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Do the Outbreak of COVID-19 Influence the China Stock Market?

Jak COVID-19 wpływa na chińską giełdę?

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Abstract
This study aims at the impact outbreak of COVID-19 influence Chinese currency and stock market over the period December 2, 2019, to January 04, 2021. The Generalized Autoregressive Conditional Homoscedastic approach captures the most common stylized fact about index returns (such as multivariate to capture the Shanghai and Shenzhen stock exchange). Our finding shows the explosive process and risk premium for the Shenzhen stock exchange (SSE) and Shanghai stock exchange (SZSE) index. And the standard deviation depreciation of the Chinese currency during the COVID-19 equivalent to 0.46% improved stock market return by 81% average returns. These results explain that high volatility of index returns is present in the Chinese stock market over the sample period. According to the analysis results, it can be concluded that the number of new cases and the number of recent deaths have a significant effect on the stock market, causing uncertainty in the sustainability.

Key words: exchange rate, stock return, COVID-19, sustainability
JEL codes: E37; F37; E31
Słowa kluczowe: Kurs wymiany, zwrot akcji, COVID-19, zrównoważoność

1. Introduction
The debate on the stock exchange rate has been a subject of academic research. With the large volume of papers regarding this matter, the speculation that trade rates impact the stock exchange is customary in the financial system and sustainable development.

We return to the stock exchange rate theory to test how this relationship develops in a tie and assess the current status during the COVID-19 stage 2020/03-2020/09 in contrast with the pre-COVID-19 stage. Normally, when the financial and sustainable development are shocked like the current COVID-19 as we are currently experiencing, people doubt the relevance of existing speculation and theories. How is the trading activity and index component after the COVID-19 pandemic; has COVID-19 impacted how trade rates have been generally accepted to influence the securities exchange and also sustainability if by what means it is the goal of this research. Our hypothetical establishment on which to look at the stock value-exchange rate connection is grounded and can be retrieved from (Dornbusch & Fischer 1980) work, but specifically in their stream-situated exchange rate framework. The stream on impact is on current records, which is reflected in the impacts they have on real yield and sustainable development. The fundamental principle of these models is the possibility that exchange impacts global competitiveness. The value of stock also responds to exchange rates because they deal with enterprises' present values and future revenues. There will impact future sustainable development as well as current investment and consumption if the stock prices change. According to Branson (1983); Frankel (1983), there are additionally the stock-situated models of exchange rates, as addressed in their craft.

These models see exchange rates as compared to market interest for resources. Given that resource valuation and evaluation depend on present estimations of future sustainable development, exchange rates are straightforwardly identified with asset prices. Empirical examinations have concluded with blended findings on whether or not exchange rates impact stock values. A few works embrace point-by-point writing literature, and interested readers allude to these works (Sui and Sun, 2016; Sha and Sharma, 2020; Chen, 2020; Fang et al., 2020). The literature is broad, but we will not investigate it here. Our theory is that the exchange rate impacts securities exchange all the more firmly after the episode of Coronavirus. The motivation for this theory is demand on recent papers introducing COVID-19 has influenced monetary, sustainable development and financial system, financial framework just as enterprise performances.

One of this paper is that none has inspected how the pandemic impacts the exchange rate connection in Shanghai and Shenzhen securities exchange. We center on the stock exchange index in light of the fact that COVID-19 illness, among developed nations, has been an exception, both as far as governance response to the emergency and results. Firstly, China was the first nation who impose a movement and travel ban. Second China has secured its country and borders. Relatively, the way to deal with individuals' sustainable development inside the nation has been confined. Thirdly, China has encountered minimal passing from the pandemic and figured out how to contain the spread of the infection much better. For example, personal experience during the stage of (SARS illness) has pushed people to wear face marks; this has partially been attributed to China's border, culture, and history. Faced with a COVID-19 pandemic, the Chinese stock exchange has been impacted differently depending on their industry. To be specific, enterprises that are non-state-owned, engaged in foreign trade, or have few assets are more vulnerable to pandemics (Chen, 2020).

Moreover, the pandemic contains risk transmission and risk spillover to other markets. (Fang et al., 2020) analyze the influence of the COVID-19 pandemic on the risk spillover of money market, stock market, and other exchange markets based on event study framework. They find that COVID-19 has an immediate effect on various financial markets, and the risk spillover of each market increases after 3-5 days of occurrence. The (GARCH-M model) generalized autoregressive conditional heteroskedasticity in mean has been employed with daily information to test our hypothesis. The exchange rate on securities exchange has gotten more strong after the outbreak of the COVID-19 pandemic reveal our empirical finding. We contribute to the recent work on the effect of COVID-19 disease on monetary policy, sustainable and financial development in the following ways. First, this study is the primary paper to consider the connection between the exchange rate and securities exchange (stock market) with regards to the outbreak time of Covid-19 illness. Our main contribution is to assess and archive the strength of exchange rate- securities exchange (market returns) connection because of the pandemic. We show that contrasted with ordinary time; the exchange rate has had a lot more grounded on the Chinese financial exchange following the pandemic. But Iyke (2020) looks at how COVID-19 predicts trade rate, informing the practice of monetary policy and financial development from a financial exchange return (market return) perspective.

2. Theoretical overview

This paper's inclusion continues with an outline of chosen literature on the disease of COVID19. This literature review is significant because the effect of the COVID-19 pandemic is more serious in the emerging economy. This paper is different from others because it examines the relationship between the stock exchange rate and the number of cases (death and confirmed cases) after the outbreak period of COVID-19. Since the subject of research is new, this literature audit is significant because Coronavirus research is at an early stage, and less is perceived of its role; it encourages us to distinguish our paper commitment and strength. This paper provided empirical evidence of the significant negative effect of the pandemic on stock market performance in the Chinese stock exchange using alternative indictors of financial exchange and the stock market and various econometric methods. Likewise, this paper has various benefits for the executive in developing markets. In fact, it allows these executives to well understanding what happened after the outbreak time of COVID-19. They can as well profit by applying key advices in determine the risk of the financial system to palliate the risk in developing markets.

The paper is related to two strands of literature. The first strand focuses on the effect of the COVID-19 pandemic on the stock exchange rate and the effect on stock return series. Regarding containing the pandemic, especially when the pandemic is a shocking as COVID-19, The world is stagnant, there is no standard book, no experimental model, which can help to learn from more about this illness (such as the pandemic like a COVID-19), regarding how they contain the pandemic. In this case, the standard of pandemic adjustment is self-study, self-leaned, or gained from different countries' experiences. They are currently developing empirical documents on COVID-19. They cover the influence of COVID-19 on monetary policy and financial development, just as financial development has achieved an undisputed quality, especially considering the availability of information prominent. (Huang and Zhen, 2020; Gil-Alana and Monge, 2020), they worked the influence of pandemic on a securities exchange (stock market) of energy firms. Liu et al. (2020) and Iyke (2020) examined the influence of COVID-19 on energy firm performance. Apergis and Apergis (2020) considered the issue with what COVID19 has meant for the energy market; inside this energy literature, three perspectives have been contemplated, the influence of COVID-19 on oil values or oil price volatility. In their investigation, Gu et al. (2020), with time, energy utilization expanded for certain firms burning-through more than in pre-illness or Pre-COVID-19 time. They use a broad dataset covering (34 thousand) firms and show that Covid-19 brought about 57% decrease in electricity consumption in the principal seven (7) day stretch. They have focused on firm responses to Coronavirus.

As such, there is an unmistakable role recognized for Covid-19 informing performance and volatility of energy markets and affecting the connection among energy and other financial development and macroeconomic components like stock returns. Generally speaking, an indisputable message from these examinations is that Covid-19 has affected energy stock costs and firm performance. Shen et al. (2020) exhibit that while COVID-19 contrarily affected Chinese firm performance, the emergency affected certain industries, like the travel industry (tourism), providing food and transportation, most as estimated by the decrease in their corporate presentation.

The Coronavirus has been affected by various financial development. (Haroon and Rizvi, 2020) they focused on securities exchange (stock market) liquidity. (He and el 2020) analyze what Covid-19 meant for various sectors of a securities exchange. Their finding is fascinating because they show that while the pandemic has adversely influenced a few areas, others (for instance, producing, data innovation, education, and medical care) have endured the emergency in a multi-country investigation. According to studies of (Chen et al., 2020), the role of Covid-19 regarding bitcoin earnings. In their examination, they present that they allude to as the dread notion index (the result of the pandemic). This index presents and interprets bitcoin's negative profits. He presents that COVID-19 is more effective in predicting exchange rate fluctuations than exchange rate gains (Iyke, 2020). The protection markets (insurance market) China has been adversely affected by COVID-19, presented by (Wang et al., 2020) work. During their examination, property and individual insurance were generally affected. They are employing household-level information to indicate that due to the COVID-19 pandemic, (Yue et al., 2020) affirm that households may change their portfolios. According (Liu et al., 2020) in their studies, they presented although the pandemic has decreased consumption of households in large cities, COVID-19 has limited influence on the consumption of provincial households. Vidya and Prabheesh (2020) investigation examine the link between Covid-19 and exchange (trade); they present a critical decrease in trade for different nations. A few investigations have also centered on securities exchange (stock market return) (Al-Awadhi et al., 2020; Zhan et al., 2020). Finally, (Liu et al. 2020) investigated China's financial development and business cycles and presented that those cycles were at that point in the contractionary stage before COVID-19; they contend that China thus, perhaps ready to more readily manage the repercussion of COVID-19. The fundamental message arising out of the literature insinuated above is that the main COVID-19 has reshaped practically all featured of monetary and financial development concentrated to date. One of the roles of this examination that has not been considered recently is the link among currency and financial exchange (stock market) and how Coronavirus disrupts this habitual link. Our contribution to the literature is definitely through tending to this issue.

The remainder of this research is organized as follows: Sections 2 present the methodology and data; the next section presents the results and discussion; the final section concludes with an outline of our findings.

3. Data and Methodology

3.1. Sample construction

In this section, we discuss our sample construction by collecting the data of a number of confirmed cases and deaths from Covid-19 from the website of (Worlddometer statistics, 2020). Our daily data started from December 02, 2019, to January 04, 2021. Next, we downloaded the daily Shanghai Composite Index and Shenzhen stock exchange index from finance.yahoo.com. Thirdly, we downloaded exchange rate CNY-US dollars and Brent crude oil price in USD dollars per barrel, data obtain from www.investing.com (2020) and finance.yahoo.com (2020), respectively. The first day in our analysis corresponds to the reported positive case of COVID-19. The data depends on normal business days, Monday to Friday excepted holidays.

For diverse reasons, we focused on the Chinese exchange rate and data period. (a) China has been an outlier, both in terms of governance reactions to the crisis of COVID-19 and the outcomes. (b) China was one of the first countries who imposed a travel ban, locked down country borders and the outbreak, (c) the Chinese have experienced the least deaths from COVID-19 and managed to contain the spread of the disease much better.

3.2. Methodology

To investigate the Chinese currency and stock market and know what happened after the outbreak of the COVID-19 pandemic. These closing prices have been taken from the Shanghai stock exchange and Shenzhen stock exchange. In this research, daily returns (r_t), the compound returns are studied, which is the first difference in the logarithm of the closing price.

$$r_t = \log\left(\frac{P_t}{P_{t-1}}\right) \quad (1)$$

P_t and P_{t-1} are the closing market index of SSE and SZSE at the current day and previous day, respectively. Since the outbreak, SSE and SZSE have been declining; in this study, our full dataset is divided into three sub-periods: the first sub-period, (a) Pre Covid-19 cover December 02, 2019, to March 11, 2020, (b) Covid-19 cover March 11, 2020, to August 31, 2020, and (c) post-outbreak cover September 01, 2020, to January 04, 2021. The results will be demonstrated separately in three stages.

3.3. Basis statistic

To determine the distributional of properties of the day SSE and SZSE return during the time of this examination, different clear statistics were calculated. It can be seen from the Table (Appendix A and B) that the normal return in the Shanghai stock exchange is higher than the normal return in the Shenzhen stock exchange. In the daily return of Shanghai and the Shenzhen stock exchange, Skewness and excessive kurtosis are clearly observed, which illustrates the essence of taking off from normal. Moreover, the J-B (Jarque-Bera statistic) as a normality test likewise corroborates that the null hypothesis of the average day-by-day return ought to be rejected at the critical level of 1%. In outline, the SSE (shanghai stock exchange) and SZSE (Shenzhen stock exchange) don't conform to the (typical) normal distribution, but they show positive Skewness in these three periods.

3.4. Testing for stationarity

In order to analyze whether the daily price index and its returns are stationary, the research employed for both of series ADF (Augmented Dickey Fully test), Dickey and Fuller (1981) and PP (Phillips-Peron test) Phillips-Peron, (1998). The outcomes of this test are presented in the appendix. The (ADF) and (PP) test for SSE and SZSE indexes shows that it is a stationary series. It is non-stationary time before the coronavirus outbreak. However, while a similar test was performed on the return, the outcome strongly rejected the null hypothesis of unit roots for all three stages. In this way, we can deduce that in all two cycles, the return series remained stationary. It can be seen from Table (Appendix A and B).

3.5. Testing for Heteroscedasticity

Quite possibly, the main issue prior to the application of the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) method is first inspected to check residuals to prove heteroscedasticity. In order to test the presence of heteroscedasticity in the residual of SSE and SZSE indexes returns, we applied the Lagrange multiplier (LM) test with (ARCH) influence proposed by (Engel 1982) (MA) moving average measure or (AR) and (MA) measure of combination and (ARMA) measure in the outline or this part, which can be an (AR) autoregressive measure, the test methodology is performed by first obtaining the residual e_t from the ordinary least squares regression of the conditional mean condition.

For instance, into (ARMA-1,1) measure, the conditional mean condition will be:

$$r_t = \phi_1 r_{t-1} + \epsilon_t + \theta_1 \varepsilon_{t-1} \quad (2)$$

The next step is regressing the squared residual on a constant and q lags; after getting the residuals, e_t. According to the following condition:

$$e_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + \cdots + \alpha_q e_{t-q}^2 + v_t \quad (3)$$

In this investigation, the autoregressive moving average (ARMA-1,1) model was adopted for the first time as for the conditional mean in the return series as an initial regression, at that point, the ARCH effect of the residual series is not into of the test of the null hypothesis. The outcome of this assessment is summed up in the appendix. The strong proof of rejecting the null hypothesis for all lags included is done with the result of the ARCH-LM test. The presence of the ARCH effect in the residual series means that we are rejecting H0; therefore, the variance of the return series is non-constant for all the stages determined.

3.6. Methodology and Model

Applying the approach of Autoregressive conditional heteroscedasticity (ARCH) and its generalization (GARCH) model represent the main approach of modeling and predict stock exchange (stock market volatility). In this study, distinctive univariate GARCH particulars are adopted to present daily SSE and SZSE, and these models are GARCH (1,1) and GARCH-M (1,1) models. There are two different conditions or specifications in introducing these various approaches. Firstly, the conditional mean and secondly the conditional variance, we briefly review this approach.

3.7. Volatility and Measurement

It is valuable, prior to beginning to describe the volatility, it is necessary to briefly clarify the volatility, in any event with the end goal of clarification the extent of this research. The term volatility alludes to the spread of all presumable results of uncertain factors. Regularly, in the field of financial markets, the spread of asset returns frequently preoccupies. Statistically speaking, the term of volatility is frequently estimated as the sample standard of the deviation:

$$\hat{\sigma} = \sqrt{\frac{1}{T-1}\sum_{t-1}^{T}(r_t - \mu)^2} \quad (4)$$

r_t, The profits (returns) on day t and μ is the normal return over the T-DAY period. At times, σ^2 is employed additionally as a volatility measure. Volatility is related with, however, not exactly the same as a risk. According to Poon S. (2005), the risk is related to undesirable results, although the strict employ of uncertainty volatility may be a positive result.

3.8. Model

In this paper, the return of security depends on its volatility. The GARCH-M model of (Engel et al., 1987) may be referred for demonstrate such a wonderful model, GARCH in mean is represented by M. The basic GARCH structure is an extension of the model which permits the conditional mean of the sequence to depend on its standard deviation or conditional variance. A basic GARCH-M (1-1) will be as:

$$r_t = \mu + \lambda\sigma_t^2 + \varepsilon_t \quad (5)$$

$$\sigma_t^2 = \omega + \alpha\omega_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (6)$$

Where μ and λ are constants, the parameter λ, is known as the risk premium parameter. A positive λ, shows that the return is emphatically related to its volatility. Increasing in average return is achieved by the expansion of conditional variance as an intermediary for risk expansion. Engel et al. (1987) expect that the function of conditional variance ε_t; is the risk premium an expending; in other hand, the greater of remuneration important to instigate the agent to hold the long-run resource (Ender, 2004). In our examination, the exchange rate influence on stock prices employing the GARCH-M9 (1,1) model estimated can be composed as:

$$SSE_t = \alpha + \beta ER_t + OIL_t + \delta V_t + COVID - 19 + \varepsilon_t \quad (7)$$

$$SZSE_t = \alpha + \beta ER_t + OIL_t + \delta V_t + COVID - 19 + \varepsilon_t \quad (8)$$

SSE_t and $SZSE_t$ are the Shanghai stock exchange and Shenzhen stock exchange returns, respectively, ER_t is the CNY-USD dollars exchange rate, OIL_t is oil price shocks, δV_t, is the conditional variance and model innovation, COVID-19 (confirmed case and death), ε_t is normally distributed. The conditional volatility is obtained as $V_t = \rho_0 + \rho_{1\rho}\varepsilon_t^2 + \rho_2 V_{t-1}$ where ρ_n (n=0,1,2) are parameters to be estimated and the sum of non-intercept terms are less than one (1) (Bollerslev, 1986).

4. Results and discussion

For heteroscedasticity, this section introduces the data description. At the point when the residuals are checked, the ARCH-LM test gives strong proof for the ARCH effect in the residual series. This section introduces the estimation results of various GARCH models for the Chinese stock exchange. For all complete pre-COVID-19, COVID-19, and post COVID-19 stages, the maximum likelihood method is used to estimate under the Gaussian assumption, which shows that we can use GARCH to perform index return fluctuations rate modeling method. Normal distribution.

The log probability function utilizes Marquardt's mathematical iteration algorithm to look for the normal parameter to maximize. In order to show that the SSE and SZSE index dropped sharply in the last section, a dummy variable will be presented in the normal state of the whole time frame. The variable is set to zero (0) in the time frame before the sharp decrease and after it is set to (1). In this manner, for a null sample, change to normal condition to:

$$r_t = \mu + DUMMY + \varepsilon_t$$

For all stages, the mean condition will in any case, be utilized as previously specified. Notwithstanding the investigated output of various GARCH approaches, the analytic test aftereffects of these models are likewise given to check whether there is as yet an ARCH effect in the investigated approach. See appendix table the results are listed. Among them, the parameter estimates of different GARCH models for SSE and SZSE index returns at specified stages.

The result is presented in the appendix table, the parameter estimates of different GARCH models for SSE and SZSE index returns for the three specified stages. GARCH (1,1) model estimation results are presented here.

Tables 1 and 2 shows that, in this variance equation from this table, GARCH term (β), ARCH term (α), the value of GARCH (1,1) is very significant and has the expected sign for all stages. The lagged conditional variance and squared disturbance have an effect on the conditional variance, which explains the significance of α and β. In the second stage of the examination process, the sum of the two regressed ARCH and GARCH coefficients $\alpha + \beta$ is less than (1), which requires a process with average regression variance.

Table 1. Panel A, Effect of exchange rate on Shenzhen stock market returns

Sample periods	**No Controls**	**DUMMY controls**
Pre Covid-19	0.3999*	3.55E-05*
During Covid-19	0.6575*	5.82E-08*
After Outbreak	0.4269*	2.90E-05*

Note: *Indicates significance at 1% level

Table 2. Panel B, Effect of exchange rate on Shanghai stock market returns

Sample periods	**No Controls**	**DUMMY controls**
Pre Covid-19	0.327*	8.64E-07
During Covid-19	0.640*	4.01E-08
After Outbreak	0.520*	0.0001*

Note: *Indicates significance at 1% level

On the contrary, PRE-COVID, during COVID-19 and POST-COVID-19, the sum of these parameters is greater than (1), which indicates that the impact on conditional variance is highly persistent (an example, the conditional variance process is explosive). Therefore, this will confirm that volatility clustering is observed in SSE and SZSE index returns. And other words, this means that large change in the rate of return tends to follow large and small changes. The ARCH-LM test statistics for all stages showed no additional ARCH effect. This presents that the variance condition is clearly defined (see table 3).

Table 3. ARCH-LM Test for residual of returns on SSE and SZSE markets

	Pre-COVID-19	**During COVID-19**	**After Outbreak**
ARCH-LM (TR^2)	8.929	45.108	1.632
Prob. Chi Square	0.0028	0.0000	0.2014

4.1. GARCH-M (1.1) model estimation

Tables 4 and 5 show that the GARCH-M Model is estimated and permitting the mean condition of the returned to depend on the conditional variance σ^2. By estimating the coefficient of σ^2 (risk premium) in the mean condition, the coefficient is positive for all the stages, which indicates that the mean value of the return series depends largely on past conditional variance and on past innovation. In other words meaning, the conditional variance used for return risk is positively related to the return level. In this outcome, when the volatility increases, returns increase by a factor accordingly. According to the theory of risk premium, these outcomes are consistent with the positive risk premium of stock indexes, which states that assets with higher risk levels are expected to receive higher returns. In all the periods, the ARCH and GARCH coefficients are significant. No ARCH effect is accepted of the null hypothesis.

4.2. ECARCH (1,1) model estimation

In order to study the leverage effect of SSE and SZSE stock exchange, or stock market index returns during the period of COVID-19, we use the EGARCH (1,1) approach. Tables 4 and 5 show that the Shanghai Stock Exchange and Shenzhen Stock Exchange in the table above presents that all estimated coefficients for all stages are statistically significant at the 1% confidence level, indicating the EGARCH (1,1) model for the stock market returns. Indicating that negative compared with the positive shock of the same, the negative shock means that the conditional variance of the next cycle is higher. The asymmetric (leverage) effect captured by the parameter estimates is also statistically significant (with a negative sign). This means the change in the Shanghai Stock Exchange and Shenzhen Stock exchange (stock market index) during the pandemic of COVID-19 have been observed in the presence of leverage effects. All the periods accept the null hypothesis that is no heteroscedasticity in the residual.

Table 4. Estimation result of GARCH model of SZSE

	GARCH (1.1)	**GARCH-M (1.1)**	**EGARCH (1.1)**
Pre- COVID-19	1.3242* 0.2561* Wald (274.84)	-0.1931* 0.1126* Wald (112.24)	-0.1931* 0.1125* Wald (112.24)
During COVID-19	0.8315* 0.2235* Wald (1215.53)	-0.8331* 0.7513* Wald (402.56)	0.0023* 0.0032* Wald (402.56)
After the Outbreak	-0.3974* 0.0086* Wald (2093.04)	4.3114* 0.6088* Wald (2093.04)	3.8186* 0.0585* Wald (2093.04)

Note: *Indicates significance at 1% level

Table 5. Estimation result of GARCH model of SSE

Sub-samples	GARCH (1.1)	GARCH-M (1.1)	EGARCH (1.1)
Pre- COVID-19	1.2071* 0.2403* Wald (42.38)	1.5128* 0.0004* Wald (1.12E+09)	-0.1013* 8.31E-06* Wald (1.12E+09)
During COVID-19	0.8614* 0.2452* Wald (560.79)	7.3377* 0.9863* Wald (402.56)	14194.15* 1865.05* Wald (402.43)
After the Outbreak	-776.3317* 108.3646* Wald (51.32)	7604.037* 1901.527* Wald (231.72)	0.8615* 0.2452* (560.79)

Note: *Indicates significance at 1% level

5. Concluding Remarks

Forecasting the volatility of stock exchange returns has become empirical research, particularly in the research field in the financial market. In this study, the exchange rate was evaluated to see the exchange rate's effectiveness in explaining Chinese stock market returns. Motivated by the continuous development of research on COVID-19 and its influence on the global economic and financial market, our hypothesis is that COVID-19 has impacted the link among China's exchange rate and stock exchange returns. Employing China's daily time information series applicable to the GARCH approach (including symmetric and asymmetric models). The approach can capture the most common stylized fact about index returns, for example (volatility clustering and leverage effects), which are consistent with the literature. The exchange rate is a statistically and significant determinant of the stock exchange (stock market returns). Our main contribution is the discovery that the standard deviation depreciation of Chinese currency during the sample period of COVD-19 equivalent to 0.46% improves stock exchange returns by 81% average returns. The paper concludes with strong evidence of exchange rate and daily return during the COVID-19 periods. The existence of conditional heteroscedasticity in the residual series and the Shanghai stock exchange and Shenzhen stock exchange data showed a significant departure from normality. The empirical investigation and the econometric analysis support the symmetric volatility hypothesis. Performing multiple sensitive tests on hypothesis testing means that the rate of return is volatile, and bad or good news (positive and negative shocks) has the same influence on prospective volatility levels. In this research investigation, an example, we only figure out and document how exchange rate change affects stock returns. In other words, a mean increase in volatility would increase returns. Here, our research's implication may trigger further studies, which is an expected and important result. The next Possible extension is to use the finding and develop trading strategies. We do not follow this way; our goals are different. So, we do not take it this way; our goals being different, we leave this way for future research. To briefing, all the explanations of GARCH specification in this article indicate that during the analysis of the COVID-19 stage, the index returns of the Chinese Stock Exchange *change* explosive volatility.

References

1. AL-AWADHI A.M., AL-SAIFI K., AL-AWADHI A., ALHAMADI S., 2020, Death and contagious infection diseases: Impact of the COVID-19 virus on stock market returns, *J. Behav. Exp. Finance*, 100326, DOI: 10.1016/ j.jbef.2020.100326.
2. APERGIS E., AND APERGIS N., 2020. Can the COVID-19 pandemic and oil price dive the US partisan conflict index?, *Energy Research Letter*, 1(1): 13144, DOI: 10.46557/001c.13144.
3. BOLLERSLEV T., 1986, Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31:307-327.
4. BRANSON W.H., 1983, Macroeconomic determinants of real exchange risk, *Managing foreign exchange risk*, ed. R.J. Herring R.J., Cambridge University Press, Cambridge: 33-74.
5. CHEN C., LIU L., ZHAO N., 2020, Fear sentiment, uncertainty, and bitcoin price dynamics: Evidence from gold and cryptocurrencies, *Journal of Finance Research Letters*, 101554, DOI: 10.1016/j.frl.2020.101554.
6. DICKEY D., FULLER W., 1981, Distribution of the estimators for Autoregressive time series with a unit root, *Econometrica*, 49: 1057-1072.
7. DORNBUSCH R., FISHER S., 1980, Exchange rates and the current account, *American Economic Review*, 70: 960-971.
8. ENDER W., 2004, *Applied econometric time series*, 2nd Ed, Wiley series in Probability and Statistics.
9. ENGEL R., BOLLERSLEV T., 1982, Modeling the persistence of conditional variances, *Econometric Reviews*, 5: 1-50, DOI: 10.1080/07474938608800095.
10. ENGEL R., LILIEN D., 1987, Estimating time varying risk premia in term structure: The ARCH-M model, *Econometrica*, 55: 391-407.
11. FANG Y., YU B., WANG W., 2020, China's financial market risk measurement and controlling under COVID-19 shock, *Journal of Central University of Finance &Economic*, DOI:10.19681/j.cnki.jcufe.2020.08.010.
12. FRANCKEL J.A., 1983, Monetary and portfolio-balance model of exchange rate determination, *Economic interdependence and flexible exchange rates*, eds. Bhandari J.S., Putnan BH., (Eds), MIT, Cambridge.
13. GIL-ALAN L.A., 2020, Crude oil price and COVID-19: Persistence of shock, *Energy Research Letter*, 1(1): 13200, DOI: 10.46557/001c.13200.

14. GU X., YING S., ZHANG S.A.R., 2020, How do firms respond to COVID-19? First evidence from Suzhou, China, *Emerging Market and Trade*, 56 (10): 2151-2197, DOI: 10.1080/1540496X.2020.1784716.
15. HAROON O., RIZVI S.A.R., 2020, Flatten the curve and stock market liquidity – An inquiry into emerging economies, *Emerging Market Finance and Trade*, 56(10): 2151-2197, DOI: doi.org/10.1080/1540496X.2020.1784716.
16. HE P., SUN Z., LI. T., 2020, Accounting index of COVID-19 impact on Chinese industries: A case study using big data portrait analysis; *Emerging Markets Finance and Trade*, 56(10): 2332-2349, DOI: 10.1080/1540496X.2020.1785866.
17. HE P., SUN Y., SUN Z., LI T., 2020, COVID-19's impact on stock market prices across different sectors – An event study based on the Chinese stock market, *Emerging Markets Finance and Trade*, 56(10): 2198-2212. DOI: 10.1080/1540496x.2020.1785865.
18. HUANG W., ZHENG Y., LI T., 2020, COVID-19: Structural changes in the relationship between investor sentiment and crude oil futures prices, *Energy Research Letters*, 1(2): 13685, DOI: 10.46557/001c.13685.
19. IYKE B., 2020, COVID-19: The reaction of US oil and gas producers to pandemic, *Energy Research Letters*, 1(2): 13912, DOI: 1046557/001c.13912.
20. LIU L., WANG E.Z., LEE C.C., 2020, Impact of the COVID-19 pandemic on the crude oil and stock markets in the US: A time-varying analysis, Energy Research Letters, 1(1): 13154, DOI: 10.46557/001c.13154.
21. LIU L., D., SUN W., ZHANG X., 2020, Is the Chinese economy well positioned to fight the COVID-19 pandemic? The financial cycle perspective, *Emerging Markets Finance and Trade,* 56(10): 2259-2276, DOI: 10.1080/1540496X. 2020.1787152.
22. PHILLIPS P.C.B., PERRON P., 1998, Testing for unit root in time series regression, *Biometrika*, 75: 335.
23. POON S., 2005, *A practical guide to forecasting financial market volatility*, Wiley Finance, England.
24. SHA Y., SHARMA, S.S., 2020, Research on pandemics special Issue of the Journal Emerging Markets Finance and Trade, *Emerging Market Finance and Trade*, 56: 2133-2137, DOI: 10.1080/154049X.2020.1795467.
25. SHEN H., FU M., PAN H., YU Z., CHEN Y., 2020, The impact of the COVID-19 pandemic on firm performance, *Emerging Market Finance and Trade*, 56: 2133-2137, DOI: 10.1080/1540496X.2020.1785863.
26. SUI L., SUN, L., 2016, Spillover effects between exchange rate and stock prices: Evidence from BRICS around the recent global financial crisis, *Research in International Business and Finance*, 36: 459-471, DOI: 10.1016/j.ribaf.2015.10.011.
27. VIDYA C.T., PRABHEESH K.P., 2020, Implication of COVID-19 pandemic on the Global Trade networks, *Emerging Markets Finance and Trade*, 56(10): 2408-2421, DOI: 10.1080/1540496X.2020.1785426.
28. WANG Y., ZHANG D., WANG X., FU Q., 2020, How does COVID-19 affect China's insurance Market?, *Emerging Market Finance and Trade*, 56(10): 2350-2362, DOI: 10.1080/1540496X.2020.1791074.
29. YUE P., KORKMAZ A.G., ZHOU H., 2020, Household financial decision making amidst the COVID-19 pandemic, *Emerging Market Finance and Trade*, 56(10): 2363-2377, DOI: 10.1080/1540496X.2020.1787149.
30. ZHANG D., HU M., JI Q., 2020, Financial market under the global pandemic of COVID-19, *Finance Research Letters*, 1011528.

Appendix A

Table 6. Descriptive Statistics of SSE returns series. Here, a full sample of data is observed from December 2, 2019, to January 04, 2021, with 71 observations for the Shanghai stock exchange and 70 observations for the Shenzhen stock market exchange during the investigation. The standard deviation and Skewness are observed.

	CONFIRMEE_CASE	**DEATHS**	**EXCHANGE_CNY_USD**	**OIL_PRICE**	**SHANGHAI_SSE**
Mean	25586.00	811.9577	6.973935	51.25014	2693.013
Median	0.000000	0.000000	6.976400	53.77000	2984.390
Maximum	80921.00	3161.000	7.060200	63.27000	3115.570
Minimum	0.000000	0.000000	6.858700	0.000000	0.000000
Std. Dev.	34080.93	1165.811	0.046335	14.35861	900.3380
Skewness	0.752878	1.016053	-0.420562	-2.599945	-2.655922
Kurtosis	1.738896	2.324824	2.672969	9.610970	8.133916
Jarque-Bera	11.41232	13.56491	2.409381	209.2837	161.4445
Probability	0.003325	0.001133	0.299785	0.000000	0.000000
Sum	1816606.	57649.00	495.1494	3638.760	191203.9
Sum Sq. Dev.	8.13E+10	95138119	0.150283	14431.89	56742593
Observations	71	71	71	71	71

Table 7. ADF Unit Root and PP test for the return series of SSE

Variables	ADF	Phillips-Perron test
Shanghai SSE	-3.5857* (0.008)	-3.6042* (0.008)
Exchange CNY	-8.5602* (0.0000)	-8.5795* (0.000)
Oil Price	-7.9505* (0.000)	-7.9505* (0.000)
Confirm Case	-6.1275* (0.000)	-6.1292* (0.000)
Death Case	-11.611* (0.000)	-6.2885* (0.000)

*, **, and *** indicate rejection of the null hypothesis at 1%, 5%, and 10%, respectively. P-Value is given in parenthesis.

Appendix B

Table 8. Descriptive Statistics of SZSE returns series

	CON-FIRMEE_ CASE	**DEATH**	**EX-CHANGE_ CNY_USD**	**OIL_PRICE**	**SHEN-ZHEN_SZSE**
Mean	25951	823.55	6.9727	51.147	0.8154
Median	0.0000	0.0000	6.9754	53.565	0.9015
Maximum	80921	3161.0	7.0489	63.270	0.9940
Minimum	0.0000	0.0000	6.8587	0.0000	0.0000
Std. Dev.	34186	1170.0	0.0454	14.435	0.2771
Skewness	0.7306	0.9945	-0.4688	-2.5760	-2.5467
Kurtosis	1.7059	2.2809	2.6754	9.4699	7.7410
Jarque-Bera	11.111	13.047	2.8717	199.51	141.22
Probability	0.0038	0.0014	0.2379	0.0000	0.0000
Sum	1816606.	57649	488.08	3580.3	57.083
Sum Sq. Dev.	8.06E+10	944694	0.1427	14379	5.3001
Observations	70	70	70	70	70

Table 9. ADF Unit Root and PP test for the return series of SZSE

Variables	ADF	Phillips-Perron test
Shenzhen SSE	-10.631* (0.000)	-10.649* (0.000)
Exchange CNY	-8.5602* (0.000)	-8.5795* (0.000)
Oil Price	-7.9505* (0.000)	-7.9505* (0.000)
Confirm Case	-6.1275* (0.000)	-6.1292* (0.000)
Death Case	-11.611* (0.000)	-25.441* (0.000)

*, **, and *** indicate rejection of the null hypothesis at 1%, 5%, and 10%, respectively. P-Value are given in parenthesis

Appendix C

Figure 1. Normal quantile plots for daily stock returns of SSE

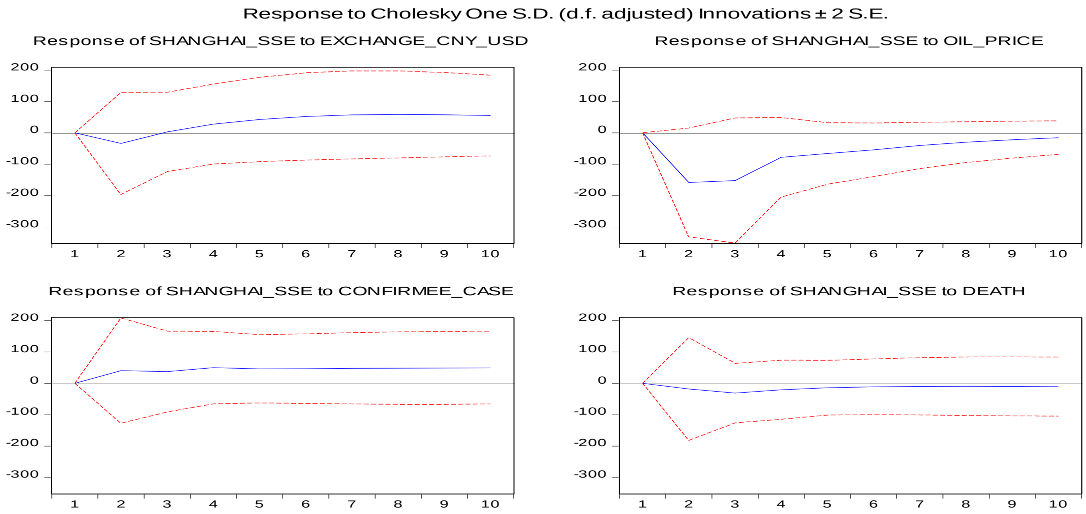

Figure 2. Normal quantile plots for daily stock returns of SZSE