The Effect of the COVID-19 Pandemic on the Relationship Between Stock Market Returns and Inflation in Iran

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دراسة تأثير جائحة فيروس كورونا على العلاقة بين عوائد سوق الأسهم والتضخم في إيران

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الملخص:

في البحث الحالي تمت دراسة تأثير جائحة فيروس كورونا على العلاقة بين عوائد سوق الأوراق المالية ومعدلات التضخم خلال جائحة فيروس كورونا بسبب المخاوف التي نشأت نتيجة للجائحة مما تسببت في انخفاض التوقعات بين مستثمري الأسهم في سوق الأوراق المالية، وفي تحليل النماذج تم استخدام بيانات الفترة ١٣٩٨/١٢/٠٥ إلى ١٤٠١/٠٣/٣٠ شمسي، تم استخدام نموذج GJR-GARCH غير المتماثل، مع الأخذ في نظر الاعتبار متغيرات معدل التضخم وعدد حالات كوفيد - ١٩، إلى جانب دالة رد الفعل اللحظية (IRFs) ، لتحقيق أهداف الدراسة الحالية، وأظهرت النتائج أن جائحة فيروس كورونا أدت إلى تفاقم تقلبات عوائد سوق الأسهم وتعطيل العلاقة الإيجابية الكاذبة بين التضخم وعوائد سوق الأسهم، وهو ما يشير إلى رفض فرضية فيشر، وبالإضافة إلى ذلك، أظهرت النتائج أن التأثيرات السلبية لفيروس كورونا على عوائد سوق الأوراق المالية قد لا تتبدد سريعاً بسبب عدم اليقين بشأن مدة استمرار جائحة فيروس كورونا، وأخيراً تم تقديم الحلول والمقترحات لتقوية السوق ضد التأثيرات السلبية لتفشي فيروس كورونا.

الكلمات المفتاحية: فيروس كورونا، عوائد سوق الأوراق المالية، معدل التضخم، دالة رد الفعل اللحظية GJR-GARCH

Abstract:-

This study examines the impact of the COVID-19 pandemic on the relationship between stock market returns and the inflation rate in Iran. The examination is conducted because of concerns that arose from the pandemic and the resulting decline in stock market investor expectations. The study uses data from February 24, 2020, to May 24, 2022. The asymmetric GJR-GARCH model, incorporating the variables of inflation rate and the number of COVID-19 cases, along with impulse response functions (IRFs), are used to achieve the current study's goals. The results indicate that the COVID-19 pandemic has intensified stock market return volatility and disrupted the false positive relationship between inflation and stock market returns, which negates the Fisher hypothesis. In addition, the results show that the negative effects of the COVID-19 pandemic on stock market returns may not quickly disappear because of the uncertain duration of the pandemic. Finally, some solutions and suggestions are provided to strengthen the market against the negative effects of the COVID-19 pandemic outbreak.

Keywords: COVID-19, Stock Market Returns, Inflation Rate, GJR-GARCH, Impulse Response Function.

ABBREVIATIONS

- COVID-19 - New Global Coronavirus Pandemic
- WHO - World Health Organization
- ARCH - Autoregressive Conditional Heteroskedasticity
- GARCH - Generalized Autoregressive Conditional Heteroscedasticity
- EGARCH - Exponential GARCH
- TGARCH - Threshold GARCH
- APARCH - Asymmetric Power ARCH
- GJR-GARCH – A GARCH Model Developed by Glosten et al. (1993)
- ARDL - Autoregressive Distributed Lag
- IRFs - Impulse Response Functions
- INF - Inflation
- ADF - Augmented Dickey-Fuller
- VAR - Vector Autoregressive

1. INTRODUCTION

The current study is based on the theory of institutional resilience. According to Aligica and Tarko (2014), this theory focuses on the relationship between humans and the environment. The aforementioned theory confirms that natural shocks can affect human life, behavior, and decision-making. The theory expands this concept to include all sources of instability. Examples of such sources of instability can be named as political, health, economic, cultural, and social shocks.

Throughout the planet, the new global coronavirus pandemic, known as the COVID-19 disease, has caused a shock. According to the World Health Organization (WHO), COVID-19 is a contagious and deadly disease that has affected the entire world. According to official WHO data, as of August 21, 2022, the total number of cases in the world was 600,229,145, and 7,506,614 in Iran. The first official case in Iran was registered on February 18, 2020. The highest number of new daily cases in the country, at the time of writing this text, was 3,245 on August 21, 2022. The scale and trend of the COVID-19 disease spread prompted the WHO to declare it a global threat on February 20, 2020, and then declared it a pandemic on March 11, 2020 (Ali et al., 2020; WHO, 2020).

At that time, the world was already in a state of panic and pessimism, which caused a sharp drop in market indexes on the day of the announcement. Previous epidemics, such as SARS and influenza, did not have a significant impact on stock prices. However, with the outbreak of COVID-19, the stock market of most countries experienced a sharp decline.

The decline in stock markets deepened when governments restricted domestic and international travel and completely quarantined affected areas to contain the spread of the virus. Therefore, the impact of the COVID-19 pandemic on the economy is potentially significant. According to Baker et al. (2020) and Ayittey et al. (2020), no previous infectious disease outbreak, including the Spanish flu, has affected the stock market as severely as COVID-19.

The stock market is an organized exchange where shares of listed companies are traded. Thus, it can be argued that the performance of the stock market is an indicator of the country's economic performance. The movement of the stock market depends on the logical and illogical behavior of investors. In addition to macroeconomic variables such as inflation, interest rate, exchange rate, and money supply, natural disasters such as floods, earthquakes, storms, and epidemics such as the new COVID-19 coronavirus, usually affect stock prices and generally the performance of emerging markets around the world (Bakry et al. 2022; Vo et al. 2022).

Among all macroeconomic variables, inflation can be considered a major variable that affects the economy of a country and also the stock market of a country, such as Iran. A macroeconomic factor like inflation also affects the overall return in the stock market. The general rise in the prices of goods and services is inflation, which has a positive or negative impact on the entire economy and is composed of different variables. Inflation can harm the country through various means, such as decreasing the purchasing power of domestic consumers. Unexpected increases or decreases in the inflation rate compared to its actual level disrupts investors' expectations and increases uncertainty in the expected return of shares. Therefore, the question arises in the investor's mind about the nature and direction of the relationship between inflation and stock market instability (Pedram et al. 2014).

Considering the above and knowing that money and capital markets, as pillars of the financial sector, are responsible for providing resources to the real sector of the economy, the efficiency of the financial sector leads to the optimal allocation of scarce resources to economic activities. Optimal resource allocation, in turn, leads to optimized savings and investment and, consequently, the growth of the national economy within close proximity to the economy's potential. In trade, finance, and investment, forecasting and reviewing fluctuations are considered important. Therefore, examining the variable or variables that can explain the relationship between the financial sector and the real sector of the economy is of great importance. As mentioned in the previous sections, the spread of the coronavirus has affected various business activities, and those involved in the stock markets are very concerned about the fluctuations in this market due to the current COVID-19 pandemic, since it is not like any previous financial disaster. (Fernandez 2020; Tran et al. 2020). Conditional heteroscedasticity models are essential econometric tools for estimating and forecasting asset return volatility (Alberg et al., 2008). To describe the dynamics of conditional variance, Engle (1982) developed the ARCH model, which calculates the variance of returns as a direct quadratic function of lagged values of variables. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, which is based on the specifications of ARCH, allows the researcher to limit the number of estimated parameters by applying non-linear constraints. It was introduced by Bollerslev (1986) as a solution to the aforementioned problem of the ARCH model. GARCH models include, among others, the Exponential GARCH (EGARCH) model by Nelson (1991), the Threshold GARCH (TGARCH), the Asymmetric Power ARCH (APARCH) model by Ding et al. (1993), and the GJR-GARCH model by Glosten et al. (1993) as a standard method for modeling fluctuations in financial time series. According to the studies conducted on the efficiency of the aforementioned models, the asymmetric GJR-GARCH model has the best fit, accuracy, and forecasting power among the rival family of GARCH models. Also, the GJR-GARCH model measures the leverage or asymmetric effect, which is an undeniable fact of stock market returns, with more precision and power. Therefore, the current study seeks to investigate the relationship between inflation and stock returns during

the COVID-19 pandemic in Iran, using the GJR-GARCH model to provide more information for decision making and planning. Therefore, to achieve the objectives of the current research, the research background is reviewed in the following, section 2, and the research method is presented in section 3. Also, in section 4, the results and discussion of the current study are presented, and finally, in section 5, the conclusion and applied suggestions are presented.

2. MATERIAL and METHODS

2.1. LITERATURE REVIEW

According to the Global Financial Stability Report in April 2020, the global pandemic has a significant impact on financial systems, and increased crisis may affect global financial stability (Global Financial Stability Report 2020). Also, another report entitled “The Great Lockdown” recently published, states that the pandemic can reduce the global economy by 3%, which is much worse than the 2008-2009 global financial crisis (World Economic Outlook 2020). While the report states that “stock markets experienced the fastest falls in history” regarding the impact of the COVID-19 pandemic on financial markets (Global Financial Stability 2020).

Considering the economic impact of the COVID-19 outbreak, the impact of the pandemic on stock market volatility due to bubble prices (inflation) is particularly important. This is because, with the continued uncertainty arising from the pandemic, the effectiveness of policy measures combined with negative investor sentiment and rising prices may affect long-term investment decisions (Diaz et al. 2022).

However, regarding inflationary pressures, the Fisher hypothesis (1930), known as the “Fisher effect,” states that the expected nominal return of the stock market should be equal to the expected inflation plus the real rate of return. In fact, this hypothesis clarifies that equity represents claims against the real assets of a business. Therefore, it can act as a hedge against inflation (Tarza et al. 2017). If this claim holds, investors can sell their financial assets in exchange for real assets when expected inflation increases. In such circumstances, Loannides et al. (2005) argue that nominal stock prices should fully reflect expected inflation and the relationship between these two variables should be positively correlated from the start. According to Lawal (2016), the argument that the stock market

return acts as a hedge against inflation may mean that investors are fully protected against an increase in the general price level through a corresponding increase in the nominal return of the stock market, and consequently, the real return remains unchanged.

However, it did not take long for different opinions to challenge the Fisher hypothesis to emerge. In the 1970s, investors found that the Fisher hypothesis falters in the short and medium term because stock market returns were negatively related to inflation (Sharpe 2002). Also, empirical studies by Bodie (1976), Fama and Schwert (1977), Modigliani and Cohen (1979), and Nelson (1976), all provided empirical evidence to show the inverse relationship between stock market returns and inflation. Fama, in 1981, presented a contradictory theory known as the proxy hypothesis. The proxy hypothesis, commonly known as Fama's generalized proxy hypothesis, argues that the claim of a positive relationship between stock market returns and inflation is false and shows that stock market returns are not protected against inflation.

In addition to the above foreign studies, some domestic studies have been conducted in this area, which can be described as follows:

Afshar (2003), in his study entitled, "Examining the Relationship between the Inflation Rate and the Growth Rate of Shareholders' Equity Returns", during the period between 1992-2001, concluded that stocks do not act as an inflation hedge. Alireza Badkoobei (1995), in his research, concluded a direct and significant relationship between inflation and stock prices during the 1991-1993 period. Bazazan et al. (2012), using GARCH, examined the influence of calendar days of the week on stock returns in the period 2006-2012. The results showed that the overall return on Saturday is positive and significant. Kaviani et al. (2018), in a study simulating the effect of monetary base and investment shocks on the rate of return on stock prices through the Dynamic Stochastic General Equilibrium (DSGE) model, and considering some of the observed realities in the Iranian economy and then optimizing and achieving first-order conditions for agents, they linearized the resulting logarithmic equations, and concluded that the monetary base shock initially has a positive effect on the rate of return on company stock prices, and then in the following periods, as the shock decreases, it returns to its stable state. Also, the investment shock, due to the increased supply of

company shares in the stock market, initially reduces the rate of return on stock prices, because more shares are offered in the market, but in the following periods, the share price increases due to the expected profitability of these investments and, consequently, the return rate increases. Khani et al. (2014), also, using a self-explanatory model with extended lags (ARDL), studied the relationship between oil price fluctuations, the consumer price index, the production of the industrial sector, and stock market returns in the short and long term. The results of the research confirm the short-term equilibrium relationship, but it is not significant in the long run. Moshiri et al. (2010) examine the relationship between nominal stock returns and inflation using the multi-scale wavelet 3 method. The results of the regression analysis in the wavelet correlation range show that the relationship between inflation and stock returns is positive in the short and long term and negative in the medium term. Najarzadeh et al. (2009), have investigated the effect of currency and price shock fluctuations on the stock price index using the vector autoregression approach and have tested the short-term and long-term relationship between the variables. The results indicate that the effect of exchange rate fluctuations and price changes in the short and long term increases and decreases the total stock price index, respectively. However, the effect of shocks caused by the inflation rate on the real return of shares is more severe than the shocks caused by the exchange rate. Namazi and Rezaei (2012), in the period between 2000-2009, by examining 30 listed companies, examined the effect of inflation rate on the quality of earnings of listed companies on the Tehran Stock Exchange, their results showed that the relationship there is no significant relationship between the predictive value of profit and the inflation rate in the six industries studied. Saeedi and Amiri (2008) have investigated the relationship between inflation and stock prices. In this article, the linear regression model and the F correlation model of the Kolmogorov-Smirnov test, and the Pearson test were used. The results show that inflation has a significant and inverse relationship with the price of shares and the stock price index of listed companies on the Tehran Stock Exchange, and there is a significant and direct relationship with the Tehran Stock Exchange index. Saeedi and Kohsarian (2009), examined the relationship between two consumer price index and the producer price index and stock returns using the

exponential GARCH model and the maximum likelihood estimation method during the period of July 1992 to May 2008 on a monthly basis. The results indicated that inflation is not appropriate for explaining stock returns and cannot describe changes in stock returns. In other words, no significant relationship was found between inflation and stock returns.

Authors around the world are constantly working on financial issues resulting from the COVID-19 pandemic because people may face unforeseen problems in the future, causing market fluctuations. Therefore, proper research may be a solution to eliminate unavoidable side effects. Knowing about fluctuations in the markets is very important, but observing them is very difficult, because fluctuations have a simultaneous, variable, and sensitive nature (Awalludin et.al. 2018). Stakeholders in the financial market are worried about the risks associated with their assets in which they invest. Therefore, modeling and predicting financial asset volatility is essential for a number of operations, including risk management, derivatives pricing and hedging, market making, market timing, portfolio selection, and many other areas. The above-mentioned modeling and forecasting is a way to measure how the return changes in a time series of asset values over time. The clustering of fluctuations, kurtosis, asymmetry in fluctuations, and the leverage effect are often used to describe the returns of financial assets. Large changes are followed by other large changes, and small changes are followed by other small changes. This is known as fluctuation clustering. Leptokurtosis means a fat-tailed distribution of returns (having more kurtosis than a standard distribution) (Aliyev et al. 2020).

Another known characteristic of financial time series is asymmetric dynamics. Asymmetry refers to the fact that volatility is higher when the return is negative, and this characteristic was introduced by Black (1976) and Christie (1982). In the literature, the leverage effect and the volatility feedback effect are used to describe the feature of asymmetric volatility (Campbell and Hentschel, 1992; Bollerslev, 1987). In fact, these negative and positive shocks cause this clustering of fluctuations. Compared to positive and negative shocks of the same magnitude, negative shocks create more fluctuations. Autoregressive conditional heteroscedasticity or threshold models are effective ways to model this asymmetric and non-linear dynamic (Aliyev et al. 2020).

2.2. RESEARCH METHODOLOGY

Based on the objective, the current study is applied and, in terms of nature, it is descriptive. Based on the approach, it is classified in the field of empirical-descriptive studies, which seeks to investigate the relationship between stock market returns and the general price index (inflation) using experimental data during the COVID-19 pandemic in Iran.

The data and information used in this study are collected through two methods: library and field. In the library section, books, and Persian and Latin professional journals and numerous articles taken from the internet were used to prepare and compile the theoretical and theoretical foundations of the research. In the field section of the current study, the required data and information related to the number of cases of COVID-19, the total stock price index, and the inflation rate during the period from February 24, 2020, to May 24, 2022, were collected from the daily status reports published by the Ministry of Health and approved by the World Health Organization, the website of Iran's Financial Data Processing Center and Tehran Stock Exchange, and from the monthly reports of the Central Bank and the National Bureau of Statistics of Iran.

Financial time series, such as stock market returns, used in this research, are calculated using equation (1) below (Rastgoo and Panahian 2020):

$$R_t = ln(\frac{I_t}{I_{t-1}}) \qquad (1)$$

In the equation (1), R_t indicates the stock market return, ln represents the natural logarithm, I_t indicates the total stock market index (the total cash and price return), and t indicates the time period. Financial time series, such as stock market returns, have three characteristics that distinguish their modeling and analysis from other typical time series. The characteristics of interest are: clustering of fluctuations, leptokurtic distribution, and the leverage effect. For example, during a financial shock or crisis, such as the crisis caused by COVID-19, the leverage effect (or the asymmetric quality of the financial time series data) is intensified, and as a result, modeling fluctuations

with ordinary methods is impossible. Instead, time-varying volatility models such as ARCH or GARCH models are used (Rastogi 2020).

The approach of combining the time-varying nature of fluctuations using the ARCH process was first proposed by Engle (1982). In addition, GARCH-type models (GARCH, EGARCH, GJR-GARCH, and TGARCH) by Bollerslev (1986), Glosten et al. (1993), Franses and Van Dijk (1996), and Franses and Van Dijk (2000) to overcome some of the limitations of ARCH models, such as overfitting and non-negativity restrictions. For this purpose, GARCH family models have become a standard method for modeling volatility in financial time series. Therefore, in this study, standard GARCH and GJR-GARCH models are used. The GARCH model is an asymmetric model that is often used as a starting point for volatility analysis. On the other hand, the GJR-GARCH model is an asymmetric model that is believed to have the best fit among the family of rival GARCH models and also has higher accuracy and forecasting power compared to GARCH and other models. It also measures the leverage or asymmetric effect, which is an undeniable fact of stock market returns. The general specifications of the GJR-GARCH model, along with the effects of inflation and the COVID-19 disease, are as follows in the variance equation (Theodossiou et al. 2022):

$$\sigma_t^2 = \omega + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \varphi_1 INF_i + \varphi_2 Cov_i \qquad (2)$$

$$I_{t-1} = \begin{cases} 1 & if \ \ \varepsilon_{t-1} < 0 \ \ \longrightarrow \ \ \text{Bad News} \\ 0 & if \ \ \varepsilon_{t-1} \geq 0 \ \ \longrightarrow \ \ \text{Good News} \end{cases}$$

In the equation (2) above, δ represents the asymmetry parameter or leverage effect, and when $\delta > 0$ and significant, it indicates the existence of asymmetry or leverage effect, and negative shocks (bad news) increase the volatility of stock market returns more than good news. However, if $\delta = 0$, the model becomes GARCH, indicating that there is no leverage effect. The coefficients γ and λ indicate the effects of ARCH (recent news) and GARCH (old news), respectively. In addition, the higher the value of λ, the GARCH coefficient, the longer it takes for shocks to the conditional variance to disappear and indicates persistent fluctuations. Also, if the sum of ARCH and GARCH effects, i.e., (γ + λ), is close to or relatively high, then a

"shock" at time t will be continuous, and it indicates a situation known as long memory or persistence of conditional variance. Also, INF and COV, respectively, indicate the independent variable of the interest rate and the number of cases of COVID-19, and φ_1 and φ_2 are the coefficients of the independent variables, respectively.

Additionally, for the analysis of stock market return responses to inflation and COVID-19 disease shocks to depict the short-term dynamics of the variables, the impulse response function (IRFs) presented by (Sims, 1980), which is an average moving of a vector autoregressive (VAR) model, is used (Pedram et al. 2014).

To achieve the goals of this study, first, the collected data and information are collected and organized to be used in equations (1) and (2) using Excel software. Then, to determine the relationship between stock market returns and inflation with the direction of the COVID-19 disease, it is analyzed using R software. Finally, impulse response functions (IRFs) are used to analyze the response of stock market returns and inflation to COVID-19 shocks, in order to depict the short-term dynamics of the variables.

The conceptual model of the research, in order to have a clear understanding of the framework and steps of the current research to achieve the desired goals, is presented below in the form of Figure 1.

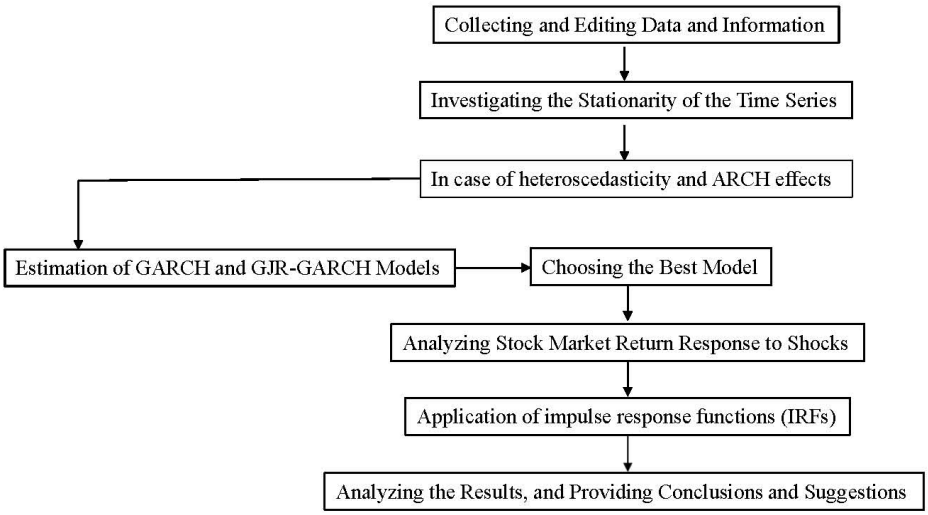

Figure 1. The Graphical Abstract
Source: Research Findings

3. RESULTS AND DISCUSSION

Table 1, shows the descriptive statistics and the correlation matrix of stock market returns, the number of COVID-19 cases, and inflation.

Table 1. Descriptive Statistics

Statistical Criteria	Variables		
	Stock Market Returns	Inflation	The Number of Cases of Covid-19
Mean	0.00298	3.158	8541.566
Std. Error	0.0166	1.94	9207.172
Min	-0.0483	0.1	0
Max	0.0438	13.7	50228
Correlation Matrix			
Stock Market Returns (R_t)	1		
Inflation (INF)	0.03525*	1	
The Number of Covid-19 Cases	0.02422*	0.04227*	1

*, indicate significance at 5%, level.
Source: Research findings

Considering the values of the standard deviation and the mean of the variables, it can be observed that the number of COVID-19 cases has the highest fluctuation in change compared to the other two variables. Also, the highest number of COVID-19 cases in the period under study is 50,228.

Based on the correlation matrix presented in Table 1, it can be concluded that there is a weak but statistically significant positive correlation between stock market returns and the inflation rate, the number of cases of COVID-19 and stock market returns, and the number of cases of COVID-19 and inflation. Since the value of the correlation coefficient between the variables is less than 0.80, it can be concluded that there is no multicollinearity problem between the variables.

The trend of changes in the variables during the period under study is shown in Figure 2.

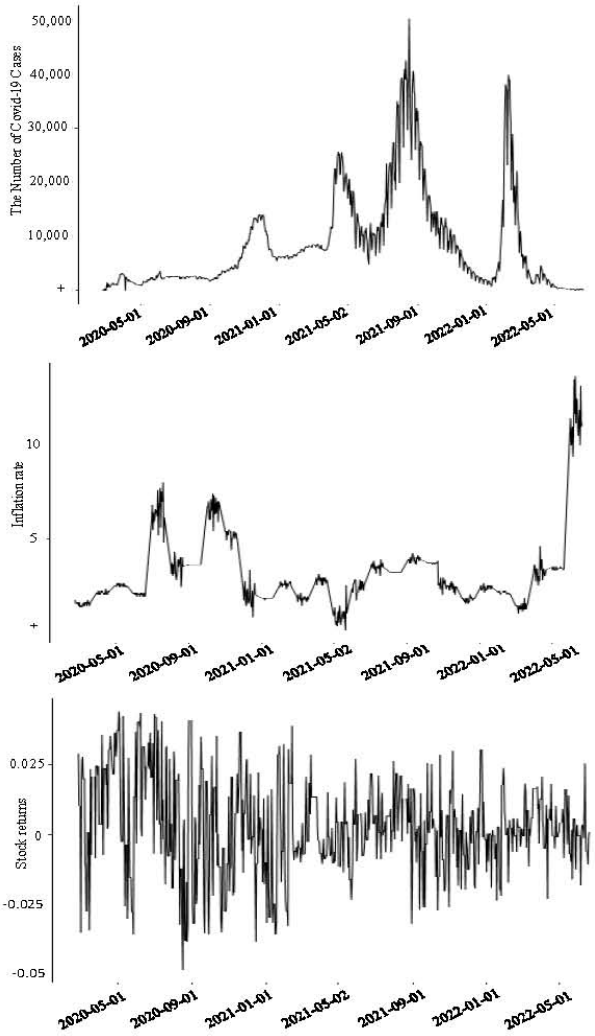

Figure 2. The trends in the changes of the variables unde study (the number of COVID-19 cases, the inflation rate, and stock returns)
Source: Research findings

As can be seen, at the beginning of the COVID-19 pandemic, the negative fluctuations of stock returns are much wider than those of the period after 2020. As can be seen from the diagrams in the figure, when the coronavirus is moving towards its peak, the fluctuations in stock returns are close to the horizontal axis, which is a tendency toward the number zero.

3.1. Stationarity (Stability) Test of Variables

Since the stationarity condition of time series is required to perform family GARCH model studies, before using GARCH models in this study, a stationarity test of the variables' time series has been done. The results of the stationarity test of the time series of the variables of interest using the Augmented Dickey-Fuller (ADF) test are shown in Table 2.

Table 2. Stationary Test Results

Variables	Augmented Dickey-Fuller test statistic (ADF)	
	t value	p-value
Stock Market Returns (R_t)	2.53	0.011
Inflation (INF)	2.878	0.004
The Number of Covid-19 Cases	2.274	0.023

Source: Research findings

As shown in Table 2, the null hypothesis of the Augmented Dickey-Fuller unit root test for all three variables is rejected, due to the significance level being less than 5% (0.05), and as a result, the alternative hypothesis is accepted, which indicates that the time series of all three variables are stable (stationary) at level (I(0)).

3.2. Test for Heteroscedasticity

Before using the family GARCH models, it is necessary to check the existence of heteroscedasticity or ARCH effect. Therefore, in this study, to detect the ARCH effect, the method provided by Engle (1982) called the Lagrange multiplier test was used, and the results of the mentioned test are shown in Table 3.

Table 3. Lagrange coefficient Heteroskedasticity test (ARCH-LM)

Variable	F value	p-value	ARCH(p,q)
Stock Market Returns (R_t)	10.77	0.001	ARCH (1,1)

Source: Research findings

According to the results in the table 3, the null hypothesis of the Lagrange multiplier test, based on the non-existence of the ARCH effect, is rejected, considering the significance level (0.001), which is

less than the significance level (0.05), and the alternative hypothesis is accepted. Therefore, the data under study have heteroscedasticity and have (1,1) ARCH effects, and the family GARCH models are suitable for analyzing volatility.

3.3. GJR-GARCH Model Results

Considering that the goal of the current research is to investigate the relationship between stock market returns and inflation during the COVID-19 pandemic, and during this period, stock market returns are affected by positive and negative shocks, and considering that there is no reason to assume that the variance of positive and negative shocks are equal, models should be used for analysis that consider the effects of positive and negative shocks asymmetrically. Therefore, the best model is the GJR-GARCH model, which considers the effects of positive and negative shocks asymmetrically. Therefore, the results of the estimation of the mentioned model are shown in Table 4.

Table 4. The Estimation Results of GJR-GARCH Model

Variables	Coefficient	t value	p-value
Conditional Mean Equation			
μ	0.9	10.644	0.000
AR(1)	0.313	76.16	0.000
AR(2)	0.504	64.63	0.000
MA(1)	0.06	35.2	0.000
MA(2)	0.4	25.22	0.000
Conditional Variance Equation			
γ (ARCH effect)	0.38	0.501	0.000
λ (GARCH effect)	0.54	2.03	0.000
Persistence ($\gamma + \lambda$) effect	0.92		
Inflation (INF)	0.804	3.304	0.04
The Number of Cases of Covid-19	0.49	2.064	0.041

Source: Research findings

As expected, the effects of ARCH (recent news) and the GARCH effect (past news) are statistically significant. As a result, this indicates that both recent and past news have a significant impact on the volatility of stock market returns. In addition, the sum of the ARCH (γ) effect and the GARCH (λ) effect is close to one.

Consequently, it suggests that the current shocks to stock market returns caused by the COVID-19 pandemic may not disappear quickly, and due to the unknown duration of the pandemic, it will continue for some time. Also, the results show that the effect of inflation rate and the COVID-19 disease on the volatility of stock market returns is positive and statistically significant. It is also observed that a shock to the stock market has a disproportionate impact. This means that the recession of the market is accompanied by greater fluctuations, which is known as the leverage effect. The leverage effect or asymmetric effect exists if bad news causes more stock market fluctuations than good news. Considering the leverage effect, which is the main reason for using the GJR-GARCH model, the results show that the leverage effect coefficient is positive and statistically significant at the 5% level and indicates the existence of a leverage or asymmetric effect. That is, a negative shock, such as the COVID-19 pandemic and the inflation rate, causes an increase in the volatility of stock market returns (Rt) more than a positive shock. Also, it can be seen that the COVID-19 pandemic has complicated and distorted the positive relationship between stock market returns and inflation, as stated in the Fisher hypothesis, and is in accordance with Fama's proxy hypothesis.

Based on the graph shown in Figure 3, it can be concluded that bad news has more fluctuations than good news in stock market returns (R_t), and it indicates that the existing effects are asymmetric and represent leverage effects in the fluctuations of interest.

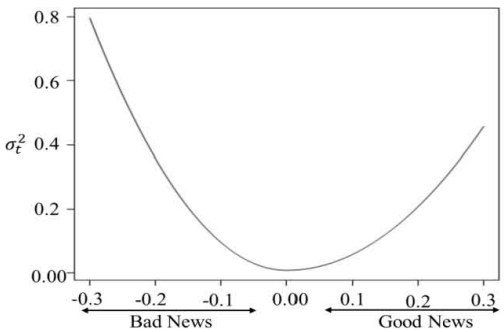

Figure 3. The Asymmetric Effect of News on Stock Return Volatility
Source: Research finding

As mentioned in the previous sections, in the case of existence of the leverage effect or asymmetry effect, meaning that the greater the impact of bad news on higher stock market fluctuations than good news, the use of the GJR-GARCH model is appropriate.

3.4. Analysis of Stock Market Return Response to Shocks (Impulses)

To analyze the response of stock market returns to inflation and shocks of the COVID-19 disease to depict the short-term dynamics of the variables, the impulse response function (IRFs), which is the average moving average of the vector autoregressive (VAR) model, is used.

3.5. VAR Model Estimation Results

Because the interpretation of the relationships between variables in a VAR model is difficult directly from parameter matrices, the impulse response function (IRFs) is therefore suggested as a tool for interpreting VAR models. The results of the estimation of the VAR model are shown in Table 5.

Table 5. Estimation of the VAR model

Variables	Equations		
	(R_t)	(INF)	(Covid-19)
R_{t-1}	0.617**	0.95	-15.62.96
$!R_{t-2}$	-0.07*	-1.59	1681.78
INF_{t-1}	-0.01 *	0.461 **	57.3
INF_{t-2}	-0.02	0.436 **	-123.48
$Covid19_{t-1}$	-0.01	0.05	0.84 **
$Covid19_{t-2}$	0.02	0.09	0.089 *
Constant	0.011	0.078	303.32
R squared	0.399	0.956	0.951
Adj.R squared	0.384	0.955	0.95
F statistic	25.93 **	859.5 **	767 **

*, ** indicate significance at 1 and 5%, level, respectively
Source: Research findings

The results of Table 5 show the existence of positive and negative effects between the variables under study.

3.6. Results of Impulse Response Functions (IRFs)

The graphs of (a), (b), and (c) in Figure 4, show the results of the impulse response function (IRFs) to display the response and the reaction of stock market returns (R_t) to shocks of their own changes (R_t), shocks of the inflation rate (INF), and shocks of the number of cases of COVID-19, with a 95% confidence interval.

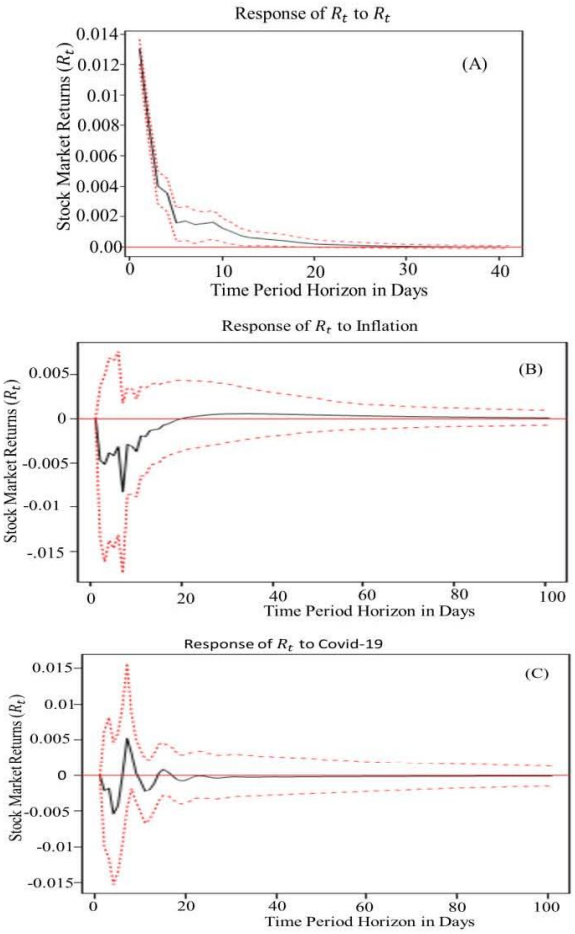

Figure 4. Impulse Response Function to Inflation and Covid-19 Shocks
Source: Research finding

Graph (a) in Figure 4, shows the positive response of stock market returns (R_t) to its own changes, and this response is statistically significant for almost the first ten days, after which it is considered meaningless. Further review of the diagram shows that the response in question converges to its equilibrium value after 20 days. Also, graph (b) shows the negative response and reaction of stock market returns (R_t) to the inflation rate (INF). According to the diagram, the negative response of stock market returns (R_t) to the inflation rate (INF) becomes ineffective and neutral after approximately 20 days. In addition, according to the diagram (c), the response and reaction of stock market returns (R_t) to the shock of the number of cases of COVID-19 during the period under study is negative. From the negative impact of the COVID-19 disease on stock market returns (R_t), it can be concluded that it is complex and difficult to predict with certainty its impact on the Iranian economy. Due to the fact that investors expect the COVID-19 pandemic to last longer, as this result was obtained and stated in the analysis of the GJR-GARCH model.

4. CONCLUSIONS

In the current research, the relationship between stock market returns and inflation during the COVID-19 pandemic in Iran was investigated. Therefore, one of the objectives of the current study is to examine the establishment of the Fisher hypothesis (the existence of a positive relationship between the inflation rate and stock market returns) or the Fama hypothesis (the existence of a negative relationship between the inflation rate and stock market returns) during the COVID-19 pandemic. In order to achieve the objectives of the current study, family GARCH models, along with the VAR model and their analysis tools (i.e., the impulse response function (IRFs)) were used for data from December 5, 2019, to June 20, 2022. As mentioned in the results and discussion section, the inflation rate and the number of cases of COVID-19 increase the volatility of stock market returns. According to the results of the leverage effect of the GJR-GARCH model, a negative intensified shock, due to the increase in the number of cases of COVID-19, causes an increase in fluctuations, and as a result, the positive relationship between the

inflation rate and stock market returns is disrupted, which negates the Fisher hypothesis. Thus, Fama's hypothesis, based on establishing a negative relationship between the inflation rate and stock market returns, is established. Therefore, the results of the current study are in accordance with Fama's generalized proxy hypothesis and indicate that the claim of a positive relationship between stock market returns and inflation is false and shows that stock market returns are not protected against inflation. Consequently, the inverse relationship between stock market returns and inflation for the current study is in accordance with the results of research by Sharpe (2002), Bodie (1976), Nelson (1976), Fama and Schwert (1977), and Modigliani and Cohn (1979). Based on the results and explanations, it can be said that the research hypothesis based on the existence of a significant relationship between stock market returns and the general price index (inflation) during the COVID-19 pandemic in Iran is accepted. In addition, the results of impulse response functions (IRFs) indicate a negative response and reaction of stock market returns to the shocks and impulses of the number of cases of COVID-19 during the period under study. As it can be seen in the diagrams of the impulse response functions, the effectiveness of the response and reaction improves over time and indicates that the negative effects of the number of COVID-19 cases on stock market returns and its disruption in the relationship between inflation and stock market returns is one of the issues that will not disappear quickly, due to the fact that the duration of the COVID-19 pandemic is unknown.

Considering the results, it is recommended that planners and financial and regulatory officials of the Tehran Stock Exchange take appropriate policy measures in order to stabilize the stock market by providing financial resources for investment and stimulating growth. Some of the proposed policy actions can include the following:

- Activating business continuity plans and preventive health measures to ensure the continuation of remote business activities without exposing employees and investors to the threat of the pandemic.
- Providing advice and guidance to stock market participants and other stakeholders regarding the operation of the stock exchange during the pandemic;

- Continuous monitoring of stock market activities to ensure the maintenance of high ethical standards;
- Correct monitoring of the consistent dissemination of market-related information through reliable and transparent media, such as official websites, electronic and social media platforms, to ensure that investors can make informed decisions about their investments.

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