysis of U.S. stock price reactions to major COVID-19 events provided a good understanding of the key factors influencing investor demand during the crisis. In general, based on empirical results, they found that the COVID-19 pandemic caused a negative and volatile market reaction. Based on empirical results on both Hang Seng Index and Shanghai Stock Exchange Composite Index [2]. The outbreak of COVID-19 was found to have a significant negative impact on financial market earnings. In particular, both the daily positive 19 cases of COVID-19 and the reported mortality rates during the outbreak significantly reduced inventory revenue [3]. Empirically tested the impact of the COVID-19 related official announcements on the market volatility (based on the S&P 500 realized volatility measures). Based on the US market empirical results [3], we conclude that both local and global cases of new infectious diseases have significantly increased the volatility of the US market, as well as mortality. This paper focuses on investigating the impacts of the COVID-19 on the China stock market and real estate prices. In general, the stock market and real estate could provide a unique view of the expected future of the economy, as Ramelli & Wagner [4] mentioned, in essence, the stock market can be viewed as an incentivized survey of expectations of future outcomes from investors' points of view. To avoid / minimize the intrusion of COVID-19 by examining the reaction of the stock market to the COVID-19 shock, with useful information / results related to government policymaking, corporate regulation, and investment guidance for investors. We expect further adverse effects on our spreads. Volatility is an important indicator for quantifying the level of risk. However, volatility is a latent variable. There are several ways to build volatility in the literature. For example, you can easily create a volatility metric using the standard deviation of returns, the absolute value of returns, or the square of returns [5, 6]. However, such volatility measures are known to be noisy and biased estimators for the underlying volatility [6, 7]. Research on the impact of wealth on consumption has attracted interest on the relationship between stock and real estate prices. In the resulting literature, two mechanisms have been proposed that may lead to a causal relationship between real estate prices and stock prices. The first mechanism, known as the wealth effect, argues that as the stock market rises, investors with unanticipated increases in wealth will push their demand for real estate up. Hence, the stock market will lead the real estate market. The second mechanism, the so-called credit price effect, emphasizes that real estate acts as security for companies with particularly weak creditworthiness. Rising real estate prices will improve the position of these companies' balance sheets and lower borrowing costs. This will lead to a higher level of investment activity by firms accompanied by a rise in their stock prices. Based on this reasoning, the credit price effect predicts that the housing market will lead the stock market. Overall, the vast majority of empirical studies provide supporting evidence of asset effect 1. However, the stock and real estate markets are also affected by economic condition. For example, the 2007 global financial crisis that began in the U.S. had a considerable negative effect on both stock and real estate prices in many countries. As Lin & Treichel [8] describes "The ensuing financial sector crisis quickly led to a significant decline in credit to the private sector as well as to a sharp rise in interest rates. The resulting collapse in U.S. financial institutions led to a collapse of equity markets, and of international trade and industrial production and spread to other advanced economies as well as to emerging markets and developing countries. We conclude that both local and global cases of new infectious diseases have significantly increased the volatility of the US market, as well as mortality [9]. Argues that globally $7 trillion has been wiped off the stock markets over the course of 2008. Another consequence of the crisis is the collapse of the housing market in many countries. During the first quarter of the 2008, the Turkish stock market, with a decline of 36.62 percent, showed the most drastic reaction to the financial crisis among the countries included in the S&P/Citigroup BMI Global Index [10]. Moreover, the REIDIN Turkey Residential Property Price Indices show a continual fall in house prices over the period March 2008 to March 2009 [11]. The overall performance of the economy was unsatisfactory during these 2years period, with GDP growth rates of 0.7 percent and 4.7 percent, respectively for 2008 and 2009 (Turkey's Statistical Yearbook, 2009). In spite of the dramatic initial reaction, the Turkish economy has shown recovery by the end of 2010 [12]. Argues "Turkey has faced limited negative impacts from the global financial crisis. The lack of securitization/ structured product markets and also inefficient housing credit market may have seemed good news for Turkey during the financial turmoil." The COVID-19 pandemic is having a great impact on global financial markets. Because of this turmoil, global financial markets have experienced heavy losses and the kind of deep changes that have not been seen since the 2008 financial crisis [13]. Assessing connectedness between financial markets during this outbreak has been a remarkable challenge facing researchers and policymakers because it helps them to analyze the behavior of the markets facing for this key event, we will prepare plans and strategies to minimize the economic impact of the occurrence of COVID 19, and make informed decisions about opportunities for global portfolio diversification. During the COVID-19 epidemic, one of the most important markets affected by this epidemic is the stock market and its fluctuations. On the other hand, the spread of the virus provides a basis for studying the effects of its outbreak on economic variables as well as stock markets. The outbreak of the coronavirus has caused negative reactions in the stock markets of various countries, causing price fluctuations in many macroeconomic variables. We propose to investigate the stock market volatility dynamics through a time-varying Generalized Auto Regressive Conditional Heteroskedasticity (GARCH) setting with realized measures of volatility [14].

In this paper, one main purpose is to study the dynamics of the volatility under the global COVID-19 pandemic. Therefore, the basic framework of the GARCH is not sufficient in describing the dynamic properties of the recent stock market and real estate data. Introducing structural changes to the model is a natural extension to better characterize such data. There are many good ways to incorporate structural changes into your model in the literature see [15]. In general, our empirical results show that there is a dramatic surge of the market level volatility for SSE and real estate during the outbreak of the COVID-19 pandemic in early 2020. As expected, this is consistent with the findings on other markets in the literature, see for example, ([16, 17]), and reference therein. We also conduct comparisons of the Stock market and real estate of china during the COVID-19 period. The rest of the work consists of: Section 3 discusses the proposed model specification and property, section 4 and 5 provides methodology and data, Section 6 provides the empirical analysis based on the real estate and china (SSE) Index. Section 7 concludes, the COVID-19 pandemic is a source of systematic risk, therefore there is a need for further research on the financial effects of the coronavirus spread. In short, the COVID-19 pandemic has had a significant impact on the international financial market. Therefore, many studies have investigated the impact of the COVID-19 pandemic on the real estate and stock market ([2, 18, 19, 20]), During a crisis period, investors and portfolio managers pay more attention to portfolio decisions. The results of the volatility spillover analysis are useful for asset allocation and risk hedging. In addition, the results of the spillover effect of volatility provide policy makers with information about market shock net receivers and net senders. This allows policy makers to plan market stabilization measures.

2. Literature Review

An early study of the relationship between real estate and stock prices looked at the correlation between the returns of these two investment alternatives. Most of these articles report a negative correlation between real estate and equity returns. The next wave of research applies the concepts of Granger causality, vector autoregressive (VAR) modeling, and cointegration techniques to study the causal interactions between real estate and stock prices. McKenna et al. [21], and Kapopoulos Panayotis [22] test for Granger causality using a single-equation framework. Chen [23], Sutton [24], Jan Kakes [25], and Sim & Chang [26] use VAR modeling. Ibrahim [27], and Lean & Smyth [28] use the cointegration technique and vector error correction modeling. Overall, only Sim & Chang [26] and Lean & Smyth [28] provide supporting evidence for the credit-price effect. Each of the other studies, though, favors the wealth effect. Both McKenna et al. [21], and Kapopoulos Panayotis [22] use differenced series in a single equation framework. McKenna et al. [21], uses data from San Francisco Bay area, which is argued to be a prime candidate for a wealth effect to be large for the following reasons. First, high-income households in the region are expected to hold relatively large shares. Second, workers in the San Francisco Bay Area are more likely to be paid in stock than workers elsewhere. Similarly, Kapopoulos Panayotis [22] reports evidence in favor of the wealth effect hypothesis for Athens real estate prices, but not for other urban real estate prices. One of the studies that use a VAR framework, Chen [23] examines the relation in Taiwanese market by including rediscount rates and the total amount of bank loans as control variables. The results show that Granger's stock price pushes up home prices, but not the other way around. In addition, bank loan changes are important in predicting both stock prices and home prices, not discount rate changes. Another study, Sutton [24] examines the extent to which house price changes in six developed markets, namely the United States, the United Kingdom, Canada, Ireland, the Netherlands and Australia, can be explained by changes in national incomes, interest rates and stock prices. This study also provides evidence of asset effectiveness. A financial crisis is a situation in which a significant number of financial institutions / assets suddenly lose a significant portion of their value. There are different types of financial crises. According to Baker et al. [29], its effects on the volatility of financial markets has been the largest in the history of pandemics (see also [30]), while Altig et al. [31] identify significant jumps in uncertainty as a reaction to the pandemic and its economic fallout. Similarly, Ashraf [32] identifies a strong market reaction early in the pandemic and then 40–60 days afterwards. Stock markets responded to the COVID-19 pandemic quickly but then the responses have varied over time depending on the stage of the pandemic. This conclusion is in line with Rai et al., [33] who find that the persistence of stock market returns increased as market uncertainty and attention to COVID-19 increased. Even in its pre-pandemic phase, COVID-19 has severely affected the real economy, with a negative impact on trade, tourism, and transport industry, generating local food shortages [34]. In addition, in the presence of stock markets price bubbles, the COVID-19 impact on the financial system could not be ignored. Likewise, several early papers focus on the COVID-19 effects on stock markets returns, e.g. [32, 35], whereas only few papers underline the COVID-19 impact on financial volatility, e.g. [34, 36, 16]. we add to this new strand of the literature and we investigate the effect of official announcements regarding the COVID-19 new cases of infection, and fatality ratio, on the United States (US) financial markets' volatility. Al-Awadhi [2] and Zhao et al. [37] find that Chinese stock market returns declined as the number of COVID-19 daily-confirmed cases and deaths increased. Global financial markets have undergone major adversities and risks due to the COVID-19 pandemic, for example, stock markets in the US have reached four circuit breakers over the course of only two weeks [38]. Furthermore, Bai et al. [39]; Jahanshahi [35], and Topcu & Gulal [40] report a significant increase in the volatility of stock returns of most infected during the first two months of the pandemic. This rise in risk levels can be tracked as a product of sentiment factors, as pandemics have led to a surge in various forms of media and enhanced market sentiment. In addition, knowing that outbreaks pose a global threat is expected to significantly increase systemic risk. The pandemic has a clear and significant impact on the economies of most countries around the world due to the recession. These effects appear to be more pronounced in certain sectors than in others, but both practitioners and researchers need to collectively find safe shelter assets that exhibit low volatility factors. Many researchers have studied the dynamic relationships between financial markets during a crisis. Therefore, classify existing studies according to the duration of the crisis. First, there is a study of examining the link between financial markets in the 1997 Asian financial crisis. Since the crisis has been caused by a collision of exchange rate markets (FX), some studies have studied dynamic connections between cross-board FX markets [41, 42], FX, and stock markets [43, 44]. The relationships between stock markets in Asia were also investigated during the crisis [45, 46, 47, 48, 49, 50]. In particular, according to several studies Huyghebaert & Wang [48], and Li & Giles [51], the US had a huge impact on Asian financial markets during the Asian financial crisis. Second, as the GFC has caused havoc in the global economy, much research has been done on the dynamic relationships between countries and various financial asset markets. The European debt crisis caused a variety of financial problems, including the collapse of financial assets and the abundance of government bonds. Therefore, many studies have investigated the dynamic interrelationships between European financial markets during the crisis, for example, dynamic connectedness in stock [52, 53], bonds [54, 55], credit default swaps [56, 57], and FX markets [58, 59]. Lastly, the recent COVID-19 pandemic is triggered by health problems, but it has already caused great damage to the global economy. Therefore, as in the case of the GFC, several studies investigate the dynamic connectedness between countries and between financial assets. For example, Mugaloglu et al. [60] investigated the interdependence of systemic risk in 11 European countries by using the composite indicator of the systematic stress series. Bouri et al. [61] display a dynamic return connectedness across various assets (gold, oil, equity, currency and bond). Umar et al. [62] examined the volatility spillovers among emerging markets and US government bonds. This study enhances the existing literature on the dynamic connectedness among Northeast Asian countries (South Korea, Japan, China) and the US. Moreover, we contribute to the literature by clarifying the influence of the GFC and the COVID-19 pandemic on their relationship. Furthermore, our empirical findings are important and useful for market participants in the stock markets of four countries. Considering the current COVID-19 pandemic worldwide, researchers have studied the impact of COVID-19 on the financial markets from several perspectives [32, 63; 64, 16, 65]. For example, Ashraf [32] examined the stock markets' response to the COVID-19 pandemic, and he found that stock markets responded negatively to the growth in COVID-19 confirmed cases, and the response varies over time Danis et al. [63] examined the short-term market reactions of U.S. and European stocks during the beginning of the COVID-19 pandemic. They found that the stock markets in a given country responded negatively to the announcement of the first death, besides country-specific monetary policy measures can calm the markets during the COVID-19 pandemic. Rahman et al. [64] examined how the

Australian stock market responded to the COVID-19 pandemic and the effect of the Governments stimulus package on Australian stock returns. They found that the stock market reacted negatively to the pandemic and the “Job Keeper” package had a significantly positive impact on Australian stock returns. The first of the two papers that use a cointegration framework, Ibrahim [27] examines the relation between stock and real estate prices in the Thai market. By including real output and consumer price data in the analysis, the paper finds strong evidence in favor of a wealth effect. It also documents that real activity has significant impact on both real estate and stock prices. The second paper Lean & Smyth [28] examines Malaysia by employing interbank deposit rates as control variable. The paper uses individual REIT rather than REIT index data. While a wealth effect is found for some REITs, for most of the others there is evidence of feedback effects between real estate and stock markets. Gounopoulos et al. [66] provided similar results in the short and the long run in Greece using the linear ARDL, even though Greece has experienced a debt crisis and downfall of the housing market in the past decade. According to [67, 68], the wealth effect is likely to be plausible in booming market periods and more noticeable when the stock market is performing better than the real estate market. market using the model of Enders & Siklos [69]. Using the Markov regime-switching model, Liow & Ye [50] found a wealth effect during periods of boom with high return volatility for the U.S., Japan, Singapore, Germany and Canada. The second theory is the credit effect, which is a channel of dependence running from housing market to the stock market. The theory supports the view that higher property prices increase the value of collateral and stimulate economic activity, which could decrease the cost of debt and increase the financing resources for businesses and households. In such a case, capital gains will lead investors to bid up the value of a firm’s stock [66].Various studies showed that the credit effect was also valid in many developed and emerging markets [70, 71, 26]. For example, Sim & Chang [26] found that housing prices Granger-cause the stock prices in South Korea, supporting the existence of the credit effect. Lin [72] found similar results in Singapore and Taiwan using the Granger causality test. In Greece, Gounopoulos et al. [66] also provided support for the credit effect in the short run, while Kapopoulos & Siokis [22] found similar results from the urban real estate prices. Yong [73] apply various GARCH models consisting of GARCH and ARCH standards to test the return volatility of China's stock index and real estate prices. The event period will be divided into COVID 19 pandemic periods using the stock index from January 2020 to March 2022 and daily closing price data from home prices. Empirical evidence shows that both stock markets and real estate prices are sustainable. Persistence decreased during the pandemic. Empirical studies suggest that volatility sustainability after COVID 19 is increasing in all markets.

3. Methodology

To analyze the effect of shock would dissipate we have used Generalized Auto Regressive Conditional Heteroskedasticity model. GARCH models are advanced variants of ARCH models. In GARCH models autoregressive and moving average components are incorporated in heteroskedastic variance. By incorporating them, GARCH model provide a parsimonious alternative to high order ARCH models. GARCH (p,q) models can be represented through the following equations:

$$y_t = \theta_0 + \theta_1 y_{t-1} + \cdots + \theta_n y_{t-n} + \epsilon_t \quad (1)$$

$$\epsilon_t | I_{t-1} \; N\,(0, h_t) \quad (2)$$

Where

$$h_t = \alpha 0 + \sum \alpha i \in t-1 + i=1 \; \beta i h t-i \quad (3)$$

$\alpha_0 > 0, \alpha_j > 0\ and\ \beta_i > 0$: to guarantee positive variance.

$0 \leq \sum^{i=n} \alpha_i + \sum^{i=n} \beta_i < 1$: to have a decaying variance.

Rate at which shock decays shall be given through the following equation: $1 - \alpha - \beta$

Before running GARCH models, we have to ensure that, the univariate series that we have taken into consideration is stationary at level. To evaluate the same, we have used test. After checking for stationarity, through using ordinary least squares, we have constructed equation. If heteroskedasticity was found in the model, then we could go for GARCH (1,1) model. In GARCH modeling with COVID-19 as an exogenous variance regress, it was found that all market indices were infected. The study by Copeland et al. [74] with the developed GARCH model proves that within 48 months, COVID-19 has consistently had an impact on increasing volatility in most global stock exchanges [75], using the GARCH (1,1) model, prove that the daily return volatility in the Romanian stock market increases. Debakshi Bora [76] using the GARCH model also prove that during COVID-19, stock market volatility in India increases. Hypothesis testing in this study uses a quantitative approach using the event study method and the GARCH model. The stages of the research carried out started from data collection and data processing, calculation and analysis of abnormal returns and JCI volatility, as well as forecasting abnormal stock returns and JCI price volatility. The research findings can provide both theoretical and practical implications. Cheung [77] suggested a testing procedure to examine causal links between the variances of series. Here, the Causality-in-Variance Test suggested by Cheung [77] is based on cross-correlation functions (CCF) of standardized residuals obtained from a GARCH model. Hafner & Herwartz [78] show that, in the case of small to medium sample sizes, the causality-in-variance test of Cheung [77] suffers from significant oversizing if the innovations underlying a conditionally heteroskedastic process are leptokurtic.

4. Data

Table (1) shows the first four moments of the data: mean, variance, skewness, and kurtosis. In summary, the instantaneous values are in line with our expectations. The COVID19 subsample has only 537579 data points. For instance, the Skewness of real estate price is -0.618380, while the Skewness of stock indices is -0.935287, we observe a 50% different in these markets. In addition, COVID19 distorts the distribution of returns more to the left because the skewness factor varies between -0.618380 and -0.935287. As expected, the big data in kurtosis values for real estate (price).

Table 1. Four moments of the data.

	REAL_ESTATE	COVID_19	INDEX
Mean	15.25835	1036.269	3344.379
Median	16.17300	58.00000	3427.990
Maximum	19.99400	57192.00	3715.370
Minimum	7.810000	0.000000	2660.170
Std. Dev.	2.482924	5001.099	260.1040
Skewness	-0.618380	7.451043	-0.935287
Kurtosis	2.241975	67.41463	2.671275
Jarque-Bera	49.18510	105458.0	80.70894
Probability	0.000000	0.000000	0.000000
Sum	8559.934	600000.0	1795932.
Sum Sq. Dev.	3452.350	1.45E+10	36262606
Observations	561	579	537

The data used in this survey includes daily closing prices for the SSE and real estate indexes. The data are retrieved from Datastream. The sample period covers COVID19-period and 1000day period around the outbreak of the COVID-19. Before outlining the methodology, we pretest the variables for unit roots and stationarity by using Augmented Dickey-Fuller (ADF) and PhillipsePerron (PP) tests. The results presented in Table (2) indicate that both tests cannot reject the null of a unit root for all series in level. However, they confirm stationarity when all the series are in the first difference. As a result, we conclude that the series are all, which is the premise of cointegration. Our methodology starts with employing the VAR-based approach of Johansen [79] in Table (3) and Johansen [80] in Table (4). Test the cointegration or long-term relationship between variables. The results of this method assume linear behavior over the long and short term and serve as a benchmark. As mentioned earlier in the text, omitting the presence of non-linear components such as threshold effects in long-term equilibrium can lead to inconsistencies in the estimated equilibrium relationships. To implement the Johansen test, you need to specify the VAR delay order. Since the Chinese stock exchange is closed on public holidays, real estate and COVID 19 price observations for these specific days have been removed to synchronize the data.

Table 2. Unit Root Test

Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic lag length selection based on Asymptotic t-statistic (p=0.1): 0 to 10
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.31716	0.9898	3	1423
Breitung t-stat	-1.20664	0.1138	3	1420
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.60216	0.2735	3	1423
ADF - Fisher Chi-square	11.3510	0.0781	3	1423
PP - Fisher Chi-square	166.930	0.0000	3	1577

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 3. Vector Auto regression Estimates.

Included observations: 459 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	COVID	STOCK	REAL_ESTATE
COVID(-1)	0.379359	-0.008073	-2.53E-05
	(0.04526)	(0.00228)	(2.2E-05)
	[8.38266]	[-3.53443]	[-1.16272]
COVID(-2)	0.274062	0.007566	3.21E-05
	(0.04516)	(0.00228)	(2.2E-05)
	[6.06828]	[3.31937]	[1.47783]
STOCK(-1)	-0.550891	0.931333	-0.000153
	(0.99100)	(0.05002)	(0.00048)
	[-0.55590]	[18.6208]	[-0.32051]
STOCK(-2)	0.331660	0.058596	9.93E-06
	(0.99265)	(0.05010)	(0.00048)
	[0.33412]	[1.16960]	[0.02083]
REAL_ESTATE(-1)	221.9942	19.11537	1.013129
	(106.546)	(5.37736)	(0.05118)
	[2.08356]	[3.55479]	[19.7970]
REAL_ESTATE(-2)	-215.1586	-18.99626	-0.024312
	(106.094)	(5.35457)	(0.05096)
	[-2.02800]	[-3.54767]	[-0.47709]
C	707.1904	31.60731	0.623995
	(586.331)	(29.5922)	(0.28163)
	[1.20613]	[1.06810]	[2.21568]
R-squared	0.370637	0.981766	0.982707
Adj. R-squared	0.362282	0.981524	0.982477
Sum sq. resids	2.12E+08	539156.6	48.83244
S.E. equation	684.3124	34.53729	0.328689
F-statistic	44.36439	4056.159	4280.921
Log likelihood	-3644.308	-2273.562	-137.0624
Akaike AIC	15.90984	9.937089	0.627723
Schwarz SC	15.97281	10.00006	0.690693
Mean dependent	216.8649	3344.701	15.24685
S.D. dependent	856.9200	254.0883	2.483044
Determinant resid covariance (dof adj.)		50764699	
Determinant resid covariance		48477372	
Log likelihood		-6015.250	
Akaike information criterion		26.30174	
Schwarz criterion		26.49065	
Number of coefficients		21	

Table 4. Johansen Cointegration.

Trend assumption: Linear deterministic trend
Series: COVID_19 STOCK REAL_ESTATE
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.037463	20.53723	29.79707	0.3871
At most 1	0.006825	3.316730	15.49471	0.9507
At most 2	0.000506	0.228154	3.841466	0.6329

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.037463	17.22050	21.13162	0.1618
At most 1	0.006825	3.088575	14.26460	0.9406
At most 2	0.000506	0.228154	3.841466	0.6329

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

COVID_19	STOCK	REAL_ESTATE
-0.001491	-0.000946	0.005144
3.74E-05	0.004063	0.337244
-0.000167	-0.001918	0.304583

Unrestricted Adjustment Coefficients (alpha):

D(COVID_19)	127.7127	3.515999	1.603833
D(STOCK)	-0.561410	-0.629917	0.749814
D(REAL_ESTATE)	0.000301	-0.027222	0.001223

1 Cointegrating Equation(s):	Log likelihood	-5907.660

Normalized cointegrating coefficients (standard error in parentheses)

COVID_19	STOCK	REAL_ESTATE
1.000000	0.634503	-3.450511
	(0.71841)	(73.7476)

Adjustment coefficients (standard error in parentheses)			
D(COVID_19)	-0.190397		
	(0.04654)		
D(STOCK)	0.000837		
	(0.00245)		
D(REAL_ESTATE)	-4.48E-07		
	(2.4E-05)		
2 Cointegrating Equation(s):		Log likelihood	-5906.116
Normalized cointegrating coefficients (standard error in parentheses)			
COVID_19	STOCK	REAL_ESTATE	
1.000000	0.000000	-56.44370	
		(77.3805)	
0.000000	1.000000	83.51920	
		(59.1073)	
Adjustment coefficients (standard error in parentheses)			
D(COVID_19)	-0.190266	-0.106522	
	(0.04656)	(0.13025)	
D(STOCK)	0.000813	-0.002028	
	(0.00245)	(0.00685)	
D(REAL_ESTATE)	-1.47E-06	-0.000111	
	(2.4E-05)	(6.6E-05)	

Based on Table (5), we observe that the real estate price correlations with the stock indices during the period of the COVID-19 outbreak. In other words, no significant structural changes between these markets have been observed with respect to the dynamic correlation between SSE and home prices and COVID19.

Table 5. Correlations

	COVID	REAL_ESTATE	STOCK
COVID	1	0.1364626381110129	-0.2285193961839048
REAL_ESTATE	0.1364626381110129	1	-0.3994239909374031
STOCK	-0.2285193961839048	-0.3994239909374031	1

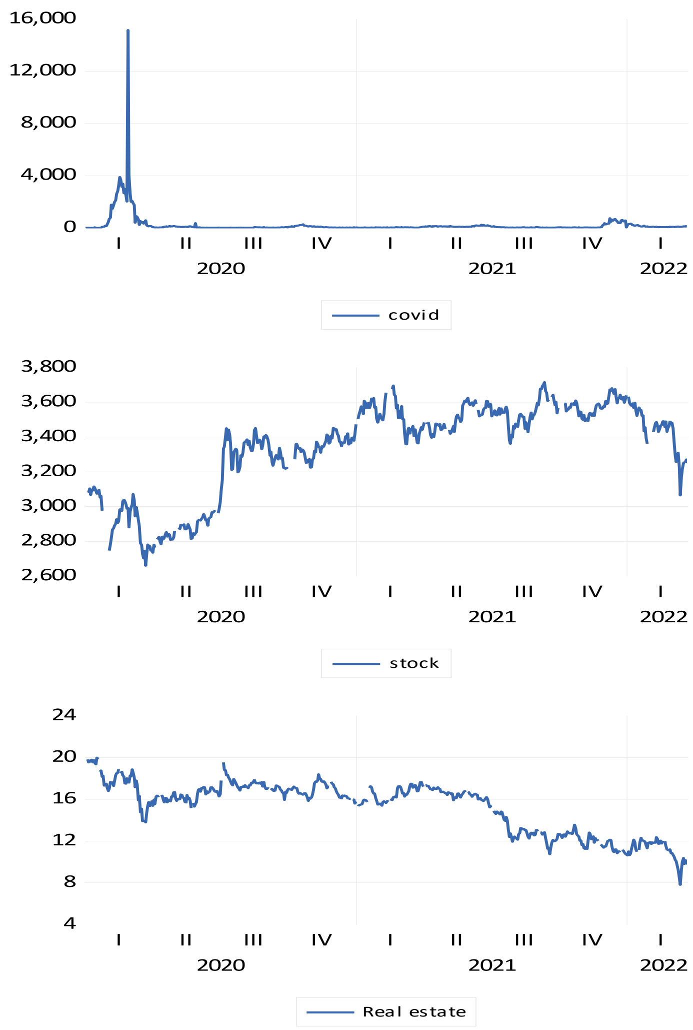

Fig. 1. Daily values for the three variables

Figure (1) shows the daily values for the three variables. As the graph shows that real estate price fallen considerably and stock indices rise over the period from COVID-19.

5. Empirical Findings

Table 6. GHARCH (1.1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
REAL(-1)	1.000252	0.000428	2336.512	0.0000
COVID_19	0.003000	0.001587	1.890565	0.0587
	Variance Equation			
C	168.7667	36.03820	4.682993	0.0000
RESID(-1)^2	0.248826	0.030748	8.092478	0.0000
GARCH(-1)	0.647055	0.034709	18.64245	0.0000
STOCK(-1)	1.000013	0.000444	2253.798	0.0000
COVID_19	0.004286	0.000884	4.848248	0.0000
	Variance Equation			
C	290.5124	57.20491	5.078452	0.0000
RESID(-1)^2	0.288396	0.034695	8.312264	0.0000

From the GARCH (1,1) model, estimation equation produces a constant value of 168.7667 for real estate price and 290.5124 for stock indices. The ARCH coefficient is 0.248826 for real estate price and 0.288396 for stock indices, indicating a fluctuating change in volatility that causes stock market movements is bigger than real estate price to experience an unstable tendency. The GARCH (1,1) coefficient value of real estate price and stock indices is 0.647055 and 0.522647 respectively indicates that for every movement that occurs in a variable, it shows that the variable quickly returns to a stable condition Real estate is more efficient than the stock market. The COVID-19 outbreak in China generated a negative shock to the Chinese stock market, which quickly spread to real estate price.

Testing the R2 test to measure how much the in-dependent variable's contribution can explain the variations that occur in the dependent variable changes is shown in the results of the GHARCH model R2 test (1,1) (Table 7). The value of the R2 termination coefficient of the GHARCH model (1,1) shows the adjusted R2 value of 0.0764, which indicates the ability of the independent variables. The t-test statistic test concluded that the volatility of the on abnormal return has a probability (0.0014) < 5% with a coefficient value of 2.54300, so that the volatility of the with abnormal returns has a positive effect.

Table 7. Result of the determination coefficient test (R2 Test) of the GHARCH model, and T-statistical rest results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Price Volatility	2.534300	0.9976	0.0014	0.0013
R-squared	0.0764	Mean dependent var		0.797
Adjusted R-squared	0.0765	S.D. dependent var		0.102
S.E. of regression	0.0333	Akaike info criterion		-1.93075
Sum squared resid	0.1275	Schwarz criterion		-1.92496
Log likelihood	21.902	Hannan-Quinn criter.		-1.92853
Durbin-Watson stat	1.151030			

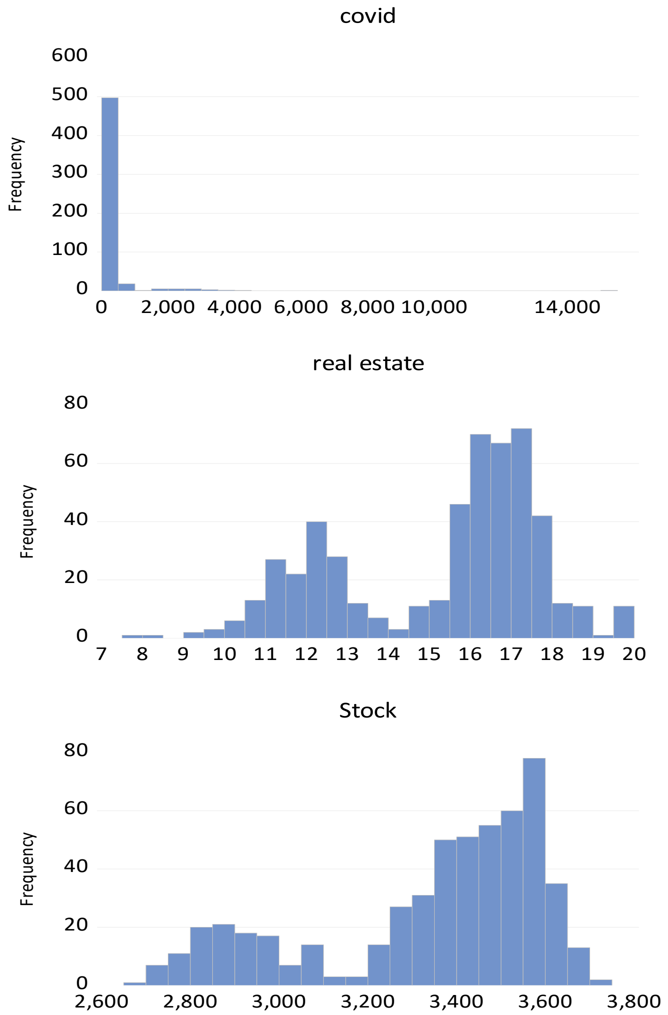

Fig. 2. The Frequency of the Covid-19, real estate price and Stock indices using daily closing prices during the sample period, a frequency is the number of times a data value occurs.

Fig. 3. The log-returns of the Covid-19, real estate price and Stock indices using daily closing prices during the sample period. Higher volatility indicates that the value of the indices can be spread out over a larger range of values, which eventually means that the value of the indices can potentially move in either direction significantly over a short period. On the other hand, lower volatility indicates that the value of the indices would not fluctuate much and will continue to remain stable over the period.

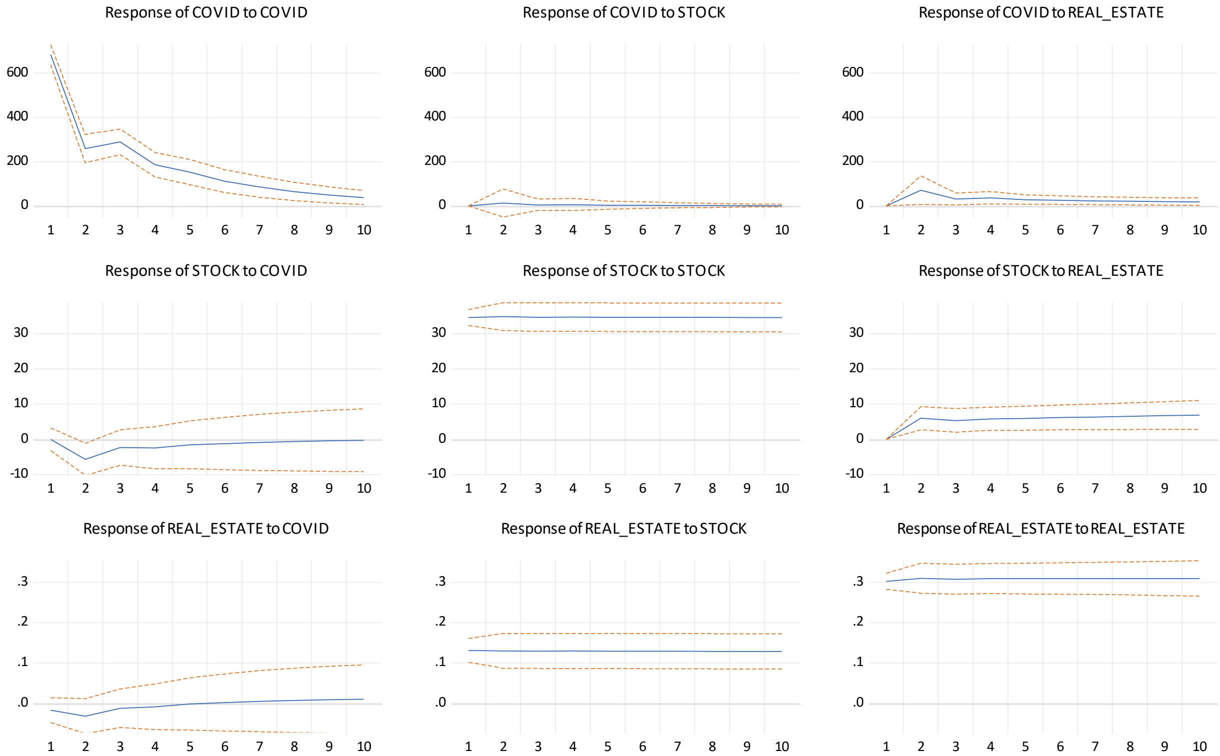

Fig. 4. The response of the Covid-19, real estate price and Stock indices during the sample period. These lines show the response of the individual transaction or request along with the time.

6. Discussion

The results of the study test found that negative abnormal returns did not appear on the event date. This means the capital market and real estate prices does not react directly to government announcements about positive COVID-19 patients. The volatility of the stock market indices in responses to the key vents of COVID-19 has led to much higher volatility than normal, and also indicates a bearish trend in the market that occurred in the second quarter of the COVID-19 period. In GHARCH modeling with COVID-19 as an exogenous variance, it was found that all market indices were infected.

7. Conclusion

This study investigates the extent to which the dynamic relationship between real estate prices and stock prices in China has changed as a result of the COVID-19 period Under the VAR and GARCH framework, we find: Cross market risk correlation is highest during the Chinese lockdown period, the contribution of the stock market index variation was larger than the contribution of real estate index variation. Our analyses have an impact on investors' ability to finance investments in real estate and stock markets [23], as a control variable. In the analyses, we employ both the Johansen cointegration, which implicitly assumes linear error correction mechanism and VAR test that allows for asymmetric error correction. Unlike the Johansen test, which finds only during the crisis period, the VAR test identifies in both stock market and real estate. This study provides theoretical and empirical benefits of testing the efficient market hypothesis in the context of China, which is still an emerging stock market, to test an event originating from the COVID-19 outbreak by measuring stock price and real estate price volatility using the GARCH model. The GHARCH model can be used to assess volatility and predict abnormal returns stock market and real estate prices when COVID-19 incident occurs. The test results prove that COVID-19 has made real estate price drop and stock market rise drastically. Investors responded directly to COVID 19 by selling stock, turning anomalous returns negative. The GARCH model can be used to assess volatility and predict abnormal returns on China stocks when the COVID-19 incident occurs. The model that can be used is GARCH (1,1). The empirical findings of the study have implications related to the possibility that the crisis in the stock market caused by the COVID-19 pandemic outbreak in the context of market inefficiency opens up opportunities for speculators to profit. Our findings offer implications for investors and policy- makers. The spillover and connectivity of asymmetric volatility provides a better way to manage portfolio diversification strategies. With negative or positive news, investors can know better about connecting markets. In addition, equity investors can accurately assess when and in which markets they are more concerned about negative and positive shocks. Policy makers can also identify markets that are the main contributors to the transmission of unfavorable shocks. Therefore, by controlling the flow of capital or announcing concrete policy measures to improve market and macroeconomic sentiment, we can intervene and reduce the transmission of adverse effects. Therefore, analyzing volatility asymmetry helps policy makers know when to intervene to stabilize the market and reduce uncertainty.

References

[1] Ramelli, Stefano. (2020). Feverish Stock Price Reactions to the Novel Coronavirus. SSRN Electronic Journal, 40-56.

[2] Al-Awadhi, A. M. (2020). Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. Journal of Behavioral and Experimental Finance, 100-326.

[3] Albulescu, C. (2020). Coronavirus and Oil Price Crash. SSRN Electronic Journal, 10-30.

[4] Ramelli, S., & Wagner, A. (2020). What the stock market tells us about the consequences of COVID-19. Mitigating the COVID Economic Crisis: Act Fast and Do Whatever, 63.

[5] Hong, H., Bian, Z., & Lee, C. C. (2021). COVID-19 and instability of stock market performance: evidence from the US. Financial Innovation, 7(1), 1-18.

[6] Zhang, Y., & Ma, Z. F. (2020). Impact of the COVID-19 pandemic on mental health and quality of life among local residents in Liaoning Province, China: A cross-sectional study. International journal of environmental research and public health, 17(7), 2381.

[7] Barndorff-Nielsen, O. E. (2008). Measuring Downside Risk - Realised Semivariance. SSRN Electronic Journal, 40-56.

[8] Lin, J. Y., & Treichel, V. (2012). Learning from China's rise to escape the middle-income trap: a new structural economics approach to Latin America. World Bank policy research working paper, (6165).

[9] Adair, P. (2009). Économie non observée et emploi informel dans les pays de l'Union européenne. Revue économique, 1117-1153.

[10] Li, H., Jeon, B. N., Cho, S. Y., & Chiang, T. C. (2008). The impact of sovereign rating changes and financial contagion on stock market returns: Evidence from five Asian countries. Global Finance Journal, 46-55.

[11] Yuksel, A. (2016). The relationship between stock and real estate prices in Turkey: Evidence around the global financial crisis. Central Bank Review, 33-40.

[12] Coskun, Y. (2011). Financial Engineering and Engineering of Financial Regulation. SSRN Electronic Journal.

[13] Benlagha, N., & El Omari, S. (2021). onnectedness of stock markets with gold and oil: New evidence from COVID-19 pandemic. Finance Research Letters.

[14] Hansen, P. R. (2016). Exponential GARCH Modeling With Realized Measures of Volatility. Journal of Business & Economic Statistics, 269-287.

[15] Dufour, J.-M. (2006). Resampling methods in econometrics. Journal of Econometrics, 411-419.

[16] Zaremba, A., Kizys, R., Aharon, D. Y., & Demir, E. (2020). Infected markets: Novel coronavirus, government interventions, and stock return volatility around the globe. Finance Research Letters(35).

[17] ahanshahi, A. A. (2020). The distress of Iranian adults during the Covid-19 pandemic–More distressed than the Chinese and with different predictors. Brain, behavior, and immunity , 124.

[18] Singh, N., Tang, Y., Zhang, Z., & Zheng, C. (2020). COVID-19 waste management: effective and successful measures in Wuhan, China. Resources, conservation, and recycling, 163.

[19] Contessi, Silvio, and Pierangelo De Pace. (2021). The international spread of COVID-19 stock market collapses. Finance Research Letters, 42.

[20] Mazur, M., Dang, M., & Vega, M. (2021). COVID-19 and the march 2020 stock market crash. Evidence from S&P1500. Finance research letters, 38.

[21] McKenna, K. Y., Green, A. S., & Gleason, M. E. (2002). Relationship formation on the Internet: What's the big attraction? Journal of social issues, 9-31.

[22] Kapopoulos, P., & Siokis, F. (2005). Stock market crashes and dynamics of aftershocks. Economics Letters, 89(1), 48-54.

[23] Chen, T. (2001). Capillary Pressure During Immiscible Displacement. Journal of Canadian Petroleum Technology, 777-786.

[24] Sutton, M. H. (2002). Financial Reporting at a Crossroads. Accounting Horizons, 319-328.

[25] Jan Kakes, Jan Willem Van Den End. (2004). Do stock prices affect house prices? Evidence for the Netherlands. Applied Economics Letters, 741-744.

[26] Sim, S. H., & Chang, B. K. (2006). Stock and real estate markets in Korea: wealth or credit-price effect. Journal of Economic Research-seoul, 103.

[27] Ibrahim, M. M. (2010). Subcutaneous and visceral adipose tissue: structural and functional differences. Obesity reviews, 11-18.

[28] Lean, H. H., & Smyth, R. (2012). interest rates and stock prices in Malaysia. International Journal of Business and Society, 49-62.

[29] Baker, S. R., Bloom, N., Davis, S. J., & Terry, S. J. (2020). Covid-induced economic uncertainty. National Bureau of Economic Research.

[30] Junior, C. J. C., Garcia-Cintado, A. C., & Junior, K. M. (2021). Macroeconomic policies and the pandemic-driven recession. International Review of Economics & Finance, 438-465.

[31] Altig, D., Baker, S., Barrero, J. M., Bloom, N., Bunn, P., Chen, S., ... & Thwaites, G. (2020). Economic uncertainty before and during the COVID-19 pandemic. Journal of Public Economics, 191.

[32] Ashraf, B. N. (2020). Stock markets' reaction to COVID-19: Cases or fatalities? Research in International Business and Finance, 54.

[33] Rai, A., Mahata, A., Nurujjaman, M., & Prakash, O. (2022). Statistical properties of the aftershocks of stock market crashes revisited: Analysis based on the 1987 crash, financial-crisis-2008 and COVID-19 pandemic. International Journal of Modern Physics C, 33.

[34] Albulescu, C. (2021). COVID-19 and the United States financial markets' volatility. Finance Research Letters, 38.

[35] Jahanshahi, A. A. (2020). he distress of Iranian adults during the Covid-19 pandemic–More distressed than the Chinese and with different predictors. Brain, behavior, and immunity, 87-124.

[36] Bakas, D. &. (2020). Commodity price volatility and the economic uncertainty of pandemics. Economics Letters, 193.

[37] Zhao, S., Lin, Q., Ran, J., Musa, S. S., Yang, G., Wang, W., ... & Wang, M. H. (2020). Preliminary estimation of the basic reproduction number of novel coronavirus (2019-nCoV) in China, from 2019 to 2020: A data-driven analysis in the early phase of the outbreak. International journal of infectious diseases, 214-217.

[38] Ji, Q., Zhang, D., & Zhao, Y. (2020). Searching for safe-haven assets during the COVID-19 pandemic. International Review of Financial Analysis, 71.

[39] Bai, Y., Yao, L., Wei, T., Tian, F., Jin, D. Y., Chen, L., & Wang, M. (2020). Presumed asymptomatic carrier transmission of COVID-19. Jama, 1406-1407.

[40] Topcu, M., & Gulal, O. S. (2020). The impact of COVID-19 on emerging stock markets. Finance Research Letters, 36.

[41] Shahzad, S. J. H., Bouri, E., Roubaud, D., & Kristoufek, L. (2020). Safe haven, hedge and diversification for G7 stock markets: Gold versus bitcoin. Economic Modelling, 212-224.

[42] Akhtaruzzaman, M., Boubaker, S., & Sensoy, A. (2021). Financial contagion during COVID–19 crisis. Finance Research Letters, 38.

[43] Fang, W., & Miller, S. M. (2002). Dynamic effects of currency depreciation on stock market returns during the Asian financial crisis.

[44] Mao, C., Shen, Q., Pan, W., & Ye, K. (2015). Major barriers to off-site construction: the developer's perspective in China. Journal of Management in Engineering, 31.

[45] Marmot, M., & Wilkinson, R. G. (2001). Psychosocial and material pathways in the relation between income and health: a response to Lynch et al. Bmj, 1233-1236.

[46] Corsetti, G., Pericoli, M., & Sbracia, M. (2005). Some contagion, some interdependence': More pitfalls in tests of financial contagion. Journal of International Money and Finance, 1177-1199.

[47] Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic correlation analysis of financial contagion: Evidence from Asian markets. Journal of International Money and finance, 1206-1228.

[48] Huyghebaert, N., & Wang, L. (2010). he co-movement of stock markets in East Asia: Did the 1997–1998 Asian financial crisis really strengthen stock market integration? China Economic Review, 98-112.

[49] Manopimoke, P. (2018). Thai inflation dynamics in a globalized economy. Journal of the Asia Pacific Economy, 465-495.

[50] Liow, K., & Ye, Q. . (2018). olatility causality and contagion in international securitized real estate markets: evidence from markov-switching analysis. Journal of European Real Estate Research.

[51] Li, Y., & Giles, D. E. (2015). Modelling volatility spillover effects between developed stock markets and Asian emerging stock markets. International Journal of Finance & Economics, 155-177.

[52] Tamakoshi, G., & Hamori, S. (2013). Volatility and mean spillovers between sovereign and banking sector CDS markets: a note on the European sovereign debt crisis. Applied Economics Letters, 262-266.

[53] Diebold, F. X., & Yılmaz, K. (2015). Financial and macroeconomic connectedness: A network approach to measurement and monitoring. Oxford University Press.

[54] Calice, G., Chen, J., & Williams, J. (2013). Liquidity spillovers in sovereign bond and CDS markets: An analysis of the Eurozone sovereign debt crisis. Journal of Economic Behavior & Organization, 122-143.

[55] Lahmiri, S., & Bekiros, S. (2018). Chaos, randomness and multi-fractality in Bitcoin market. Chaos, solitons & fractals, 28-34.

[56] Alter, A., & Beyer, A. (2014). The dynamics of spillover effects during the European sovereign debt turmoil. Journal of Banking & Finance, 134-153.

[57] Bouri, E., de Boyrie, M. E., & Pavlova, I. (2017). Volatility transmission from commodity markets to sovereign CDS spreads in emerging and frontier countries. International Review of Financial Analysis, 155-165.

[58] Karfakis, C., & Panagiotidis, T. (2015). The effects of global monetary policy and Greek debt crisis on the dynamic conditional correlations of currency markets. Empirica, 795-811.

[59] Apergis, N., Baruník, J., & Lau, M. C. K. (2017). Good volatility, bad volatility: What drives the asymmetric connectedness of Australian electricity markets? Energy Economics, 108-115.

[60] Mugaloglu, E., Polat, A. Y., Tekin, H., & Dogan, A. (2021). Oil price shocks during the COVID-19 pandemic: evidence from United Kingdom energy stocks. Energy Research Letters.

[61] Bouri, E., Cepni, O., Gabauer, D., & Gupta, R. (2021). Return connectedness across asset classes around the COVID-19 outbreak. International Review of Financial Analysis, 73.

[62] Umar, Z., Gubareva, M., Tran, D. K., & Teplova, T. (2021). mpact of the COVID-19 induced panic on the environmental, social and governance leaders equity volatility: a time-frequency analysis. Research in international business and finance, 58.

[63] Danis, K., Fonteneau, L., Georges, S., Daniau, C., Bernard-Stoecklin, S., Domegan, L., ... & Schneider, E. (2020). High impact of COVID-19 in long-term care facilities, suggestion for monitoring in the EU/EEA. Eurosurveillance.

[64] Rahman, M. A., Zaman, N., Asyhari, A. T., Al-Turjman, F., Bhuiyan, M. Z. A., & Zolkipli, M. F. (2020). Data-driven dynamic clustering framework for mitigating the adverse economic impact of Covid-19 lockdown practices. Sustainable cities and society, 62.

[65] Onali, E. (2020). Covid-19 and stock market volatility. SSRN 3571453.

[66] Gounopoulos, D., Kosmidou, K., Kousenidis, D., & Patsika, V. (2019). he investigation of the dynamic linkages between real estate market and stock market in Greece. The European Journal of Finance, 647-669.

[67] Cerutti, E., Claessens, S., & Laeven, L. (2017). The use and effectiveness of macroprudential policies: New evidence. Journal of Financial Stability, 203-224.

[68] Li, H. Y., Cao, H., Leung, D. Y., & Mak, Y. W. (2020). The psychological impacts of a COVID-19 outbreak on college students in China: a longitudinal study. International journal of environmental research and public health.

[69] Enders, W., & Siklos, P. L. (2001). Cointegration and threshold adjustment. Journal of Business & Economic Statistics, 166-176.

[70] Bahmani-Oskooee, M., & Ghodsi, S. H. (2018). Asymmetric causality between the US housing market and its stock market: Evidence from state level data. The Journal of Economic Asymmetries, 18.

[71] Mallick, H., & Mahalik, M. K. (2012). Fundamental or speculative factors in the housing markets of emerging economies? Some lessons from China. Journal of Economic Policy Reform, 57-67.

[72] Lin, J. Y. (2011). New structural economics: A framework for rethinking development. The World Bank Research Observer, 26(2), 193-221.

[73] Yong, S. J. (2021). Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments. Infectious diseases, 737-754.

[74] Copeland, W. E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devadanam, V., ... & Hudziak, J. J. (2021). Impact of COVID-19 pandemic on college student mental health and wellness. Journal of the American Academy of Child & Adolescent Psychiatry, 134-141.

[75] Gherghina, Ș. C. (2021). Corporate Finance. Journal of Risk and Financial Management, 44.

[76] Debakshi Bora, D. B. (2021). The outbreak of COVID-19 pandemic and its impact on stock market volatility: Evidence from a worst-affected economy. Journal of Public Affairs.

[77] Cheung, Y.-W. (1996). A causality-in-variance test and its application to financial market prices. Journal of Econometrics, 33-48.

[78] Hafner, C. M., & Herwartz, H. (2006). Volatility impulse responses for multivariate GARCH models: An exchange rate illustration. Journal of International Money and Finance, 25(5), 719-740.

[79] Johansen, P. (1988). Inductive inference of ultimately periodic sequences. BIT, 573-580.

[80] Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. Econometrica, 1551.

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