



Stock Market Returns in Iran in Three Waves of COVID-19 Pandemic: Evidence of Multiple Breaks Regression

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Abstract

Despite the recession in global financial markets, the Tehran Stock Exchange experienced significant growth during the COVID-19 outbreak. Therefore, this article tries to solve this puzzle by analyzing the effect of three Coronavirus waves on the total index of Tehran Stock Exchange, its sub-indices, and the different industries with daily data of Iran and the regression method with multiple breakpoints. The results show that each wave of COVID-19 has different effects on the stock market. COVID-19 in the first wave had a negative effect on the index of industries such as refined petroleum, chemical, Metals, and transportation but had a positive effect on industries such as medicine and food. However, in subsequent waves, the response of different industries to the new pandemic is complicated for two reasons. First, the nominal exchange rate has a positive and significant effect on main industries such as motor vehicles, banks, refined petroleum, metals, and chemical (which have a considerable weight in the Tehran Stock Exchange). This effect can show the positive trend in the index, especially in the first and second waves of the COVID-19. Second, the government's manipulation in raising the stock prices of these main industries to finance its budget deficit caused the Tehran Stock Exchange index to move in the opposite direction in some periods in response to the Coronavirus.

Highlights

- The effect of three Coronavirus waves on Tehran stock Exchange's total index and sub-indices is examined.
- Each wave of COVID-19 has a different effect on the stock market.
- Government manipulation in some industries, such as motor vehicles, banks, refined petroleum, metals, and chemicals, caused the Tehran Stock Exchange index to move in opposite directions due to COVID-19.

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1. Introduction

Natural disasters (e.g., floods, earthquakes, hurricanes, and pandemics) usually negatively affect stock prices worldwide. However, Iran's stock market during the COVID-19 shows distinctive evidence. The new virus outbreak, which began in China in December 2019, spread immediately worldwide less than a month. On March 11, 2020, the World Health Organization declared the new virus a pandemic. The outbreak of epidemics in the past, such as SARS and Influenza viruses, did not significantly impact stock prices, but with the outbreak of Covid-19, the stock market of most countries suffered a sharp drop in prices. Unlike other countries, during the first and second waves of the COVID-19 outbreak, the stock market index in Iran increased by 431% since the first case of COVID-19 was recorded on February 19 until early July 2020 and decreased by 63% in the third wave.

In recent years, the stock market in Iran has been influenced by several specific features. First, the government has a significant role in Iran's economy, directly and indirectly in the shareholders of large listed companies, especially financial institutions. Second, Iran's government is financed through the sale of shares and a tax on the transfer of shares from the stock exchange. Third, Iran's economy has been under the most severe international sanctions since 2018, which have affected government budgets and stock returns. Fourth, Iran's economy has suffered from widespread economic and financial instability over the past three years, with inflation above 40 percent, nominal exchange rates more than 8-fold, and sharp fluctuations in asset markets such as housing and stocks. These features should be considered in analyzing the trend of the Iranian stock market.

Therefore, it is worthwhile to examine the puzzle as to what factors influenced the trend of the Tehran stock exchange during the COVID-19 outbreak? What is the role of factors affecting stock prices such as competing asset markets such as gold and exchange rate in a country with high inflation and sanctions, and government intervention to meet its severe budget deficit and shareholder expectations? How different is the impact of COVID-19 on the stock prices of different industries? Industries such as pharmaceuticals, communications, and electronics flourished during the COVID-19 outbreak and industries that suffered more from COVID-19, such as transportation, metals, petrochemicals, Motor Vehicles and cement, and the financial sector, including banks, insurance companies, and investment companies? We also examine the critical question of whether, during the three waves of COVID-19 outbreaks, different periods can be identified for the total stock market index and different industries that have been affected by the factors mentioned. To answer the above questions, this study aims to investigate the three Coronavirus waves on the total index and its main sub-indices and the prices of different industries with daily data of the Iranian stock market.

In this paper, the total index and various industries of the Iran stock market are examined within 250 days after the outbreak Covid-19 pandemic. We use a

regression method with breakpoints and evaluate the effect of conventional variables such as gold price, exchange rate, oil price, and the Corona variable on these indices.

The paper is organized as follows. Section 2 provides a literature review. Section 3 describes the data. Section 4 presents the methodology. Section 5 contains the empirical results of the model (different models) and discusses the results obtained. Finally, Section 6 contains conclusions.

2. A Review of the Related Literature

Before the COVID-19 pandemic, several studies focused on the effects of pandemics on the economy (e.g., Keogh- Brown & Smith, 2008; Karlsson et al., 2014). Nevertheless, the effect of pandemics on the stock market has rarely been studied. After the SARS outbreak, many papers studied its adverse effects on tourism and the economy. Chen et al. (2007) found that the stock prices of Taiwanese hotel companies fell sharply following the outbreak of SARS. Fan et al. (2018) estimated the annual damage due to epidemics risks about 0.6% of the total revenue for each year. While many researchers have analyzed the negative impact of SARS on the economy, Chen et al. (2009) studied the asymmetric effects of SARS outbreaks on specific industries. They found that the SARS outbreaks positively affected biotechnology companies and had a negative effect on the tourism industry.

Recently, some researchers have examined the effect of COVID-19 on financial markets such as the stock market. Ali et al. (2020) examined the global financial markets in terms of fluctuations with the transmission of the COVID-19 epidemic from China to Europe and then to the United States and found that with the COVID-19 transmission to the United States, even relatively safe commodities such as gold have also fallen in price. The outbreak of the Coronavirus has even reduced oil prices (Sharif et al., 2020). Sansa (2020) found the significant adverse effect of COVID-19 on the Shanghai and New York Dow Jones stock market Index. Shehzad et al. (2020) argued that the Corona pandemic had severely damaged the US and Japanese stock markets. They found that the new pandemic affected the stock markets of countries such as the United States, Germany, and Italy more than the global financial crisis in the past. Morales and Andreosso- O'Callaghan (2020) and Just and Echaust (2020) found that the Italian stock market has caused fear and recession in other European stock markets.

Al-Awadhi et al. (2020) found that both the daily growth of confirmed cases and the deaths from COVID-19 have a significant negative impact on Chinese stock returns. Upon further analysis, they found that the effect of Covid-19 was positive in some sections (e.g., information technology and drug production). Mazur et al. (2021) found that the outbreak of COVID-19 has different effects on different sectors. While the effect of COVID-19 on the natural gas, food, healthcare, and software sectors was positive, it had a negative effect on the oil, real estate, entertainment, and hospitality sectors. Herwany et

al. (2021) showed that the returns of the financial property, real estate, and construction sectors decreased during the pandemic outbreak in Indonesia.

Yousfi et al. (2021) analyzed the effects of the first and second waves of the COVID-19 epidemic on the US stock market and the risk transfer between the Chinese and US stock markets. They found that fluctuations between CSI300 (China) and the S&P500 (US) have risen since the pandemic. Gunay et al. (2021) found that the three sectors of consumer staples, industry and real estate in the Australian stock market suffered the most during the first and second waves of the COVID-19 outbreak. Choi and Jung (2021) found that in the short term, a pandemic has asymmetric effects on Korean stock market performance and concluded that as the incidence of Covid-19 increases, fluctuations in Korean stock market returns also increase. The effects of COVID-19 on countries with different regimes also vary. Since liberal countries report actual confirmed cases and casualties, less liberal countries report lower confirmed cases and casualties. So there is a significant negative relationship between the countries' degree of freedom and the pandemic impact on the stock market (Erdem, 2020).

Some studies related to the Corona epidemic and the financial market provide exciting results. Corbet et al. (2021) found that the effect of the COVID-19 pandemic on companies with similar names to the epidemic was significant. On the other hand, coronavirus disease increases herding behavior in European stock markets (Espinosa- Mendez & Arias, 2021). Some studies are looking for a solution to pandemic risk. Bhar and Malliaris (2021) concluded that quantitative easing reduces long-term interest rates in times of crisis. Therefore, using an unconventional monetary policy to resolve the financial crisis caused by COVID-19 can also be effective. Mairal (2011) and Young et al. (2013) found that epidemic news worried investors. Thus, the influx of pandemic news can affect shareholder investment decisions. Li et al. (2014) studied the effect of a scary news event on the stock market. They found that the epidemic crisis could provide an excellent opportunity to study and analyze the behavior of financial markets in response to news related to crises. Ichev and Marinc (2018) found that stock market investors had acted irrationally in response to news of the Ebola outbreak. They also argued that the Ebola outbreak affects small companies more than large companies.

Rabhi (2020) found that the effects of Covid-19 cases and fears of news of COVID-19 deaths on the Asian stock market were adverse and statistically significant. Cepoi (2020) found that stock market reactions are asymmetrically dependent on COVID-19 information. Baig et al. (2021) found that as the number of cases and deaths due to COVID-19 increased, US stock market stability and liquidity declined dramatically. They also showed that enforcing restrictions and locking cities raises public fears that help increase instability. Salisu & Vo (2020) used health news obtained through Google searches to examine how Covid-19 news affects the global stock market.

Fluctuations in oil prices affect the stock markets of different oil-exporting countries through several channels. For example, as oil prices fall, it creates a budget deficit, so the government must increase the monetary base by borrowing from the central bank to cover the budget deficit (Ebrahimi & Shokri, 2012). The cost of goods produced by industrialized countries rises as oil prices rise, harming the liquidity of imported companies and thus lowering their stock prices (Arouri & Rault, 2010). The oil price had a low co-movement with the stock exchange in Iran. Thus, the oil market can be a suitable alternative for risk aversion investors (Samadi et al., 2021). When the oil price drops, the stock index falls. This relation means that a decrease in oil price harms the Iranian economy (Payandeh Najafabadi et al., 2014).

The effect of exchange rates on stock prices is assumed to be negative in Branson's (1983) portfolio model. However, in oil-exporting countries, fluctuations in exchange rates can have different effects. As the exchange rate increases, on the one hand, the income of exporting companies increases, and therefore, the exchange rate has a positive effect on the stock prices of these companies (Abbasian & Yehea-Nemer, 2017). On the other hand, increasing the exchange rate reduces the profits of importing companies, which from this perspective, exchange rates have a negative relationship with the stock market (Lu et al., 2001).

For channels of Covid-19 virus impact on the stock market, it is necessary to pay attention to how long the disease lasts? If the virus has a low prevalence, the economic effects of the virus can be considered as an economic shock or a risk. However, if the disease persists for a long time, it can affect the future cash flow of firms and their profitability, which reduces the production, revenue, and profits of companies and ultimately leads to a decrease in stock value (Taherinia & Hassanvand, 2020). In a study, Owjimehr & Samadi (2022) introduced four indicators (stringency index, government response index, containment & health index, and economic support index) to show government intervention in the face of the Covid-19 outbreak and showed that these indicators have Different effects on Iranian stock returns in the period from February 22, 2020 to June 12, 2021. In addition, they found that the stringency index, the government response index, and the containment & health index reduced stock returns, but the economic support index increased returns.

As can be seen above, the impact of pandemics on the stock markets of different countries has recently been examined. The results of most studies show that the stock markets of different countries have faced a sharp decline in the price index after the COVID-19 outbreak (Al-Awadhi et al., 2020; Rabhi, 2020; Mazur et al., 2021; Baig et al., 2021; Xu, 2021). However, unlike all stock markets in the world, during the COVID-19 outbreak, the Tehran stock exchange took a different trend, and even in a period, we saw the Tehran stock exchange boom. In addition, the outbreak of Covid-19 had different effects on the supply and demand of different companies. After the quarantine of cities and the ban on domestic and foreign travel, the demand for hotels and tourism

services decreased sharply, which led to a decrease in the shares price of these companies (Mazur et al., 2021).

On the other hand, with the spread of the epidemic and the transmission of fear of the unknown disease among communities, the demand for health and pharmaceutical goods for prevention increased. In addition, investment in Covid-19 disease prevention infrastructure increased, which increased the value of shares of pharmaceutical and healthcare companies. On the other hand, as Faghih & Forouharfar (2022) argued, the Covid-19 crisis has different dynamics and socio-economic consequences at the regional, national and global levels that need to be examined from different perspectives. Therefore, in this study, we investigate the different behavior of the Tehran stock exchange during the outbreak of the Covid-19 epidemic to solve the puzzle of the Tehran stock exchange.

3. Data

We obtain the data on the Tehran Stock Exchange Index and its sub-indices from Tehran Stock Exchange Company¹, daily new deaths of COVID-19 from the World Health Organization², the price of gold, the exchange rate, and the price of Brent crude oil from the Gold, Coin, and Currency Information Network³. All data is daily, and the study period is from the outbreak of Coronavirus, February 21, 2020 to October 27, 2020. Figure 1 shows the number of deaths from COVID-19 and the Tehran Stock Exchange index (TEDPIX). This figure shows three waves of COVID-19 in Iran according to the mortality trend due to COVID-19.

The first wave begins in late February 2020 with an upward trend in the number of deaths due to COVID-19 and peaks by the end of March with about 150 deaths a day. Then it decreases to a minimum by about 40 deaths by mid-May. Controlling the number of patients and deaths caused by COVID-19 in this wave was achieved by preventing official, cultural, sports, and family gatherings and ceremonies, quarantining cities, lockdown most businesses, closing schools and universities, and starting virtual training and teleworking of employees.

The second wave begins in late May and culminates in more than 200 deaths in late July. The reopening of businesses and offices and the increase in travel at the beginning of the summer season had an impact. Then the downward trend in the number of casualties continues until the beginning of September. In the third wave, from the beginning of September, due to the summer trips and the beginning of Moharam ceremonies and then the reopening of schools in part-

¹ <https://tse.ir/en/indices.html>

² Iran's data are less than real for several reasons, including shortcomings in the corona test and failure to record the statistics of patients who have not been referred to medical centers. This point should be considered in the analysis of the results.

³ https://www.tgju.org/profile/price_dollar_rl

time, the number of COVID-19 casualties increased again. It reached its peak by November 2020, with more than 400 deaths a day.

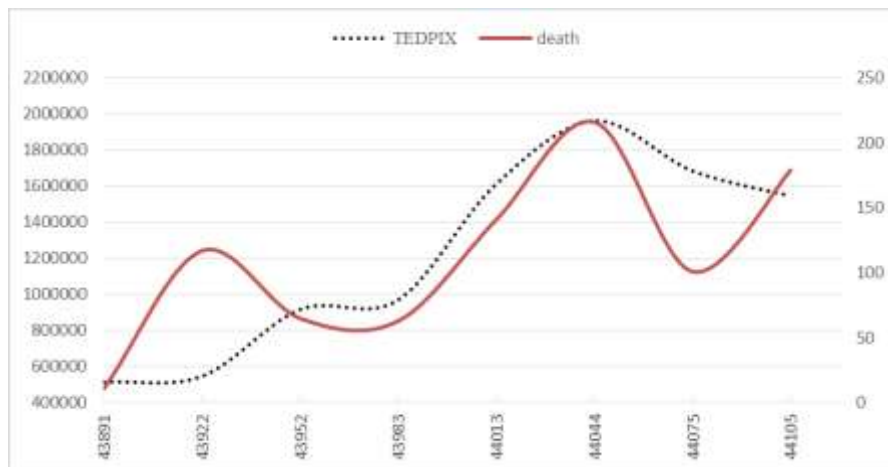


Figure 1. The trend of the Tehran Stock Exchange index during the three waves of COVID-19 in Iran

Source: Tehran Stock Exchange, World Health Organization, Gold, Coin, and Currency Information Network (tgju.org) and Authors Calculations.

The Tehran Stock Exchange index trend shows that in the first wave of the Coronavirus outbreak in Iran when a large part of economic activity was suspended, the stock market index was almost constant in March. However, its sharp rise began in late March, and almost it grew by 300 % until early August and declined sharply in the following months.

This stock index growth in Iran was contrary to other countries of the world, where they faced a slowdown in economic growth and a decrease in stock market indices after the Corona pandemic. For this reason, It is understood that the Coronavirus had a positive impact on the Iranian stock market, while three points should be considered about this impact: Firstly, how were the stock market returns during the three waves of the COVID-19 outbreak? Secondly, how different was the impact of the pandemic on the stock prices in different industries? Finally, what is the impact of other factors on stock prices, such as gold prices, exchange rates, and shareholder expectations during the COVID-19 outbreak? These points will be analyzed in the following sections.

Table 1 shows stock market return and related variables in three waves of COVID-19 in Iran. In the first wave, along with the expansion of COVID, the Iranian stock market index, the price of gold, and the exchange rate increased, but the world price of oil decreased. However, when the number of cases and casualties in COVID-19 decreases, the stock market, and other variables increases again. All of these variables increased even in the second wave, whether during the decrease or the increase of the COVID-19. However,

throughout the third wave, the stock market has been declining, but the price of gold and the exchange rate have risen.

Table 1. Stock market return and growth rate of related variables in three waves of COVID-19 in Iran

variables		start to peak of the first wave	peak of first wave until start of second wave	start to peak of second wave	peak of second-wave until start of third wave	start to peak of third wave
New Case of COVID-19	case	-	-28.0%	49.2%	-36.9%	314.3%
New death of COVID-19	death	-	-62.3%	312.3%	-57.0%	242.6%
TEDPIX return	TEX	19.1%	61.4%	109.6%	-13.2%	-22.7%
Gold	G	9.6%	8.6%	49.9%	4.8%	14.8%
Exchange rate	E	8.8%	9.5%	18.5%	11.8%	23.3%
Oil price	O	-40.4%	3.5%	20.8%	4.9%	-9.0%

Source: Tehran Stock Exchange, World Health Organization, Gold, Coin, and Currency Information Network (tgju.org) and Authors Calculations.

Table 2 shows the returns in different industries of the Iran stock market during three waves of COVID-19. The rate of return of these industries during these three waves has been very different, but the trend of all of them is consistent with the total stock market trend.

Table 2. Returns in different industries of Iran stock market in three waves of COVID-19

Index		start to the peak of the first wave	the peak of the first wave until the start of the second wave	start to the peak of the second wave	the peak of the second wave until the start of the third wave	start to the peak of the third wave
TEDPIX	TEX	19.1%	61.4%	109.6%	-13.2%	- 22.7%
Industry index	ind	16.6%	59.9%	113.4%	-14.1%	- 22.9%
Financial Index	fin	40.1%	72.2%	84.6%	-6.5%	- 22.3%
Top 30 Index	30g	11.7%	82.4%	136.8%	-7.8%	- 27.9%
Refined Petroleum	pet	-9.0%	66.4%	268.6%	-26.8%	- 36.6%
Metals	met	7.5%	63.1%	134.9%	-6.5%	- 31.1%
Chemicals	che	11.9%	55.9%	91.1%	-10.4%	- -4.2%
Motor Vehicles	aut	18.7%	136.2%	211.9%	-34.9%	- 30.4%
Transportation	trs	4.6%	68.0%	179.4%	-13.2%	- 48.6%
Food Products	fod	57.0%	51.2%	17.8%	-7.1%	- 24.9%
Cement	cem	22.8%	39.2%	58.3%	-12.5%	- 24.7%
Pharmaceuticals	drg	40.2%	35.3%	38.0%	-19.2%	- 17.1%
Machinery	msh	16.1%	46.7%	60.8%	-14.2%	- 19.8%
Information	inf	38.2%	37.9%	111.3%	-11.7%	- 33.8%
Telecommunications	rad	32.9%	59.0%	59.0%	7.3%	- 42.0%
Bank	bnk	41.7%	75.2%	94.0%	-5.8%	- 22.1%
Insurance	ins	26.2%	64.8%	55.2%	-11.9%	- 20.6%
Investment Companies	inv	29.1%	94.0%	65.4%	-9.8%	- 23.3%
max		Fod: 57.0%	aut: 136.2%	pet: 268.6%	bnk: -5.8%	che: -4.2%
min		Oil: -9.0%	drg: 35.3%	fod: 17.8%	aut: -34.9%	trs: -48.6%

Source: Tehran Stock Exchange, World Health Organization, Gold, Coin, and Currency Information Network (tgju.org) and Authors Calculations.

4. The Study Model

As the statistical data show, the return trend in the Iranian stock market during the three waves of COVID-19 has structural breaks. For this reason, the ordinary least squares (OLS) technique may not be appropriate. In the OLS method, there is a basic assumption that the regression parameters remain constant from one observation to another, and the regression coefficients do not change over time and are stable. Therefore, this method is suitable for stable economic structures but not for economies that experience multiple shocks in different cycles. Because in unstable economic structures, regression coefficients vary from observation to observation due to different shocks. Therefore, this instability is suitable for regression methods with structural breaks (Hansen, 2000; Perron, 2006). Changing regression coefficients at dates in the sample period, despite the structural change, has an essential role in analyzing time series. The breaking points of the regime can be determined a priori identified or using appropriate techniques (Perron, 1997). We consider the following multiple linear regression with T periods, m potential breaks, or m+1 regime.

$$y_t = x_t' \beta + z_t' \delta_j + u_t \quad (1)$$

For: $j=1, \dots, m+1$

For the observations $T_j, T_{j+1}, \dots, T_{j+1}-1$ in regime j. Where y_t is the dependent variables are TEDPIX (the total index of Tehran stock exchange) and 17 sub-indices. The x_t variables are those whose parameters do not vary across regimes, including constant (c). In contrast, the z_t variables have regime-specific coefficients, including DEATH (the number of new deaths of COVID-19), nominal exchange rate, gold price, and oil price. β and δ_j (for $j=1, \dots, m+1$) are the corresponding vectors of coefficients; u_t is the disturbance term. The break dates (T_1, \dots, T_m) are explicitly treated as unknown (the convention that $T_0 = 0$ and $T_{m+1} = T$ are used). We intend to estimate the unknown regression coefficients and the breakpoints when T observations on (x_t, y_t , and z_t) are available. By minimizing the overall sum of squared residuals, we have:

$$\sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} [y_t - x_t' \beta - z_t' \delta_j]^2$$

Let $\hat{\beta}(\{T_j\})$ and $\hat{\delta}(\{T_j\})$ denote the estimates based on the given m-partition (T_1, \dots, T_m) denoted $\{T_j\}$. Substituting these estimations in the objective function and denoting the resulting sum of squared residuals as $S_T(T_1, \dots, T_m)$, the estimated breakpoints ($\hat{T}_1, \dots, \hat{T}_m$) is such that:

$$(\hat{T}_1, \dots, \hat{T}_m) = \operatorname{argmin}_{(T_1, \dots, T_m)} S_T(T_1, \dots, T_m) \quad (2)$$

With the minimization taken over a set of admissible partitions, the parameter estimates are those associated with the partition $\{\hat{T}_j\}$, that is:

$$\hat{\beta} = \hat{\beta}(\{\hat{T}_j\}) \quad \hat{\delta} = \hat{\delta}(\{\hat{T}_j\})$$

This framework involves many contributions according to the assumptions imposed. Some conditions for errors and breakpoints are required to obtain theoretical results on consistency and limited distribution (Perron, 2010).

4. Empirical Results

We first examined the classical hypotheses. Diagnostic tests do not rule out all the classical assumptions for the models. Breusch-Godfrey LM test shows no serial correlation, the Jarque-Bera test statistic indicates a normal distribution of data, and the Breusch-Pagan-Godfrey test shows no heteroskedasticity in data. Hence, our estimations are reliable¹.

Multiple breakpoint test was performed based on Bai-Perron's (2003) tests of L+1 vs. L globally determined breaks with these options: Trimming 0.15, Maximum breaks 5, and significant level. Sequential and Significant Scaled F-statistic determined at least two breaks in models (Table 3).

Table 3. Multiple breakpoint tests

Dependent variable	Scaled F-statistic Break Test	
	0 vs. 1	1 vs. 2
TEDPIX	23.05*	24.60*
Industry index	26.9*	37.7*
Top 30 Index	97.06*	40.22*
Financial Index	36.50*	37.76*
Refined Petroleum	263.97*	56.99*
Metals	21.85*	8.53*
Chemicals	87.83*	41.85*
Motor Vehicles	157.60*	131.67*
Transportation	239.46*	29.51*
Food Products	249.61*	81.33*
Cement	109.36*	55.75*
Pharmaceuticals	149.20*	38.09*
Machinery	98.11*	25.08*
Information	115.46*	53.54*
Telecommunications	160.57*	104.30*
Bank	241.37*	37.07*

¹. The data set used and analyzed during the current study and the results of all tests is available upon request from the relevant author.

Table 3 (Continued). Multiple breakpoint tests

Insurance	169.59*	52.11*
Investment Companies	324.00*	45.11*

Source: Research findings

Note:

(1) Critical Value for 0 vs. 1 break is 20.08, and for 1 vs. 2 breaks are 22.11 according to Bai-Perron (2003).

(2) * Significant at the 0.05 level.

Before analyzing the model's results, because the time series of the variables has a unit root and are nonstationary, therefore must first be tested by the Engle and Granger approach whether variables have cointegrated? For this purpose, the residual component stationary of all models was tested by the Augmented Dickey-Fuller (ADF) test. The results are shown in Table 4. In the last column of this table, the degree of integration of each model residual is reported, where I(0) indicates that the degree of integration is zero, that is, stationary, and I(1) indicates nonstationary. In the 18 models, only the residual of the financial index model and the information index model is nonstationary, and the results are unreliable. However, the results indicate a cointegrating relationship between variables in other models.

Table 4. Augmented Dickey-Fuller (ADF) test for a unit root in Residual of the Models

Residual of Models:	ADF test statistic		Result of test
	With Intercept	With intercept and trend	
TEDPIX	-5.67***	-5.44***	I(0)
Industry index	-6.31***	-5.95***	I(0)
Top 30 Index	-5.39***	-5.33***	I(0)
Financial Index	-1.86	-1.59	I(1)
Refined Petroleum	-4.22***	-4.17***	I(0)
Metals	-6.31***	-6.28***	I(0)
Chemicals	-6.73***	-6.63***	I(0)
Motor Vehicles	-3.27**	-3.30*	I(0)
Transportation	-5.02***	-5.03***	I(0)
Food Products	-1.81	-1.90	I(1)
Cement	-3.97***	-3.95***	I(0)
Pharmaceuticals	-4.03***	-3.98***	I(0)
Machinery	-5.35***	-5.31***	I(0)
Information	-1.29	-1.26	I(1)
Telecommunications	-6.04***	-6.03***	I(0)

Table 4 (Continued). Augmented Dickey-Fuller (ADF) test for a unit root in Residual of the Models

Bank	-1.95	-5.55***	I(0)
Insurance	-4.02***	-3.92**	I(0)
Investment Companies	-6.19***	-6.03***	I(0)

Source: Research findings

Note:

(1) *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively. I(0) is integrated of zero degree.

(2) The statistic Unit root with break test for Financial Index is -3.93 and for Food Products -6.71.

Because the total stock index and its sub-indices are the dependent variables in this model, we estimated 18 equations. These estimations are detailed in Tables 1 to 4 of the Appendix (A1-A4) and are summarized in Table 5.

The nominal exchange rate coefficient (which means a decrease in the value of the Iranian Rial) in the models is positive in 18 cases. Its value is much larger than the coefficient of other variables such as Gold, Oil price, and COVID-19. The exchange rate has positively affected the industry index, the index of 30 large companies, metals, chemicals, Refined Petroleum, and even Motor Vehicles, especially in the first and second waves. However, it has had a negative impact on the transportation, food, information, machinery, and Pharmaceuticals industries (Tables A1-A4). Considering that the nominal exchange rate in Iran increased more than eight times during this period, the positive and significant effect of the exchange rate on the main industries of the Tehran Stock Exchange can show the positive trend of the index, especially in the first and second waves of the COVID-19. Also, the variable of the total index of the Tehran Stock Exchange (TEDPIX) is present in all models to control the trend of the Stock Exchange. In a way, this variable plays the role of beta coefficient for each industry, which measures market risk (Tables A1-A4).

Table 5 shows that in the first wave, COVID-19 had a slight, negative, and significant effect on the total index of the Tehran stock exchange. COVID-19 had the same effect on two other essential indices of the Tehran stock exchange, namely the industry index and the index of 30 large companies. However, it did not have a significant effect on the financial index. Among the main industries of the stock market, the refined petroleum industry, the metals industry, and the chemical industry, like the main index, were affected by COVID-19. However, similar to other studies (e.g., [Herwany et al., 2021](#)), this variable did not significantly affect the motor vehicle industry (automobile). Moreover, in line with the literature (e.g., [Mazur et al., 2021](#); [Al-Awadhi et al., 2020](#)), the impact of COVID-19 on the transportation industry is negative.

The impact of COVID-19 on the food, cement, and pharmaceutical industries is positive, which is the opposite of the total index. This impact on the information, machinery and communications industries has not been significant. The critical point is that while COVID-19 should have positively affected the

return of the information and communication industries due to the virtualization of activities, this has not been the case in Iran. In the financial sector, banks and investment companies have had a positive impact on COVID-19, but this impact on insurance has not been significant. The government's plan to transfer its shares in banks through an exchange-traded fund (ETF) shows the role of the government in the prosperity of bank shares, contrary to the increase in COVID-19. In this wave, the most negative impact was on the transportation and refined petroleum industries, and the most positive impact was on the food and pharmaceutical industries.

Table 5. Summary of Regression Results

group	Number of equations	Dependent variable	Regime I	Regime II	Regime III
Main Index	1	TEDPIX	-0.012**	0.071***	-0.078**
	2	Industry index	-0.005***	0.003	0.004***
	3	Top 30 Index	-0.022***	-0.012	-0.002
	4	Financial Index	0.036	0.121	-0.044
Main industry	5	Refined Petroleum	-0.042***	0.022	0.048***
	6	Metals	-0.034***	-0.028	-0.202***
	7	Chemicals	-0.019***	-0.014	0.024***
	8	Motor Vehicles	0.01	0.175***	0.204***
Other industry	9	Transportation	-0.054***	0.08	-0.094***
	10	Food Products	0.060***	0.03	0.022
	11	Cement	0.024***	0.074***	-0.043
	12	Pharmaceuticals	0.053***	0.236***	0.022
	13	Machinery	-0.004	0.076***	0.049***
	14	Information	-0.001	0.032	-0.132***
	15	Telecommunications	0.020	-0.039**	0.041
financial	16	Bank	0.028***	-0.070**	-0.040***
	17	Insurance	0.011	0.043	0.088
	18	Investment Companies	0.022***	-0.007	-0.027***

Source: Research findings

Note: *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

In the second wave, during April, May, and June, although the number of deaths due to the COVID-19 increased, the total stock index also grew rapidly. For this reason, a positive and significant relationship has been reported between

the number of deaths of COVID-19 and the total return of the stock market. However, when we study different industries, the coefficient of this variable is not significant in many industries, and only in the Motor Vehicles industry (as one of the main industries of Tehran stock exchange) and pharmaceutical, cement, and machinery industries have a positive and significant effect. This relationship with the pharmaceutical industry, similar to studies in other countries (Gunay et al., 2021; Al-Awadhi et al., 2020; Mazur et al., 2021), is not strange, but a positive relationship with the Motor Vehicles industry shows an essential fact in the Iranian stock market. During these months, the stock prices of companies in the Motor Vehicles industry, which significantly impacted the total trend of the stock market in Iran, increased far beyond the financial base of these companies due to government support and market cooperation. However, deaths from the Coronavirus also increased. Thus, the logical link between stock returns and COVID-19 was lost.

In the third wave, the relationship of COVID-19 with the total index is negative and significantly similar to the first wave. However, it has a positive and significant relationship with the industry index, while its relationship with the index of 30 larger companies and the financial index is not significant. Indices at the industry level can make these results clear. Among the four major industries, COVID-19 has a positive relationship with the refined petroleum, chemical, and Motor Vehicles industries and a negative relationship with the metals industry.

As shown in Table 5, again, like the second wave, the Motor Vehicles industry index increased with the number of deaths related to COVID-19 and decreased with its decrease. The two oil and chemical industries were in a similar situation, and the government's role in manipulating the price of these stocks was significant. The relationship between COVID-19 and other industries is such that it has a negative relationship with the transportation industry and the information industry and a significant positive relationship with the Motor Vehicles industry. However, it does not have a significant relationship with other industries, including pharmacy.

Hence, similar to the results of previous studies (Al-Awadhi et al., 2020; Mazur et al., 2021; Herwany et al., 2021; Gunay et al., 2021; Choi & Jung, 2021), we also concluded that the effect of COVID-19 on various industries is asymmetric. As shown in the appendix tables, the coefficients of other study variables, i.e., exchange rate, gold price, oil price, and trend of the index (beta) on the dependent variables in each index, are reported differently.

5. Concluding Remarks

The stock indices growth in Iran during the COVID-19 pandemic was puzzling. The results show that each wave of coronavirus outbreak has a different effect on the stock market in Iran. In the first wave, this effect on the total index, industry index, and index of 30 large companies was slight, negative, and significant. However, it did not have a significant effect on the

financial index. In the second wave, there is a positive statistical relationship between the number of deaths due to COVID-19 and the total index, which was due to government support to cover its budget deficit by manipulating the stock prices of automobile companies. In the third wave, although the relationship of COVID-19 with the total index is negative and significant, it has a positive and significant relationship with the industry index. In contrast, its relationship with the index of 30 larger companies and the financial index is not significant. Among the four major industries, COVID-19 has a positive relationship with the Refined Petroleum, chemical, and Motor Vehicles industries, reflecting the government's role in stimulating the stock market of these industries.

The impact of COVID-19 on the main industries of the stock market in the first wave was such that it was negative on the refined petroleum industry, chemical industry, and metal industry. In the second wave, it was only positive for the automobile industry. In the third wave, it was positive for the refined petroleum industry, chemical industry, and automobile industry and negative for the metals industry. These results show that the government's plan to cover its budget deficit through the stock market through manipulation in the three industries of Motor Vehicles, refined petroleum and chemical was in the second and third waves. As a result, the trend of the entire stock index has changed with the COVID-19.

The impact of COVID-19 on other industries is such that, in line with theoretical foundations and empirical evidence, it has harmed the transportation industry and had a positive impact on the food, cement, and pharmaceutical industries. Contrary to expectations, it has not significantly impacted the ICT industry. In the financial sector, in the first wave, the effect of the COVID-19 outbreak on banks and investment companies has been positive, with the government also raising its budget deficit from the sale of bank shares.

The impact of other variables on stock prices, such as exchange rate, gold price, and expectation during the epidemic crisis, as shown in the four appendix tables, shows that each industry group was differently affected by these variables. Among these variables, the exchange rate has positively affected the main industries, and the trend of Iran's stock market indices has been affected by it.

After the epidemic, some service companies and small businesses were severely affected by the Coronavirus due to a change in shopping techniques by buyers (online and telephone purchases instead of in-person). Some food, pharmaceutical, and health industries showed positive returns due to higher consumer demand during the epidemic. The tourism and transportation industries fell sharply due to government restrictions (such as closing roads) to reduce the spread of COVID-19. However, with the spread of pandemics, the stock market will stagnate, and governments must be prepared to deal with crises and their adverse effects on financial markets.

The policy implications of this study indicate that the selected method can provide accurate and factual information about the impact of the COVID-19

pandemic on various industries in the Iranian stock market, which can help policymakers make better and more appropriate policies. In addition, empirical findings suggest that government intervention should be reduced to stabilize the Iranian stock market. Finally, the results of this study provide interesting facts about the stock market reaction to the outbreak of epidemics and crises for investors to secure their assets. Future studies on the subject under discussion can be expanded by considering sanctions, cultural and social variables, and government actions such as restricting travel and closing roads.

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<https://www.who.int/>
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Appendices

Table A1. Regression Results for Main Indices in Iran's Stock Market

	TEDPIX ^b	Industry index	Top 30 Index	Financial Index
Regime I				
N. of observations	38	47	44	51
DEATH	-0.012***	-0.005***	-0.022***	0.036
Exchange rate	0.063	0.156***	0.339***	-1.034
Gold	-0.112	-0.061***	-0.120	0.460
Oil price	-0.048***	-0.003	-0.047***	0.026
TEDPIX ^C	1.000***	0.970***	1.020***	1.248***
Regime II				
N. of observations	66	23	75	24
DEATH	0.071***	0.003	-0.012	0.121
Exchange rate	0.109***	0.079	0.257***	5.867***
Gold	-0.045	-0.035	-0.268***	-2.868
Oil price	0.059	0.019***	0.202***	2.848***
TEDPIX	0.830***	0.999***	1.199***	-1.729***
Regime III				
N. of observations	18	89	40	85
DEATH	-0.078***	0.004***	-0.002	-0.044
Exchange rate	-0.075	0.027***	0.139***	-0.138
Gold	0.265	-0.018***	-0.174***	0.136
Oil price	-0.198	-0.051***	-0.465***	0.389
TEDPIX	0.754***	1.042***	1.373***	0.769***
c	1.245*	-0.599*	-5.417*	1.861
R ²	0.999	1.000	0.999	0.915
F-statistic	5609.102	226412.900	15294.370	105.384

Source: Research findings.

Note:

(1) All variables in logarithmic scale.

(2) dependent variables are in the first row.

(3) TEDPIX for second column is AR(1).

(3) *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

Table A2. Regression Results for Main Industry Indices in Iran's Stock Market

	pet	met	che	aut	trs
Regime I					
N. of observations	32	44	49	52	50
DEATH	-0.042***	-0.034***	-0.019***	0.010	-0.054***
Exchange rate	1.215***	0.682***	0.438***	0.576***	0.789***
Gold	-0.078	-0.360***	-0.282***	0.122	-0.061
Oil price	0.054	-0.067***	-0.036***	0.083***	-0.169***
TEDPIX	0.299***	0.979***	1.014***	0.867***	0.838***
Regime II					
N. of observations	55	60	50	44	52
DEATH	0.022	-0.028	-0.014	0.175***	0.080
Exchange rate	0.526***	0.271***	0.098	0.824***	-1.018***
Gold	-0.509***	-0.387***	0.024	-0.065	1.162***
Oil price	0.086***	-0.238***	0.057	-0.469***	0.156
TEDPIX	1.387***	1.412***	0.929***	0.980***	0.884***
Regime III					
N. of observations	72	55	60	63	58
DEATH	0.048***	-0.202***	0.024***	0.204***	-0.094***
Exchange rate	-1.006***	0.634***	0.832***	-1.910***	-0.479***
Gold	0.604***	-0.164	-0.408***	1.334***	0.062
Oil price	0.297***	-0.963***	-0.680***	1.591***	1.142***
TEDPIX	1.394***	1.100***	0.964***	1.194***	1.474***
c	-2.967*	-2.337*	-3.625*	-9.284*	-8.789*
R ²	0.997	0.997	0.998	0.997	0.990
F-statistic	3093.191	3478.064	5832.531	2923.814	922.416

Source: Research findings.

Note:

(1) All variables in logarithmic scale.

(2) dependent variables are in the first row.

(3) *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

Table A3. Regression Results for Other Industry Indices in Iran's Stock Market

	fod	cem	drg	inf	msh	rad
Regime I						
N. of observations	35	69	88	23	45	34
DEATH	0.060***	0.024* **	0.053***	-0.001	-0.004	0.020
Exchange rate	-1.373***	- 0.479* **	-0.294***	- 1.658** *	-0.211	-1.111***
Gold	0.356***	- 0.276* **	0.226***	0.316	-0.050	0.292
Oil price	-0.067	0.051* **	0.132***	-0.088	-0.037	-0.045
TEDPIX	1.202***	0.848* **	0.624***	1.471** *	0.837***	1.465***
Regime II						
N. of observations	53	54	31	86	35	76
DEATH	0.030	0.074* **	0.236***	0.032	0.076***	-0.039**
Exchange rate	-0.058	- 0.157* **	0.278***	- 1.782** *	0.558***	-0.443***
Gold	0.125	0.038	-0.007	0.974** *	- 0.587***	0.640***
Oil price	0.364***	0.103	-1.441***	- 0.089** *	0.127***	0.306***
TEDPIX	0.214***	0.195* **	0.731***	0.814** *	0.710***	0.398***
Regime III						
N. of observations	71	36	40	50	79	50
DEATH	0.022	-0.043	0.022	- 0.132** *	0.049***	0.041
Exchange rate	-0.185***	- 0.552* **	-0.347***	-0.366	- 0.452***	-0.469***
Gold	-0.313***	0.232* **	0.309***	0.305	0.064	-0.307
Oil price	1.003***	0.706* **	0.719***	1.119** *	0.378***	0.970***
TEDPIX	0.638***	0.189* **	0.411***	0.094	0.783***	1.298***
c	5.450*	7.206*	2.299*	1.814	4.405*	-2.233*
R ²	0.986	0.993	0.988	0.981	0.994	0.989

Table A3 (Continued). Regression Results for Other Industry Indices in Iran's Stock Market

F-statistic	664.471	1387. 122	778.623	487.08 1	1540.18 6	865.984
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Source: Research findings.

Note:

(1) All variables in logarithmic scale.

(2) dependent variables are in the first row.

(3) *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.

Table A4. Regression Results for Financial Indices in Iran's Stock Market

	fin	bnk	ins	inv
Regime I				
N. of observations	51	47	84	36
DEATH	0.036	0.028***	0.011	0.022***
Exchange rate	-1.034	-1.245***	-0.071	-1.029***
Gold	0.460	0.611***	-0.143	0.232***
Oil price	0.026	-0.029	0.001	0.008
TEDPIX	1.248***	1.235***	1.095***	1.373***
Regime II				
N. of observations	24	24	48	25
DEATH	0.121	-0.070**	0.043	-0.007
Exchange rate	5.867***	0.312	0.544***	0.029
Gold	-2.868	-0.324	-0.600***	-0.040
Oil price	2.848***	-0.109**	0.348	0.420***
TEDPIX	-1.729***	1.003***	0.965***	0.667***
Regime III				
N. of observations	85	89	28	99
DEATH	-0.044	-0.040***	0.088	-0.027***
Exchange rate	-0.138	-0.121**	-0.546***	-0.231***
Gold	0.136	0.195***	0.732***	0.026
Oil price	0.389	0.203***	0.268	0.327***
TEDPIX	0.769***	0.703***	0.389***	0.842***

Table A4 (Continued). Regression Results for Financial Indices in Iran's Stock Market

c	1.861	-3.165*	-1.129	-0.156
R ²	0.915	0.998	0.989	0.998
F-statistic	105.384	4199.932	891.691	5277.644

Source: Research findings.

Note:

(1) All variables in logarithmic scale.

(2) dependent variables are in the first row.

(3) *, **, *** denote statistical significance at the 0.1, 0.05, and the 0.01 levels, respectively.