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Volatility of financial markets index affected by COVID-19

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ABSTRACT

The spread of Corona Virus (COVID-19) has a significant impact on financial markets around the world. This creates an unprecedented amount of risk and causes investors to incur significant losses in a very short period of time. The aim of this study was to investigate the volatility of the main stock market indices of COVID-19 in countries with the highest number of Corona Virus patients during the period 12/30/2019 to 04/27/2020 with the help of daily data by test. GARCH-BEKK is done. The results of this study show that, the COVID-19 method in China has not affected the fluctuations of the Chinese stock index according to the obtained results, but in Iran and Italy with the outbreak of COVID-19, the stock index has begun to grow and increase. The outbreak of COVID-19 in South Korea has also caused the stock index to fall. On the other hand, fluctuations in China's stock market index have no effect on Iran's stock index, but reduce Italy's stock index and increase South Korea's stock index.

Keywords:

COVID-19, stock market index, pandemic, financial markets

1. Introduction

The Covid-19 pandemic, originally known as a public health crisis, has become a global economic crisis that can have severe and potentially long-term effects on economic activity, employment and trade (ILO, 2020). Current forecasts suggest that the crisis may lead to a $ 2,000 billion drop in global income (UNCTAD, 2020) halving economic growth from 2.9 percent in 2019 to 1.5 percent in 2020 (OECD 2020) and raising unemployment to a minimum. 25 million people worldwide (ILO, 2020). Given the daily data on unprecedented jumps in unemployment and more than expected reductions in production and national holidays that have just begun in some countries, it seems that the costs of this pandemic on the economy and the labor market is both longer and more destructive than the International Labor Organization's initial global survey. COVID-19 has led to more than 1.4 million confirmed cases and more than 83,000 deaths worldwide. It has also raised fears of an economic crisis and impending recession. Social distances, isolation, and travel restrictions have reduced labor in all sectors of the economy and led to the loss of many jobs. Schools have been closed and the need for manufactured goods and products has decreased. In contrast, the need for medical equipment has increased significantly. The food sector has also seen high demand due to panic purchases and food storage (Nikola et al., 2020).

The spread of the new Corona Virus (COVID-19) in early 2020 led to lower stock prices, increased stock price volatility, lower nominal interest rates, and possibly a contraction in real economic activity. Much of the uncertainty depends on the final extent of the epidemic, which is based on the number of people who are eventually infected and killed. Also, the full global economic consequences of this disease are not epidemic (Barrow et al., 2020).

On the other hand, overflows in returns and fluctuations are usually observed with risk (Daibold and Yilmaz, 2009). Recognizing volatility in financial markets is very important for risk managers, decision makers and insurers, especially after the financial crisis. As a result, the study of fluctuations changes the direct consequences of designing the desired portfolio and developing policies to prevent the transmission of harmful shocks (Ben Saida et al., 2018).

The spread of turbulence between financial indicators indicates the process of information transfer between markets. Given that financial markets are interrelated, the information generated in one market can affect other markets. Given these poor economic conditions due to the prevalence and spread of COVID-19 worldwide, we considered it necessary to attention the financial and economic effects of the COVID-19 on the stock markets of countries that have been the major victims of the disease. Let's check.

2. Literature Review

2.1. Overflow of fluctuations in markets

Today, whatever is experienced in one market affects other markets. This has focused researchers on understanding how shocks and overflows are fluctuated from one market to another (Arago and Fernandez 2007). On the other hand, the intensity and direction of transmission of shocks and overflow of fluctuations may be affected by structural failures in fluctuations (Darat and Bencato, 2003). Typically, the occurrence of a shock or the presence of a shock in one market affects other markets, and this has led researchers to pay more attention to how shocks and fluctuations are transferred from one market to another. In general, looking at time series, we can see that often these time series in a period or periods under the influence of economic, political, social, domestic and global events, such as financial crises, oil shocks, instability Political, war, or sudden changes in foreign exchange policies have been fluctuated sharply. So that these events sometimes remain in the markets for a long time. Fluctuations in a market cause the investor to want to revise and adjust his portfolio and change the composition of his portfolio assets. This exacerbates the turmoil in the crisis market and also transmits fluctuations and shocks to other markets. With these explanations, the correct pricing of financial assets and the correct diagnosis of fluctuations, improving the forecast of future price fluctuations, optimal allocation of resources and optimal selection of the portfolio are important. Therefore, in this section, first the theoretical foundations related to the variables will be explained and then the related backgrounds will be discussed (Sefidbakht and Ranjbar, 2017).

Given the asymmetric overflows in the financial and commodity markets, policymakers can assess the effects of policy implementation better and are also useful in assessing risk and stock portfolio

diversification strategies for investors (Chen et al., 2019).

2.2. COVID-19 pandemics

The outbreak of COVID-19 in January 2020 caught the world's attention. The spread of the virus and the increase in the number of confirmed cases provoked rapid reactions from the Chinese government. On January 23, 2020, the quarantine of the entire city of Wuhan shocked the whole world, and it was later revealed that this is an effective policy of the Chinese government. One week later, who announced that the outbreak in China is an international public health emergency (PHEIC) concern. At that time, the total number of confirmed cases was 7,711, of which only 83 were in 18 countries outside China[1].

South Korea was the second country that has experienced the unpleasant outbreak of COVID-19, and Iran soon followed. It took a week for South Korea to go from 31 cases to more than 1,000, and it took 12 days for Iran to go from zero to more than 1,000. Using data from the Johns Hopkins Corona Virus Resource Center, the confirmed cases of the 6 most affected countries are plotted (Figure 1).

While China and South Korea were generally under control in March, the hub moved to Europe and the United States. Italy had the highest number of casualties, while the United States leading the total number of confirmed cases.

Around the WHO's official announcement of a global epidemic, financial markets around the world have begun to stagnate. Take the s & p500, for example, which peaked on February 19, 2020 (3389.15), but fell to 2237.40 on March 22, 2020, more than 30% in one month. The standard deviation of daily returns in February was 0.0069. This number increased to 0.0268 in March. As 2003, Acute Respiratory Syndrome (SARS) was estimated to cost between $ 30 billion and $ 100 billion worldwide (Smith, 2016). While SARS was predominantly in China, the COVID-19 pandemic now acts as a global crisis, acting as a "pathogen once in a century" (Gates, 2020). It is expected to have a deeper impact on the economy.

COVID-19 has affected communities, businesses and organizations around the world, inadvertently affecting financial markets and the global economy. Government responses and incoherent inconsistencies have disrupted the supply and demand chain. Initially, in China, traffic restrictions meant a sharp decline in manufactured goods by Chinese factories, while quarantine and self-isolation policies reduced consumption, demand, and use of products and services[2]. As COVID-19 spreads around the world, China is recovering faster than any other country and is strengthening its trade bargaining power with the United States. In fact, Chinese companies will be in a good position to reach their Western counterparts, who are heavily dependent and inevitably affected by the stock market[3].

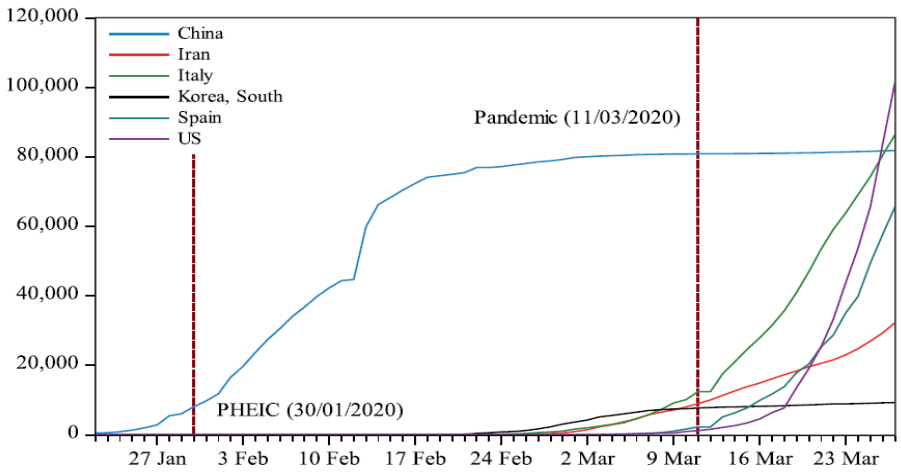

Figure 1: Number of infected people in the countries most affected[4]

Zhang et al. (2020), aiming to outline country-specific risk patterns and systemic risks in global financial markets, as well as the possible outcome of policy interventions, such as the US decision to implement a 0% interest rate and a quantitative indefinite reduction (QE). Analyzed, the results of their research showed the extent to which these policies can create more uncertainty in global financial markets. Nicola et al. (2020) examined the economic and social effects of COVID-19 on individual aspects of the global economy, given the prevalence and prevalence of coronation around the world, unemployment and school closures, and many occupations and changes in consumption. Gödel (2020), in an article evaluating the enormous economic and social impact of COVID-19, based on articles that have predicted such a large-scale event and its economic consequences, the impact of other epidemics and its prevalence. Is. Examining the characteristics of COVID-19, along with what research shows, is the effects of other past events that are approximately parallel to COVID-19 in the direction of subsequent research.

2.3. Research Hypotheses

Hypotheses of this research according to its subject are as follows:

1) The spread of COVID-19 in China caused changes in the SSEA stock index in this country.
2) The spread of COVID-19 in South Korea caused changes in the KS11 stock index in this country.
3) 3- The spread of COVID-19 in Iran caused changes in the TEPIX stock index in this country.
4) The spread of COVID-19 in Italy caused changes in the FTITLMS stock index in this country.

3. Methodology

The present research is a descriptive correlational research and according to the possibility of using its results, it is one of the applied researches. The data of the present study include daily data from December 30, 2019 to April 27, 2020, to examine the stock market indices of Iran, China, South Korea and Italy, as well as the daily price of Brent oil, the daily price of gold and the daily exchange rate. Provided by investing.com. Information on the spread of the coronavirus has also been extracted from the World Health Organization website.

Library research and data mining through valid databases and the method of collecting data and information related to research for library research, using the study of valid and scientific articles and research. In order to analyze the research data, we first use Excel software to sort and classify the data. Then we use 10Eviwes software to analyze the data and test the hypotheses. Initially, statistical indicators were used to show the characteristics of the studied variables. In order to test the research hypotheses, we first examine the descriptive statistics of the research and the normality of the data. Then, using Dickey-Fuller test, we examine the mania of the variables, and finally, using the GARCH-BEKK model, we determine the two variables of the overflow effect of fluctuations.

3.1. Research Model

In this study, first we intend to show the relationship between stock market risk of the countries and the prevalence of COVID-19, and for this purpose, to study daily information on the prevalence of coronavirus in Iran, China, South Korea and Italy and the main stock market indicators. These countries (respectively: FTITLMSM, KS11, SSEA, TEPIX) are used. Then we examine the relationship between the daily price of oil and the price of gold and the exchange rate with the daily prevalence of COVID-19. Also considering these conditions, we examine the correlation between stock markets in the mentioned countries.

In this paper, we investigate the effects of overflow fluctuations between indices obtained through the conditional covariance matrix. As a result, we use a simple methodology method for the conditional average equation, with the exception of external variables that can be considered in the volatility of the bond yield, which is as follows:

$$H_t = \acute{C}\mathrm{C} + A\acute{\varepsilon_{t-1}}\varepsilon_{t-1}A + \acute{B}H_{t-1}B$$

H_t Matrix of variance - Conditional covariance N × N Time t and B, A, C are matrices N × N. The non-diagonal elements of matrices A and B show the fluctuations and transmissions of fluctuations between

markets, respectively. Significance test of non-diagonal elements of matrices A and B is a criterion for judging the direction of impulse transmission and overflow of fluctuations between markets. In the case of the generalized variance conditional variance heterogeneity, the H_t positive 2 × 2 matrix is as follows:

$$\begin{bmatrix} h_{11.t} & h_{12.t} \\ h_{21.t} & h_{22.t} \end{bmatrix} = \acute{w}w + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \varepsilon^2_{1.t-1} & \varepsilon_{1.t-1}\varepsilon_{2.t-1} \\ \varepsilon_{1.t-1}\varepsilon_{2.t-1} & \varepsilon^2_{1.t-1} \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} h_{11.t-1} & h_{12.t-1} \\ h_{21.t-1} & h_{22.t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

H_t is a 2 × 2 matrix of variance-conditional covariance at time t and C is a low triangular matrix of 2 × 2 constants with 4 parameters. A is a 2 × 2 square matrix of parameters and shows the degree of correlation between past error squares and conditional variances (or, in other words, the effects of impulses or unforeseen events on fluctuations). The diagonal elements of matrix A represent the effect of their own arc (meaning that conditional variances are multiplied by the square of the passing errors). In addition, B is a 2 × 2 square matrix of parameters and shows to what extent the current levels of conditional variances are correlated with past conditional variances. The diagonal elements in matrix B show their GARCH effect (significance of variance with intervals b_{12} and b_{21} means that the current conditional variance is affected by the previous conditional variance) and the non-diagonal elements of matrices A and B, i.e. a_{12}, a_{21}, b_{12}, and b_{21}, show how shocks and fluctuations are transmitted across markets over time. For example, error sentences a_{12} a_{21} indicate the direction of shocks and news, while covariance statements b_{12} and b_{21} indicate the direction of oscillation transmission (Kang et al., 2011).

3.2. Research Variables

The variables of the present study include daily information of COVID-19 patients in the countries that have been most affected. In this study, information from China, South Korea, Iran and Italy, as well as stock market indices of these countries, which include the index, respectively. SSEA, KS11, TEPIX and FTITLMS have been trading since the COVID-19 outbreak in these countries until 03/27/2020.

4. Results

4.1. Descriptive Statistics

Descriptive statistics on stock market indices of China, South Korea, Iran and Italy used in this study are summarized in Table (1). In this table, the values of average, average, maximum, minimum, standard deviation of data, elongation, skewness and statistics and probability of Jarque-Bera are shown, respectively.

As it can be seen in the table above, the standard deviation specified for the variables indicates that there have been many fluctuations in these markets. Among these markets, the Iranian stock market is the most scattered. Also, normal distribution is not seen in the Iranian stock market due to more elongation than normal (+3 and 3-). In these markets, Jarque-test statistics reject the research variables at the 5% level for normality. Because the p-value is less than 0.05.

Table 1- Descriptive statistics of research variables

	SSEA	KOSKOPI	IRAN	FTITLMS
Mean	3055.696	2006.327	505119.1	22620.66
Median	3056.790	2059.330	505801.0	23907.05
Maximum	3264.580	2267.250	820505.3	27675.06
Minimum	2787.620	1457.640	353807.7	16286.37
Std. Dev.	٤127.75	218.094	102204.0	3871.764
Skewness	٦-0.01	-0.563	٣0.880	٣-0.25
Kurtosis	٨1.69	2.131	٣3.631	٣1.295
Jarque-Bera	٣8.415	٣10.042	٩17.33	15.679
Probability	0.014	0.006	0.000	0.000

4.2. Investigating the Persistent of relationships

Due to the fact that the data used in the present study is of the time series type. It is necessary to check the data stability before estimating the models. In the present study, in order to investigate the static or persistent of the time series, the root test of Dickey-Fuller unit has been used, the results of which are shown in Table (2).

4.2.1. Unit Root Dickey-Fuller test

The generalized Dickey-Fuller test has been examined in width from source to trend.

As can be seen in the table above, in the case of width from the origin to the trend, the p-value in the test is more than 0.05, so the null hypothesis that the data remains the same is rejected. But with a one-time difference, the p-value in them has reached less than 0.05, meaning they have reached.

Table 2- Dickey-Fuller test

variable	Stste	The intercept with the trend				
		t-Statistic	Critical values			Prob.
			1%	5%	10%	
industry	Level	-1.739	-3.486	-2/886	-2.579	0.409
	1 difference	-11.859	-3.487	-2/886	-2.580	0.000
oil products	Level	-1.082	-3.486	-2/886	-2.579	0.721
Car Index	Level	-10.598	-3.487	-2/886	-2.580	0.000
Bank Index	Level	2.953	-3.486	-2/886	-2.579	1.000
	1 difference	-6.956	-3.487	-2/886	-2.580	0.000
Metal Product Index	Level	-0.637	-3.486	-2/886	-2.579	0.857
	1 difference	-15.59	-3.487	-2/886	-2.580	0.000
Food Index	Level	-1.739	-3.486	-2/886	-2.579	0.409
	1 difference	-11.859	-3.487	-2/886	-2.580	0.000

4.3. Estimation of patterns and parameters

In the present study, GARCH (1, 1) and the diagonal BEKK model were used to estimate the parameters and simultaneously estimate the conditional mean, variance and covariance of the stock market variables of China, South Korea, Iran and Italy. The results are as follows:

In all tables provided by the GARCH model, according to the obtained results, the coefficient M (1, 1) of the fluctuations of the first variable and its effect on itself, the coefficient M (1, 2) of the effect of the overflow fluctuations on the other variable and The coefficient M (2, 2) shows the fluctuations of the second variable and its effect on itself.

Due to the similarity of the test on all variables, these coefficients in the relationship between COVID-19 on the SSEA stock index of China, since the value of a significant level related to the impact of 19 on the SSEA stock index is 0.6844 and Is greater than 0.05, i.e. P-value = 0.6844> 0.05. As a result, this claim is rejected. On the other hand, the value of Z statistic, which is equal to 0.406, which is between ∓1.96, confirms the rejection of this claim. The results of this study show that the prevalence of the corona has not affected the trend of the Chinese stock market index.

Table 3 - BEKK Model with the effect of COVID-19 fluctuations in China on the SSEA stock index

	Coefficient	z-Statistic	Prob.
M(1,1)	7.811	1.465	0.143
M(1,2)	4.491	0.406	0.684
M(2,2)	4.152	0.568	0.570
A1(1,1)	0.007	0.098	0.922
A1(2,2)	0.994	5.069	0.000
B1(1,1)	0.976	45.732	0.000

Table 4- BEKK Model with the effect of COVID-19 fluctuations in South Korea on the KS11 stock index

	Coefficient	z-Statistic	Prob.
M(1,1)	3.547	2.136	0.033
M(1,2)	-4.123	-2.780	0.005
M(2,2)	1.223	4.142	0.000
A1(1,1)	0.979	10.374	0.000
A1(2,2)	0.977	9.164	0.000
B1(1,1)	0.447	12.301	0.000

In examining the relationship between COVID-19 on the KS11 stock index, since the value of the significant level related to this test is equal to 0.0054 and less than 0.05, the result of this claim is rejected, i.e. P-value =0.0054 > 0.05 and on the other hand the value of the Z statistic, which is equal to the value of -2.780, which is outside the values of ∓1.96%, is accepted and confirms this claim. Therefore, due to the outbreak of COVID-19 in South Korea, the country's stock index has fallen.

In the research findings related to the effect of COVID-19 fluctuations in Iran on the TEPIX stock index, since the significant level related to the effect of COVID-19 on the TEPIX stock index is equal to 0.007 and is less than 0.05, i.e. P-value = 0.007 > 0.05. As a result, the claim of relationships between these variables is confirmed. On the other hand, the value of Z statistic, which is equal to 2.703, which is outside the values of ∓1.96, confirms the confirmation of this claim. Therefore, according to the results of the research in the table above, the prevalence and spread of COVID-19 will increase the TEPIX stock index in Iran.

In relation to COVID-19 in Italy on the FTITLMS stock index, since the value of the significant level related to the impact of the industry index on the price of oil is equal to 0.0005 and less than 0.05, i.e. P-value = 0.05> 0.0005 as a result of this The claim was rejected and on the other hand the value of Z statistic which is equal to the value of 3.484 which is outside the values of 1.96 و and confirms the acceptance of this claim. The results of this study show that the Italian stock index (FTITLMS) has increased with the spread of the Corona virus.

In relation to the effect of SSEA stock index fluctuations on KS11 stock indices, TEPIX, FTITLMS, since the value of the significant level related to the effect of SSEA stock index on KS11 stock indices is equal to 0.012 and less than 0.05, i.e. P-value = 0.05 > 0.012. This claim is accepted as a result. On the other hand, the value of the Z statistic, which is equal to the value of 2.494, which is outside the values of ∓ 1.96, confirms the acceptance of this claim and indicates that the fluctuations of the Chinese stock market index are directly related to the fluctuations of the South Korean market index. However, this claim is not accepted in relation to the significant level of impact of the SSEA stock index on TEPIX stock indices. Because it was 0.05 <0.693P-value = and Z = -0.390, this also refutes this claim. Regarding the significant level of the effect of SSEA stock index fluctuations on FTITLMS stock indices, it can be said that since the P-value is equal to 0.019, the null hypothesis is accepted and on the other hand, the value of Z statistic is equal to -2.331. It therefore shows that fluctuations in China's stock index are inversely related to Italy's stock index.

Table 5- BEKK Model with the effect of COVID-19 fluctuations in Iran on the TEPIX stock index

	Coefficient	z-Statistic	Prob.
M(1,1)	5.961	2.193	0.028
M(1,2)	4.388	2.703	0.007
M(2,2)	3.838	4.156	0.000
A1(1,1)	0.664	10.606	0.000
A1(2,2)	0.652	10.794	0.000
B1(1,1)	0.733	26.840	0.000

Table 6- BEKK Model with the effect of COVID-19 fluctuations In Italy on the FTITLMS stock index

	Coefficient	z-Statistic	Prob.
M(1,1)	0.004	0.6335	0.527
M(1,2)	0.015	3.4845	0.000
M(2,2)	0.0025	1.7135	0.087
A1(1,1)	0.0725	1.0505	0.293
A1(2,2)	0.9375	4.9275	0.000
B1(1,1)	0.9965	79.4215	0.000

Table 7- BEKK model with the effect of SSEA stock index fluctuations on KS11, TEPIX, FTITLMS stock indices

	KS11 stock index			TEPIX stock index			FTITLMS stock index		
	Coefficient	z-Statistic	Prob.	Coefficient	z-Statistic	Prob.	Coefficient	z-Statistic	Prob.
M(1,1)	795.171	5.884	0.0000	565.208	3.137	0.001	696.731	4.566	0.000
M(1,2)	325.741	2.495	0.0126	-12. 262	-0.390	0.696	-3202.712	-2.331	0.019
M(2,2)	524.579	3.700	0.0002	6.152	2.371	0.017	100208.8	4.850	0.000
A1(1,1)	1.066	6.908	0.000	1.029	5.300	0.0000	1.046	4.239	0.000
A1(2,2)	1.057	6.837	0.000	1.014	4.883	0.0000	1.033	4.182	0.000
B1(1,1)	0.000	0.000	1.000	-0.004	-0.020	0.9838	0.000	0.000	1.000

5. Discussion and Conclusions

The Corona Virus first started from China then has involved Iran, Italy and South Korea after that it has gone through the world. But its effects and the rapid spread of COVID-19 has remarkably affected financial market, economy and society in the world and it could change it too much in a short time. This amount of changes has done incredible risk, and it causes that the investors harm too much in this short time.

In this part we discuss the results of its effects and overflow the fluctuation between COVID-19 in stock market in these four countries that includes SSEA, KS11, TEPIX and FTITLMS. We also considered the effects of fluctuations of SSEA on KS11, TEPIX and FTITLMS. According to the achieved results, COVID-19 has not affected on stock fluctuations in China. But in Iran and Italy the stock indices have started to increase, it is because we perhaps can say that it is one of the reasons of increase in stock indices in Iran. People have followed the way to investigate and earn money in this way because of the spread of Corona Virus and also the decrease of bank interest and by following this people investigated their money in the stock market and in caused the increase of stock market. But it caused the decrease of the stock market in South Korea. On the other hands the stock fluctuations in China have not effected the stock market in Iran, but it has caused to decrease the stock indices in Italy and increase in South Korea.

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