DOKUZ EYLUL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS
ECONOMICS PROGRAM
MASTER'S THESIS

THE IMPACT OF COVID-19 PANDEMIC ON TURKISH STOCK MARKET: A TIME SERIES ANALYSIS WITH STRUCTURAL BREAKS

Halil Erdem ERDEM

Supervisor
Prof. Dr. Evrim TURGUTLU

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DECLARATION

I hereby declare that this master's thesis title as "The Impact of COVID-19 Pandemic on Turkish Stock Market: A Time Series Analysis with Structural Breaks" has been written by myself in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honour.

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Halil Erdem ERDEM

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ABSTRACT

Master's Thesis

The Impact of COVID-19 Pandemic on Turkish Stock Market: A Time Series Analysis With Structural Breaks

Halil Erdem ERDEM

Dokuz Eylül University

Graduate School of Social Sciences

Department of Economics

Economics Program

Although many studies analyze the impact of the COVID-19 pandemic on the financial markets, the number of studies that analyze the effects comprehensively for Turkey is limited. In this study, daily data between April 8, 2020, and March 22, 2021, were used. The number of COVID-19 cases, deaths, and recovered patients in Turkey, the number of cases in the world, and Europe, interest rate, TL/US Dollar exchange rate, gold price, and VIX index were used as explanatory variables. VAR analysis was performed to determine the dynamic relationship between these variables with BIST-100, BIST-30, BIST-Financial, BIST-Industry, and BIST-Services indices. The results show that there is an inverse relationship between the cases in Turkey, interest rate, and indices except for the BIST-Services index. A positive relationship was found between the number of COVID-19 deaths, and BIST-100, BIST-30, BIST-Financial indices. There is an inverse relationship between index returns and exchange rate, VIX index, and gold prices. The robustness of the VAR results is supported by ARDL analysis. Finally, Impulse-Response analyses and Granger causality tests were applied. The findings indicate that returns reacted negatively to the negative shocks about COVID-19, positively to the number of recovered patients. According to the Granger causality tests, we find that the number of cases, and deaths in Turkey, and interest rate Granger causes BIST-100, BIST-30, BIST-Industry returns. While the number of cases in Turkey

Granger causes BIST-Financial return, the interest rate was the Granger causes BIST-Financial and BIST-Services returns.

Keywords: COVID-19, Turkish Stock Market, Unit Root, Structural Breaks, VAR Analysis, ARDL, Granger Causality Test, Impulse-Response Function.

ÖZET

Yüksek Lisans Tezi

COVID-19 Pandemisinin Türkiye Hisse Senedi Piyasası Üzerindeki Etkisi: Yapısal Kırılmalarla Zaman Serisi Analizi

Halil Erdem ERDEM

Dokuz Eylül Üniversitesi
Sosyal Bilimler Enstitüsü
İngilizce İktisat Anabilim Dalı
İngilizce İktisat Programı

COVID-19 pandemisinin finans piyasalarına etkisini analiz eden çok sayıda çalışma olmasına rağmen, Türkiye için etkileri geniş kapsamlı analiz eden çalışmaların sayısı sınırlıdır. Bu çalışmada 8 Nisan 2020-22 Mart 2021 tarihleri arasındaki günlük veriler kullanılmıştır. Türkiye'deki COVID-19 vaka, ölüm ve iyileşen hasta sayıları, dünyadaki ve Avrupa'daki vaka sayıları, faiz oranı, TL/US Dolar kuru, altın fiyatı ve VIX endeksi açıklayıcı değişkenler olarak kullanılmıştır. Bu değişkenlerin BIST-100, BIST-30, BIST-Mali, BIST-Sınai ve BIST-Hizmetler endeksleriyle aralarındaki dinamik ilişkinin tespiti için VAR analizi yapılmıştır. Sonuçlar, BIST-Hizmetler dışındaki endekslerle Türkiye'deki COVID-19 vakaları ve faiz oranı arasında ters yönlü bir ilişkiyi gösteriyor. COVID-19 ölüm sayılarıyla BIST-100, BIST-30 ve BIST-Mali endeksleri arasında pozitif ilişki bulunmuştur. Endeks getirilerinin kurla, VIX endeksiyle ve altın fiyatlarıyla arasında ters yönlü ilişki vardır. ARDL analizi ile VAR sonuçlarının tutarlılığı desteklenmiştir. Son olarak, Etki-Tepki analizleri ve Granger nedensellik testleri uygulanmştır. Getiriler COVID-19 ile ilgili olumsuz haberlerdeki şoklara negatif, iyileşen hasta sayısına pozitif tepkiler vermiştir. Granger nedensellik testlerine göre Türkiye'deki vaka ve ölüm sayısı ve faiz oranının BİST-100, BİST-30, BİST-Sınai getirilerinin Granger nedenleri olduğu bulunmuştur. Türkiye'de vaka sayıları BIST-Finansal getirisinin Granger nedeni iken, faiz oranı BIST-Finansal ve BIST-Hizmetler getirilerinin Granger nedenidir.

Anahtar Kelimeler: COVID-19, Türkiye Hisse Senedi Piyasası Birim Kök, Yapısal Kırılmalar, VAR Analizi, ARDL, Granger Nedensellik Testi, Etki-Tepki Fonksiyonu

THE IMPACT OF COVID-19 PANDEMIC ON TURKISH STOCK MARKET: A TIME SERIES ANALYSIS WITH STRUCTURAL BREAKS

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INTRODUCTION

The COVID-19 virus, which emerged in China in December 2019, affected the whole world in a short time. While the COVID-19 epidemic has deadly consequences in human life, it has also left serious damage to the economies. Globally, the economies of all countries have faced a crisis. With the measures taken by governments such as curfew and quarantine, this situation brought the economies to a standstill. Governments have implemented financial support packages for the real sector and low-income people to reduce the economic effects of the epidemic. It is currently unclear how such large supports will affect the economies after the epidemic.

Due to the negative effects of quarantine and similar practices on domestic demand and the slowdown in the global economy, Turkey will inevitably be affected by this situation. The firms operating in the services sector were closed for a long time and the rate of use of industrial capacity decreased dramatically in the Turkish economy. The rate of use of industrial capacity, which was 75,6 percent in the first quarter of 2020, was calculated as 75.0 percent in the first quarter of 2021 (CBRT, 2021). It should not be overlooked that the problems caused by the decrease in oil prices will also narrow the Russian and Middle Eastern markets.

Although the impact of the COVID-19 epidemic on the global markets is not fully understood yet, it is seen that the financial markets have immediately reacted to the epidemic. The developments related to the pandemic increase the uncertainty in the stock markets and cause strong effects. Zhang et al. (2020) state that in the 10 countries with the highest number of cases by March 2020, the market risk level increased from 0.0071 in the previous months to 0.0196. The market risk level is established by considering the standard deviations of daily returns. Compared to other countries, it was found that China's highly volatile stock market became the lowest in March. On the other hand, Gormsen and Koijen (2020) explain that the reason for the decline in the stock markets was due to the uncertainties in the growth expectations of the investors. Heyden and Heyden (2020) use a case study to measure the response of the US and European financial markets to the first case and the first death. In the study, which is based on monetary and fiscal policies, it has been determined that investors react negatively to the first death and financial contractions, and more softly to monetary policies.

The risks arising from the COVID-19 pandemic have also caused negative effects on the world stock markets. In March 2020, there were rapid decreases in financial markets. S&P 500 for the USA, Nikkei for Japan, Kosdaq for South Korea, and FTSE 100 for the UK have experienced the greatest declines. In March 2020, S&P 500 decreased 7%, Nikkei decreased 7%, Kosdaq 8%, and FTSE 100 decreased 5.7% (BBC, 2020). After the outbreak of the crisis, the VIX index, known as the fear index, also started to rise. When investors started to worry about the future of the stocks in the stock market, they started to use the option mechanism to insure/hedge their assets. The VIX index will inevitably rise due to the increase in demand and option prices. In other words, the fact that the VIX index will rise is seen as an indicator of concern and anxiety in the market (Öner et al. 2018).

Every country will feel the crisis at different levels after the epidemic is over. Countries with high social capital and state capacity will be more successful in overcoming the economic effects of the epidemic. The main priority of governments will be to preserve the resilience of the health system, ensure the survival of companies and solve the problem of unemployment. In the longer term, it is necessary to analyze the global economy well and to determine policies by including academicians in the process.

In this study, we investigate the effect of the COVID-19 pandemic on the Turkish stock market in detail. We also employ, gold prices, exchange rate, interest rate, and VIX index, which are thought to have a strong effect on the stock market. To this end, we aim to shed light on the dynamics of the Turkish stock market over the COVID-19 pandemic using econometric models.

CHAPTER ONE
MOTIVATION OF THE STUDY

In this section, general opinions about our study are explained. First, the definition of the problem and then the aims of the study were mentioned.

1.1. PROBLEM DEFINITION

With the COVID-19 pandemic, major effects are observed on the economies of countries. The ultimate effects of the pandemic are unknown, as the process is still ongoing. Among the developing countries, Turkey is also seriously affected by this epidemic. The sector that reacts the fastest in cases of epidemics, wars, crises, etc. is the financial sector. The stock markets that households and companies use for investment purposes are very important in this respect. It is very difficult to determine how different areas of the economy are affected one by one as the process continues. However, when we look at the stock markets, it can be easily seen how different sectors can react instantly. It is very important how households and companies will evaluate their investments and how the government will manage this process. The BIST-100, BIST-30, BIST-Financial, BIST-Industry and BIST-Services indices that we used in our study will enable us to see the effects of the COVID-19 pandemic in detail.

1.2. AIM OF THE STUDY

The purpose of this study is to explain the positive and negative effects of the current COVID-19 pandemic on the Turkish stock market. Using the number of cases, number of deaths, number of recovered patients in Turkey, number of cases in the world, number of cases in Europe, interest rate, TL/US Dollar exchange rate, gold price, and VIX index, this study aims to analyze how BIST-100, BIST-30, BIST-Financial, BIST-Industry, and BIST-Services index returns are affected by this phenomenon. Since the effects in the pandemic process will be observed, daily data between 8 April 2020-22 March 2021 will be used. The ultimate goal is to make policy recommendations on what can be done to avoid negative impacts and what should be done to further sustain positive impacts. We also employ econometric methods and models that take into account possible structural breaks. The study will be completed by making policy recommendations for the continuation of the pandemic process and after.

CHAPTER TWO

THEORETICAL BACKGROUND, METHODOLOGY, DESCRIPTIVE STATISTICS, EMPIRICAL RESULTS

2.1. THEORETICAL BACKGROUND

In addition to its serious effects on human health, the COVID-19 epidemic also causes negative effects on countries financially and economically. While health professionals are working to end the epidemic all over the world, other branches of science are researching the effects of the pandemic. Studies in the financial and economic fields are also increasing day by day. To understand how the financial markets in different countries were affected by the pandemic, analyses are made on stock returns and stock market indices. Zeren and Hızarcı (2020) choose Spain, France, Germany, Italy, China, and South Korea among the countries with the highest number of cases. They perform a Maki Cointegration analysis using daily data from January 23 to March 13, 2020. According to the results of the analysis, they found that the total number of cases was associated with the stock markets of Spain, China, and South Korea, but not with France, Germany, and Italy. In the long run, they conclude that all stock markets act together with the number of deaths.

Ben Ayed et al. (2020) use stock returns of all companies listed in the Tunisian stock market between January 20 and April 20 to analyze the impact of the pandemic on the stock market. In the study, they perform Swamy-Arora panel data analysis, and the number of daily cases and include the number of recoveries and the number of deaths in the model. While there was a positive relationship between the increase in the number of cases and stock returns, findings indicate a presence of a negative relationship with the increase in the number of deaths. However, a positive relationship is present between the rate of increase in the number of recovered patients and stock returns, but this relationship is not strong.

In another study, Senol and Zeren (2020) explain the effects of the number of cases and deaths on Europe, the world, and emerging markets and the G7 MSCI index using Fourier cointegration analysis. As a result of their analysis using daily data from January 21 to April 7, 2020, it has been determined that there is a long-term relationship between financial markets and the COVID-19 outbreak.

Ashraf (2020) investigates the daily change and growth in the financial market using the number of COVID-19 cases and deaths between January 22 and April 17, 2020, using the OLS method. This study comprises 64 countries the findings indicate that the increase in the number of cases affects the stock prices negatively. Findings state that the announced deaths numbers had a weak effect on stocks. As a result, it was seen that the stock markets reacted very quickly to the pandemic, and it was underlined that this situation could change over time, depending on the severity of the pandemic.

Claiming that a dramatic movement is observed in the financial markets, Zhang et al. (2020) state that each country has its risks. Looking at the results of the research, observation suggests that the risks in the global market increase rapidly with the COVID-19 pandemic. It has been concluded that the stock markets of the countries are directly related to the severity of the pandemic. The study emphasizes that the economic losses in the countries increased the volatility in the financial markets and the future of the markets was uncertain.

Researching how 17 sectors in the Egyptian financial market have been affected by the COVID-19 outbreak, Elsayed and Mansour (2020) use the daily number of cases, the number of deaths, the total number of cases, and the total number of deaths announced between March 1 and May 10, 2020, as a data set. When the stock returns of 17 sectors were analyzed, it was emphasized that all of them were more affected by the total number of deaths. It was found that the number of new cases announced was affected more than the total number of cases.

Ramelli and Wagner (2020) investigate the effects of international trade, financial policies, and market reactions on stocks. Attention has been drawn to the global value chain and trade's payment for firm value. They stress that how important the cash assets of the virus, which spread especially in Europe, the USA, and China, are for companies and investors. As a result of the study, they conclude that companies need to get rid of their dependence on trade, epidemics, etc. It was explained that they should be prepared for crises and that they should always keep their financial positions under control.

Gormsen and Koijen (2020) come up with a forecasting model for growth expectations by addressing stock and profit share expectations during the pandemic period. They state that the decisions taken by the states to slow down the epidemic damage the economies. They used profit share add-on, stocks, and indices data to determine this loss due to the macro indicators not being disclosed on time. The fluctuations in stocks are very important as they show the reaction of the investor to the epidemic. The study points out that due to the epidemic restrictions that started in Italy, the expectations will move the financial markets down. To determine this, they use EuroStoxx 50 and S&P 500 indices and 30-year bonds of Germany and the USA as indicators. Results show that stock market indices experienced sharp decreases, but government bonds were positively affected. In the interval between February and March 2020, observations suggest that the effect on profit share expectations was very negative.

Analyzing the impact of infectious diseases on the Chinese stock market between January 10, 2020, and March 16, 2020, by making panel regression analysis, Al-Awadhi et al. (2020) use the number of daily cases and the increase in death rate as independent variables. They use the Shanghai Stock Exchange Composite Index and Hang Seng index as dependent variables in the research. According to the findings of the study, an inverse relationship was found between the increase in the number of deaths, cases, and stock market indices.

Liu et al. (2020) examine the impact of the COVID-19 pandemic on 21 stock market indices of Korea, Italy, England, the USA, Germany, Singapore, and Japan, the countries that are most affected by the epidemic. This study investigates the short-term effect using daily data between February 21, 2019, and March 18, 2020. The case study performs to determine the cumulative abnormal returns and abnormal returns of the indices. As a result, the study observes that the stock markets experience a grave collapse with the epidemic in the countries included in the study. In addition, more negative effects founded in abnormal returns of Asian countries compare to other countries.

To examine the impact of COVID-19 on the US and Chinese stock market, Sansa (2020) research the date range from March 1 to March 25, 2020. As an independent variable they use the number of confirmed cases, and for the dependent variables, they use the Dow Johns and Shanghai stock markets. According to the results of the simple regression analysis, there is a positive relationship between the number of COVID-19 cases and the stock markets.

Alber (2020) focuses on France, Germany, China, Spain, the USA, and Italy, where the epidemic was most intense, to measure the impact of the confirmed COVID-19 cases and deaths on the financial markets. He also reanalyzes the total number of cases and total deaths. The negative effect of the pandemic on stock market returns was significant only for Germany, Spain, France, and China. In the study, where the total number of cases and deaths between March 1 and April 10, 2020, was used as a data set, the study determines that the stock market returns were more sensitive to the number of cases than the number of deaths. It has been emphasized that the total number of cases is more effective in stocks than the number of newly announced cases.

In another study by Zhang et al. (2020), they analyze the correlation between the number of COVID-19 cases and the stock markets of 12 countries. In the study, the start date was taken as the day when the World Health Organization declared the disease as a pandemic, while the deadline was 27 March 2020. The main purpose of this study is to create a map showing systemic risks. They emphasize that the risks in the global financial market increased in correlation with the epidemic. Another finding is that countries with a high number of cases react more to their stocks. Finally, since the economic effects of the epidemic are not completely clear, it paves the way for the formation of uncertain and volatile new markets.

Analyzing the cointegration between financial markets and the epidemic, Gunay (2020) first focuses on the volatility of financial markets. He examines the correlation between the stock markets of China, Spain, the UK, the USA, Italy, and Turkey. GARCH and DCC-MVFIGARCH analyzes were performed in the study using the data set between January 3, 2005, and April 3, 2020. The study determines that the stock markets of other countries, except for the Turkish and Chinese stock markets, have experienced structural breaks in this date range.

Crises such as the epidemic brought along some opportunities as well as negative effects. In general, the negative effects of the epidemic are more, but it is seen that some sectors have increased their assets in a short time. Feng et al. (2020)

investigate the positive developments in the US stock markets in their study. They set up scenario analyzes by considering only the news about the epidemic, without using a specific database. According to the findings, it has been determined that companies with more positive news than negative news earn money. In this direction, they show the investors the stocks in which they can invest.

Goker et al. (2020) focus on the effects of the pandemic on Turkey's financial markets in their research. In the study, which included 26 sector indices in Borsa İstanbul in the analysis, they take the index closing prices between January 2, 2019, and April 9, 2020. They use the case study method to include different factors in the analysis. By comparing the cumulative average abnormal returns of different sectors, they analyze how the sectors reacted to the epidemic. Although there are differences in some time intervals, the three most adversely affected sectors, in general, are textile, sports, and tourism. As a result, investors are moving away from these sectors. On the other hand, they observe positive developments in basic consumption sectors such as chemistry, banking, and food. It is normal for people to turn to basic consumption sectors. Therefore, these sectors have become more attractive for investors.

Another study investigates how Turkey's finance and real sectors were affected by the pandemic. Ozturk et al. (2020) conduct a study to research this. Between January 2 and April 15, 2020, confirmed COVID-19 case numbers in the world, Europe, Turkey, Credit Risk Premium, VIX index, and Chicago Options Exchange data were used. They conduct a panel data analysis and find that all sectors were negatively affected. The service, finance, and industry sectors were affected to approximately the same extent, but differences were identified between the other sectors. While wholesale and retail trade, beverage and food sectors are less affected by the epidemic; transportation, sports, machinery, and insurance sectors are the most affected.

Looking at the literature, most of the research has been done on developed countries. The number of studies investigating how the financial markets of developing countries, including Turkey, are affected by the COVID-19 epidemic is insufficient. Moreover, the scarcity of datasets used in the research was insufficient to explain the effects of the pandemic. We aim to contribute to the literature by using a larger data set and analyzing many different models to better see the effects of the epidemic on the Turkish stock market. We also take into account the possible structural break(s) in the series.

2.2. METHODOLOGY

While investigating the effects of the COVID-19 pandemic on the Turkish stock markets, the stationarity levels of the time series to be used first were determined. Augmented Dickey-Fuller and Philips-Perron tests are performed for unit root analysis that does not take into account structural breaks. However, structural breaks may exist in the series. To this end, we also employ, Zivot-Andrews unit root test that takes structural breaks into account. Then, VAR analysis was performed to determine how the series were affected by each other and the Impulse-Response functions were examined. Granger Causality Test was used for the causality relationship between dependent and independent variables. All tests were conducted for twenty-five models installed. First, econometric analyzes to be used in the study are explained.

2.2.1. Augmented Dickey-Fuller Test

The conventional Dickey-Fuller (DF) Test was developed by David Dickey and Wayne Fuller (1979). This test rests on the weak or covariance stationary concepts are used in time series analysis. There are three conditions for weak stationarity. A Y_t time series becomes stationary when all conditions are satisfied. The three conditions are as follows:

$E(y_t) = \mu$ Equation 1

$Var(y_t) = \sigma^2$ Equation 2

$Cov(y_t, y_{t-k}) = \rho_k$ Equation 3

Equation 1 states that the mean of the series is constant over time, Equation 2 states that the variance is constant over time, Equation 3 states that the covariance of the time series with its lag value is independent of time and depends only on the lag length. Stationarity is determined by the random walk process. In Equation 4, random walk without constant term and trend is defined for ϕ=1. "ε_t"~$iid(0, \sigma^2)$

$y_t = \phi y_{t-1} + \varepsilon_t$ Equation 4

If ϕ=1, the series is non-stationary

If ϕ<1, the series is stationary

The DF test uses the first difference of the random walk shown in Equation 4. In Equation 4, if "y_{t-1}" is subtracted from both sides of the equation, Equation 5 is obtained.

$\Delta y_t = \delta y_{t-1} + \varepsilon_t$ Equation 5

$\Delta y_t = \mu + \delta y_{t-1} + \varepsilon_t$ Equation 6

$\Delta y_t = \mu + \beta t + \delta y_{t-1} + \varepsilon_t$ Equation 7

The model obtained in Equation 5 is the model without constant term and trend. Equation 6 refers to the model in which the constant term is found, and Equation 7 refers to the model in which both the constant term and the trend are found.

If there is a unit root in the series; $\delta = 1-\phi = 0$ (ϕ=1)

If the series is stationary; $\delta = 1-\phi < 0$ (ϕ<1)

The hypotheses used in the DF test are expressed as follows:

H_0: $\delta = 0$ There is a unit root and the series is non-stationary.

H_1: $\delta < 0$ There is no unit root and the series is stationary.

The test statistic used for these hypotheses: $t_\delta = \hat{\delta} / S_{\hat{\delta}}$. Dickey and Fuller proved that this test statistic does not show the t-distribution and produced new critical values. MacKinnon (1991, 1996) produced critical values by performing extensive simulations.

As seen in Equations 5, 6, 7, the Autoregressive (AR(1)) process is used in the DF test. If there is a higher-order correlation in the time series, the error term loses its white noise feature. To eliminate this problem, the ADF test uses the AR(p) process. The "p" lagged difference terms are added to the equation. As a result, Equation 8 with no constant term and trend, Equation 9 with constant term and, Equation 10 with constant term and trend are obtained.

$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{P} \beta_i \Delta y_{t-i} + \varepsilon_t$ Equation 8

$\Delta y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{P} \beta_i \Delta y_{t-i} + \varepsilon_t$ Equation 9

$\Delta y_t = \mu + \beta t + \delta y_{t-1} + \sum_{i=1}^{P} \beta_i \Delta y_{t-i} + \varepsilon_t$ Equation 10

The hypotheses used for these equations are the same as the standard DF hypotheses. If the calculated test statistic is less than the critical value, the null hypothesis is rejected.

2.2.2. Philips-Perron Test

Phillips and Perron (1988) developed an alternative non-parametric method that controls the serial correlation in the unit root analysis process. The Phillips-Perron (PP) test rests on the DF equations shown in Equations 5, 6, and 7. By developing the "t_δ" statistics, PP test ensures that the asymptotic distribution was not affected by the serial correlation.

$$\tilde{t}_\delta = t_\delta \left(\frac{\gamma_0}{f_0}\right)^{\frac{1}{2}} - \frac{T(f_0-\gamma_0)s_{\hat{\delta}}}{2f_0^{\frac{1}{2}}s} \qquad \text{Equation 11}$$

In Equation 11, "$\hat{\delta}$" denotes the estimator, "t_δ" represents the DF statistic, "$s_{\hat{\delta}}$" is the standard error, "s" represents the standard error of regression, "γ_0" estimator of error variance (where k is the number of an independent variable (T-k)s^2/T obtained), "f_0" stands for residual spectrum at frequency zero.

The hypotheses used in the PP test are expressed as follows:

H_0: $\delta = 0$ There is a unit root and the series is non-stationary.

H_1: $\delta < 0$ There is no unit root and the series is stationary.

The asymptotic distribution of the PP test is the same as the ADF test. If the calculated test statistic is less than the critical value, the null hypothesis is rejected.

2.2.3. Zivot-Andrews Test

Zivot and Andrews (1992), who argue that there may be internally determined structural breaks in time series and that these breaks will affect stationarity, used a dummy variable for structural breaks. If the start point of the time series is expressed as T1, break time TB, and endpoint as T_N, its representation will be $T_1<T_B<T_N$. The dummy variables used in the study are shown as follows:

$$D_U = \begin{cases} 1 & \text{if } t>T_B \\ 0 & \text{other} \end{cases} \qquad D_T = \begin{cases} t-T_B & \text{if } t>T_B \\ 0 & \text{other} \end{cases}$$

"D_U" represents the break in the mean of the series. "D_T" is used in the model to indicate the date of the break in the time series. Zivot and Andrews (ZA) test rest on the ADF test. The following models including dummy variables are estimated to test for unit root with an endogeneous structural break.

Model A: $y_t = \mu + \beta t + \theta DU(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} C_i \Delta y_{t-i} + \varepsilon_t$ Eq. 12

Model B: $y_t = \mu + \beta t + \gamma DT_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} C_i \Delta y_{t-i} + \varepsilon_t$ Eq. 13

Model C: $y_t = \mu + \beta t + \theta DU(T_b) + \gamma DT_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} C_i \Delta y_{t-i} + \varepsilon_t$ Eq. 14

There is no autocorrelation problem between the error terms, and it is normally distributed. "ΔY_{t-i}" was added to the model to eliminate the autocorrelation problem of error terms. "t" stands for time. Model A represents a break in intercept, Model B represents a break in trend, Model C represents a break in both.

The hypotheses used in the ZA test are expressed as follows:

H_0: There is a unit root and the series is non-stationary.

H_1: There is no unit root and the series is stationary.

If $\alpha = 0$, the null hypothesis (H_0) cannot be rejected, there is a unit root.

2.2.4. Vector Autoregression Model

In the method developed by Sims (1980), the relationship between multiple time series is analyzed by generalizing univariate autoregressive (AR) models. In the established model, lagged values of all variables, including the dependent variable's own lagged values, are used. The exogeneity or endogeneity between the dependent and independent variables used in the model is not certain.

VAR(p) model with p lagged for k stationary time series can be denoted as below:

$$y_t = A_1 y_t + \cdots + A_P y_{t-p} + Cx_t + \varepsilon_t \qquad \text{Eq. 15}$$

- $y_t = (y_{1t}, y_{2t}, \ldots, y_{kt})$, k x 1 vector of endogeneity,
- $x_t = (x_{1t}, x_{2t}, \ldots, x_{dt})$, d x 1 vector of exogeneity,
- $A_1, \ldots, A_p$, k x k coefficients matrix of lagged variables,
- C, k x d coefficients matrix of exogeneity,
- $\varepsilon_t = (\varepsilon_{1t} + \varepsilon_{2t} + \ldots + \varepsilon_{kt})$, $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon'_t) = \sum_\varepsilon$, $E(\varepsilon_t \varepsilon'_s) = 0$ $(t \neq s)$ is the one-dimensional error vector.

In Equation 15, the standard VAR is defined as only lagged values on the right side of the equation. The equation will be estimated by the OLS method.

In Equation 15, if k=2, p=1 VAR(1) model:

$$y_{1t} = \alpha_{11} y_{1t-1} + \alpha_{12} y_{2t-1} + c_1 + \varepsilon_{1t} \qquad \text{Equation 16}$$

$$y_{2t} = \alpha_{21} y_{1t-1} + \alpha_{22} y_{2t-1} + c_2 + \varepsilon_{2t} \qquad \text{Equation 17}$$

Matrix format:

$$\begin{pmatrix} y_1 t \\ y_2 t \end{pmatrix} = \begin{pmatrix} \alpha_{11} & a_{12} \\ \alpha_{21} & \alpha_{22} \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \end{pmatrix} + \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} \varepsilon_1 t \\ \varepsilon_2 t \end{pmatrix} \qquad \text{Equation 18}$$

$$y_t = \begin{pmatrix} y_1 t \\ y_2 t \end{pmatrix}, A_1 = \begin{pmatrix} \alpha_{11} & a_{12} \\ \alpha_{21} & \alpha_{22} \end{pmatrix}, C = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix}, \varepsilon_t = \begin{pmatrix} \varepsilon_1 t \\ \varepsilon_2 t \end{pmatrix}$$

For k variables, p lagged value:

$$y_{1t} = \alpha_{11}^1 y_{1t-1} + \ldots + \alpha_{1k}^1 y_{kt-1} + \ldots + \alpha_{11}^p y_{1t-p} + \ldots + \alpha_{1k}^p y_{kt-p} + c_1 + \varepsilon_{1t} \qquad \text{Equation 19}$$

$$y_{2t} = \alpha_{21}^1 y_{1t-1} + \ldots + \alpha_{2k}^1 y_{kt-1} + \ldots + \alpha_{21}^p y_{1t-p} + \ldots + \alpha_{2k}^p y_{kt-p} + c_2 + \varepsilon_{2t} \qquad \text{Equation 20}$$

$$y_{kt} = \alpha_{\kappa 1}^1 y_{1t-1} + \ldots + \alpha_{kk}^1 y_{kt-1} + \ldots + \alpha_{k1}^p y_{1t-p} + \ldots + \alpha_{kk}^p y_{kt-p} + c_k + \varepsilon_{kt} \qquad \text{Equation 21}$$

Matrix format:

$$\begin{pmatrix} y_1t \\ y_{2^t} \\ \cdots \\ y_{k^t} \end{pmatrix} = \begin{pmatrix} \alpha_{11}^1 \dots & \alpha_{1_k}^1 \\ \cdots & \cdots \\ \alpha_{k_1}^1 \dots & \alpha_{kk}^1 \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \\ y_{kt-1} \end{pmatrix} + \dots + \begin{pmatrix} \alpha_{11}^p \dots & \alpha_{1_k}^p \\ \cdots & \cdots \\ \alpha_{k_1}^p \dots & \alpha_{kk}^p \end{pmatrix} \begin{pmatrix} y_{1t-p} \\ y_{2t-p} \\ \cdots \\ y_{kt-p} \end{pmatrix} + \begin{pmatrix} c_1 \\ c_2 \\ \cdots \\ c_k \end{pmatrix} + \begin{pmatrix} \varepsilon_1 t \\ \varepsilon_{2^t} \\ \cdots \\ \varepsilon_k t \end{pmatrix} \quad \text{Eq. 22}$$

The lagged values of y_{1t} affect the variable y_{2t}, the lagged values of y_{2t} affect the variable y_{1t}. Since there are only lagged values of the variables on the right side of the equation in Equations 16 and 17, the analysis results should be consistent with the result to be found by the OLS method. As a result, in the model with two-time series y_{1t} and y_{2t}, it is checked whether the movement of the y_{1t} (y_{2t}) series in a certain time is affected by the present and past values of the y_{2t} (y_{1t}) series.

2.2.5. Auto-Regressive Distributed Lag

Pesaran et al. (2001) established an autoregressive distributed lag (ARDL) model, which gives robust results even if the time series is stationary in level or in the first difference to detect the cointegration relationship in their study. ARDL approach has statistically better features. It gives more reliable results in small samples.

The model with the "y" dependent variable and two independent variables (h, k) is given in Equation 16.

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{i^1} \Delta y_{t-i} + \sum_{i=0}^{m} \alpha_{i^2} \Delta k_{t-i} + \sum_{i=0}^{m} \alpha_{i^3} \Delta h_{t-i} + \alpha_4 y_{t-1} + \alpha_5 k_{t-1} + \alpha_6 h_{t-1} + \varepsilon_t \quad \text{Eq. 23}$$

It is determined that the variables are I(0) or I(1). Appropriate lag is selected where the statistical criteria of Akaike (AIC) and Schwarz (SIC) have the lowest value and there is no autocorrelation problem.

H_0: $B_1=B_2=0$ There is no cointegration.

H_1: $B_1 \neq B_2 \neq 0$ There is cointegration.

If F statistic > F upper bound; H_0 is rejected and there is cointegration.

If F statistic < F lower bound; H_0 is accepted and there is no cointegration.

If F lower bound < F statistic < F upper bound; unstable region.

2.2.6. Impulse-Response Function

Impulse-Response functions are used to estimate how a shock to any variable translates into responses in the system.

To reveal impulse-response functions, first, the suitable VAR model for the series should be determined. Then, when a one unit shock is given to any of the series, the Impulse-Response function is checked to analyze how the other series respond to this shock. By determining the number of periods themselves, researchers can periodically analyze the effect of a one-unit shock in a series on other series with graphics.

If the Impulse-Response function with y and z two variables is written in matrix format:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{pmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{pmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_1 t \\ e_2 t \end{bmatrix} \qquad \text{Equation 24}$$

If the moving average is written for the $\{\varepsilon_{yt}\}$ and $\{\varepsilon_{zt}\}$:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{pmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{pmatrix} \begin{bmatrix} \varepsilon_{yt-1} \\ \varepsilon_{zt-1} \end{bmatrix} \qquad \text{Equation 25}$$

or $x_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i}$

This moving average equation is for measuring the interaction between the y and z series. ϕ_i represents coefficients, $\{\varepsilon_{yt}\}$ and $\{\varepsilon_{zt}\}$represents shocks. The cumulative effects of the ε_{yt} and/or ε_{zt} term are obtained from the sum of the appropriate coefficients of the indices of the impulse-response functions. For example, it should be known that the effect of ε_{zt} change on y_{t+n} after n periods is ϕ_{12}(n). Therefore, the cumulative sum of the effects of the ε_{zt} series on the y_t series after n periods is $\sum_{i=0}^{n} \phi_{12}$(i). n → ∞, the long-term effect multiplier is obtained. Since y_t and z_t series are considered stationary, the sum of $\sum_{i=0}^{\infty} \phi_{jk}^2$(i) is finite for all cases. Plotting the impulse-response function (the coefficients ϕ_{jk}(i)) is used to explain the various jumps in the series and to see the responses of the series.

2.2.7. Granger Causality Test

In economic studies, the causality relationship between the variables is made with the help of causality tests. Granger (1969) emphasized that causality can be made between stationary series in his study. The basic principle of the method is to increase the predictive power of the other variable by adding the previous values of one variable to the model. The Granger causality equations for the two variables x and y are given below:

$$y_t + \alpha_0 x_t = \delta_1 + \sum_{i=1}^{n} \alpha_i x_{t-i} + \sum_{k=1}^{m} \theta_k y_{t-k} + \varepsilon_{yt} \quad \text{Equation 26}$$

$$x_t + \nu_0 x_t = \delta_2 + \sum_{j=1}^{n} \gamma_i x_{t-i} + \sum_{k=1}^{m} \nu_k y_{t-k} + \varepsilon_{xt} \quad \text{Equation 27}$$

If $\alpha_0 = \upsilon_0 = 0$, causality model is valid.

The hypotheses used in the Granger causality test are expressed as follows:

H_0: $\sum_{i=1}^{n} \alpha_i = 0$; x_t is not the cause of y_t

H_1: $\sum_{i=1}^{n} \alpha_i \neq 0$; x_t is the cause of y_t

There are four possible results from the causality test:

1. x is the Granger cause of y,
2. Y is the Granger cause of x,
3. There is no Granger causality between x and y,
4. There is bidirectional Granger causality between x and y.

2.3. DATA AND DESCRIPTIVE STATISTICS

In this study, we use daily data over the period April 8, 2020: March 22, 2021. The reason for choosing April 8 as the starting date is that the number of people who have recovered from the COVID-19 virus in Turkey has been announced since that date. To prevent data loss, other variables were taken from this date as well. The daily closing prices of BIST-100, BIST-Financial, BIST-Services, BIST-Industry indices are taken from the Borsa Istanbul (BIST) data system. The daily closing price of the BIST-30 index is taken from the investing.com website. Return series is defined as the price change or percentage change of a series over a certain time. Real investors usually invest by tracking stock returns, not stock prices.

Therefore, indices have been converted to return form so that the analyzes can be done in line with the literature.

In line with our hypotheses, we use the number of cases, the number of deaths, the number of recoveries to represent the impact of the COVID-19 pandemic. These series are taken from the data system of the Ministry of Health of the Republic of Turkey. We use the growth rate of these variables by taking log differences. Daily data on COVID-19 is released in the evening. Since the stock market is closed in this period, its impact is examined the next day. To eliminate this problem, a lagged value of Turkey’s data on COVID-19 was used. The positive and negative news from the worldwide COVID-19 cases can be considered as a source of shocks to the financial markets. To this end, we controlled for the number of new cases in the world and the number of new cases in Europe. We have included these variables also as the rate of increase. These data are taken from the World Health Organization data system.

TL/US Dollar exchange rate and weighted average interest rate, which are among the other independent variables in our study, were taken from CBRT Electronic Data Distribution System. The closing price of gold (in grams) is taken from the World Gold Council data system. The closing price of the VIX index, also known as the fear index, was obtained from the investing.com website. We have included the growth rate/return value of these variables in the analysis. The data and variables are described in Table 1 below:

Table 1: Description of Variables

Dependent Variables		
		Source
1 *returnbist100*	$\ln(bist100_{i,t}/bist100_{i,t-1})$	Borsa Istanbul
2 *returnbist30*	$\ln(bist30_{i,t}/bist30_{i,t-1})$	investing.com
3 *returnfinancial*	$\ln(financial_{i,t}/financial_{i,t-1})$	Borsa Istanbul
4 *returnservices*	$\ln(services_{i,t}/services_{i,t-1})$	Borsa Istanbul
5 *returnindustry*	$\ln(industry_{i,t}/industry_{i,t-1})$	Borsa Istanbul
Independent Variables		
6 *trcases*	Growth rate in the number of confirmed Covid-19 cases - TR	Ministry of Health (Turkey)
7 *trdeaths*	Growth rate in the number of confirmed Covid-19 deaths - TR	Ministry of Health (Turkey)
8 *trrecovery*	Growth rate in the number of confirmed Covid-19 recovery - TR	Ministry of Health (Turkey)
9 *worldcases*	Growth rate in the number of confirmed Covid-19 cases - World	World Health Organization
10 *eucases*	Growth rate in the number of confirmed Covid-19 cases - Europe	World Health Organization
11 *dollar*	TL/US dollar exchange rate return	Electronic Data Delivery System (EVDS)
12 *gold*	Gram price return of gold in TL	World Gold Council
13 *vix*	Fear index return	investing.com
14 *interestrate*	Growth rate of weighted average interest rate	Electronic Data Delivery System (EVDS)

Table 1 shows all the variables used in the study in detail. The measures defining the statistical general characteristics of the data set we used in the study are presented in Table 2.

Table 2: Descriptive Statistics

	Variable	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Obs.
1	*returnbist100*	0.0018	0.0035	0.0381	-0.0979	0.0148	-1.7003	12.0093	239
2	*returnbist30*	0.0012	0.0026	0.0410	-0.0995	0.0153	-1.3265	10.7259	239
3	*returnfinancial*	0.0015	0.0020	0.0528	-0.0980	0.0174	-0.9668	8.1876	239
4	*returnservices*	0.0016	0.0026	0.0466	-0.0957	0.0138	-1.6650	13.2849	239
5	*returnindustry*	0.0033	0.0041	0.0450	-0.0966	0.0148	-1.8699	12.6351	239
6	*trcases*	0.0243	0.0068	4.2844	-0.3972	0.2968	12.4166	179.1551	239
7	*trdeaths*	0.0069	0.0106	0.3846	-0.3542	0.1017	0.2821	5.0867	239
8	*trrecovery*	0.0474	0.0171	4.1059	-0.5506	0.3359	7.8026	91.4208	239
9	*worldcases*	0.0194	0.0246	0.4192	-0.4095	0.1478	-0.2809	3.3389	239
10	*eucases*	0.0298	0.0219	1.5674	-0.4536	0.2154	1.6793	13.2584	239
11	*dollar*	0.0007	0.0005	0.0807	-0.0536	0.0107	1.0946	18.6439	239
12	*gold*	0.0009	0.0017	0.0816	-0.0884	0.0151	-0.9341	13.2608	239
13	*vix*	-0.0005	-0.0126	0.6164	-0.1881	0.0862	2.7609	17.897	239
14	*interestrate*	0.0037	0.0001	0.1939	-0.1380	0.0371	0.9951	9.6470	239

Note: Skewness (>0 skewed right, =0 symmetric, <0 skewed left). Kurtosis (>3 heavier, =3 normal, <3 lighter)

Among the variables included in the analysis, *returnbist100*, *returnbist30*, *returnfinancial*, *returnservices*, *returnindustry*, *worldcases*, and *gold* variables show a left-skewed structure. The variables *trcases*, *trdeaths*, *trrecovery*, *eucases*, *dollar*, *vix*, and *interestrate* have a right-skewed structure. The volatility indicator of the series is the standard deviation value and the *trrecovery* variable has the highest volatility level. The kurtosis coefficient is an indicator of the tail distribution of the series and all the variables have heavier tails than normal. By checking the standard deviations, we realize that variables representing the impact of the COVID-19 pandemic have the highest volatility over the sample period.

2.4. EMPIRICAL RESULTS

Table 3: Unit Root Tests without Structural Break

Variable	ADF (I_0)		PP (I_0)	
	Intercept	Intercept& Trend	Intercept	Intercept& Trend
returnbist100	-13.906*	-13.966*	-13.917*	-13.944*
returnbist30	-13.547*	-13.611*	-13.547*	-13.615*
returnfinancial	-13.891*	-13.942*	-13.826*	-13.899*
returnservices	-12.090*	-12.352*	-12.090*	-12.330*
returnindustry	-14.927*	-14.946*	-14.912*	-14.928*
trcases	-14.837*	-14.843*	-14.834*	-14.839*
trdeaths	-8.023*	-7.993*	-16.270*	-16.250*
trrecovery	-14.876*	-14.835*	-14.887*	-14.845*
worldcases	-1.773	-1.520	-29.378*	-29.484*
eucases	-3.948*	-4.042*	-24.778*	-28.099*
dollar	-9.620*	-9.578*	-13.154*	-13.111*
gold	-10.334*	-10.432*	-15.138*	-15.242*
vix	-17.773*	-17.730*	-18.581*	-18.527*
interestrate	-15.186*	-15.146*	-19.134*	-19.114*

Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively. Critical t values based on MacKinnon (1991). Automatic lag selection for the Augmented Dickey-Fuller unit root test is determined using SIC (Schwarz Information Criteria). Bandwidth for Phillips Perron unit root test is determined according to Bartlett Kernel. I(0) represents a level.

We first apply the conventional ADF unit root test to check for the stationary of the series. The results are reported in Table 3, below. The figures in the first two columns indicate that *returnbist100*, *returnbist30*, *returnfinancial*, *returnservices*, *returnindustry*, and *trcases*, *trdeaths*, *trrecovery*, *eucases*, *dollar*, *gold*, *vix*, *interestrate* series are stationary in the level. However, since we cannot reject the null hypothesis of unit root, we find that *worldcases* is not stationary. To check for the robustness of the ADF unit root test results, we also apply the PP unit root test. The last two columns of Table 3 indicate that all series are stationary at their level.

We have also checked the stationarity properties of the series through unit root with structural break tests. We have employed the ZA test to endogenously detect any structural breaks in the series. The finding indicates that the series is all stationary with a structural break. We understand that the growth rate of the number of world cases series is stationary with a structural break in contrast to our finding in the ADF test. Hence, we can conclude that the structural break in this series has led to a false unit root in the ADF test. The results are reported in Table 4, below.

Table 4: Unit Root Test with Structural Break

Variable	Zivot and Andrews (ZA) I_0		
	k	t-statistics	break date
returnbist100	2	-8.633*	02/11/2020
returnbist30	2	-8.240*	29/10/2020
returnfinancial	2	-9.592*	05/11/2020
returnservices	2	-8.194*	29/10/2020
returnindustry	2	-8.335*	30/10/2020
trcases	1	-11.552*	01/12/2020
trdeaths	2	-6.568*	08/06/2020
trrecovery	1	-11.144*	17/12/2020
worldcases	2	-17.148*	11/01/2021
eucases	2	-15.677*	27/10/2020
dollar	2	-9.157*	09/11/2020
gold	2	-9.705*	09/11/2020
vix	1	-11.134*	30/10/2020
interestrate	2	-12.844*	06/07/2020

Note: Critical value at the 1 percent significance level is -5.57 (Zivot and Andrews, 1992). *denote the rejection of the H_0 hypothesis at a 1 percent level. I(0) represents a level.

According to the results of unit root tests, which take structural breaks into account and do not take them into account, it has been determined that the series are stationary at the level.

After determining the stationarity degrees of the series as I(0), to investigate the relationship among the variables, we first employ the VAR model. While estimating the VAR model, it is very important to choose the appropriate lag value. If an incorrect lag number is selected, the estimation of the parameters will give an incorrect result. Among the many information criteria in the literature, Akaike Information Criterion (AIC) and Schwarz Criterion (SC) are used the most, and the number of lags with the smallest value is selected. In all the models we created for the VAR analysis in the study, both information criteria indicate that optimal lag length is “0”. We also employ ARDL analysis to check the robustness of the results. After estimating the VAR and ARDL models, we estimate the Granger Causality Test to determine the direction and source of this relationship. We then provide Impulse-Response Model estimations to analyze the impact of a shock on a variable to the system.

First, we use, *returnbist100* a dependent variable and estimate the following five models:

Model 1: $returnbist100_t = \alpha_0 + \alpha_1 t + \alpha_2 trcases_{t-1} + \alpha_3 interestrate_t + \alpha_4 vix_t + \alpha_5 gold_t + \varepsilon_t$

Model 2: $returnbist100_t = \beta_0 + \beta_1 t + \beta_2 trdeaths_{t-1} + \beta_3 interestrate_t + \beta_4 vix_t + \beta_5 gold_t + \varepsilon_t$

Model 3: $returnbist100_t = \theta_0 + \theta_1 t + \theta_2 trrecovery_{t-1} + \theta_3 interestrate_t + \theta_4 vix_t + \theta_5 gold_t + \varepsilon_t$

Model 4: $returnbist100_t = \gamma_0 + \gamma_1 t + \gamma_2 trcases_{t-1} + \gamma_3 interestrate_t + \gamma_4 worldcases_t + \gamma_5 dollar_t + \gamma_6 vix_t + \varepsilon_t$

Model 5: $returnbist100_t = \phi_0 + \phi_1 t + \phi_2 trcases_{t-1} + \phi_3 interestrate_t + \phi_4 eucases_t + \phi_5 dollar_t + \phi_6 vix_t + \varepsilon_t$

VAR analysis was performed to determine the dynamic relationship between the variables in the established models. We use the lagged values and estimate all series simultaneously to then when a one-unit shock is applied to the independent variables in the model, Impulse-Response graphs are examined to determine the response of the dependent variable to these shocks.

Table 5: VAR Models for *returnbist100*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
trcases(-1)	-0.006** (0.003)			-0.005*** (0.003)	-0.005** (0.003)
trdeaths(-1)		0.017** (0.009)			
trrecovery(-1)			0.002 (0.002)		
worldcases				-0.007 (0.005)	
eucases					0.002 (0.004)
interestrate	-0.041*** (0.024)	-0.050** (0.024)	-0.046** (0.024)	-0.035 (0.022)	-0.033 (0.022)
dollar				-0.722* (0.073)	-0.715* (0.073)
vix	-0.042* (0.010)	-0.043* (0.010)	-0.042* (0.010)	-0.029* (0.009)	-0.029* (0.009)
gold	-0.434* (0.056)	-0.443* (0.058)	-0.428* (0.056)		
constant	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.005* (0.002)	0.005* (0.002)
trend	-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.280	0.279	0.269	0.361	0.357
Adj. R-squared	0.264	0.263	0.253	0.344	0.340
F-statistic	17.433* [0.001]	17.359* [0.001]	16.503* [0.001]	21.027* [0.001]	20.628* [0.001]
Diagnostic Tests					
Serial Correlation LM	3.556 [0.061]	0.376 [0.540]	1.503 [0.222]	0.141 [0.707]	0.112 [0.738]
Heteroskedasticity	1.943 [0.055]	2.546* [0.021]	3.154* [0.001]	1.527 [0.159]	1.867 [0.076]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses. Probability values are in brackets. The Breusch-Godfrey LM test null hypothesis “no serial correlation at lag 1” cannot be rejected at the 5 percent level. The Harvey test for heteroskedasticity has a null hypothesis of homoskedasticity that cannot be rejected at the 5 percent level.

5 models established for BIST-100 were also significant at %1 level. While the 1 percent increase in increase in the number of cases in Turkey decreased the BIST-100 return by 6 per thousand, the 1 percent increase in the number of deaths increased it by 2 percent. No significant relationship was found for the number of recovered patients. In Table 5, *interestrate*, *vix*, and *gold* variables are used in common in the 1st, 2^{nd,} and 3rd models. A 1 percent increase in the rate of increase in interest rates leads to an average of 4 percent decrease in the BIST-100 index return. A 1 percent increase in the VIX index return causes an average of 4 percent decreases in the BIST-100 return in all three models. The 1 percent increase in the

gold return causes the BIST-100 return to decrease by 44 percent on average in the first three models. Looking at Model 4 and Model 5, it is seen that the rate of increase in the number of cases in Turkey reduces the return of BIST-100 by 5 per thousand. BIST-100 return for both models, interest rate decreased by approximately 2 percent, TL/US Dollar exchange rate decreases by 72 percent, and VIX index decreases by 3 percent. Differently, while the rate of increase in the number of cases in the world was used in Model 4, the rate of increase in the number of cases in Europe was used in Model 5. But both were not found to be statistically significant.

It is seen that statistics related to COVID-19 have little effect on BIST-100 return series. The fact that the epidemic continues has a serious impact on the results. Individuals and institutions evaluate their savings in two ways. The first is to get interest income by buying bonds or making deposits in the bank, and the second is to buy stocks. When interest rates increase, the stock market will inevitably be adversely affected. The increase in the VIX index, which reflects the fear and anxiety in the markets, is an indication that the stock markets may enter into a crisis. It can be seen from the analysis results that the increase in the VIX variable negatively affects the *returnbist100* variable. Since Turkey is a country dependent on foreign financing, stocks have a very strong relationship with the dollar. Due to this strong effect, the *dollar* variable affects *returnbist100* the most among the variables used in the analysis. This situation can be interpreted as foreign investors exiting the market by selling some of their stocks. When there is uncertainty in the stock market, investors turn to other options. If investors want to avoid stock market volatility, they may prefer to invest in gold. In this case, the stock market is adversely affected.

The ARDL model estimation results are reported in Table 6 below:

Table 6: ARDL Models for *returnbist100*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
returnbist100(-1)	-0.042 (0.063)	-0.063 (0.063)	-0.050 (0.063)	-0.070 (0.059)	-0.070 (0.059)
trcases(-1)	-0.006** (0.003)			-0.004*** (0.003)	-0.005*** (0.003)
trdeaths(-1)		0.017*** (0.009)			
trrecovery(-1)			0.002 (0.002)		
worldcases				-0.007 (0.005)	
eucases					0.001 (0.004)
interestrate	-0.041*** (0.024)	-0.049** (0.024)	-0.048* (0.024)	-0.037 (0.022)	-0.033 (0.022)
dollar				-0.731* (0.074)	-0.723* (0.074)
vix	-0.042* (0.010)	-0.043* (0.010)	-0.042* (0.010)	-0.029* (0.009)	-0.029* (0.009)
gold	-0.434* (0.056)	-0.423* (0.056)	-0.431* (0.056)		
constant	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.005* (0.002)	0.005* (0.002)
trend	-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.282	0.279	0.271	0.365	0.361
Adj. R-squared	0.262	0.259	0.252	0.345	0.341
F-statistic	14.568* [0.001]	14.373* [0.001]	13.836* [0.001]	18.252* [0.001]	17.903* [0.001]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses.

Table 6 shows 5 different ARDL models established for *returnbist100*. All of the established models were found to be statistically significant. The results indicate that *trcases(-1)* have a negative and significant impact on the BIST-100 return series, in conformity with our expectations. The number of recoveries in Turkey has a positive but insignificant impact. When we consider the impact of alternative financial variables on BIST-100 return, we find that the US dollar exchange rate has the greatest negative impact whereas gold prices and interest rate series have a negative impact on the BIST-100 return. VIX also has a negative and significant coefficient implying that greater volatility and fear of risk translate into lower returns for BIST-100 firms. When these results are compared with the VAR analysis results, it is seen that they support each other.

Table 7: Pairwise Granger Causality Tests for *returnbist100*

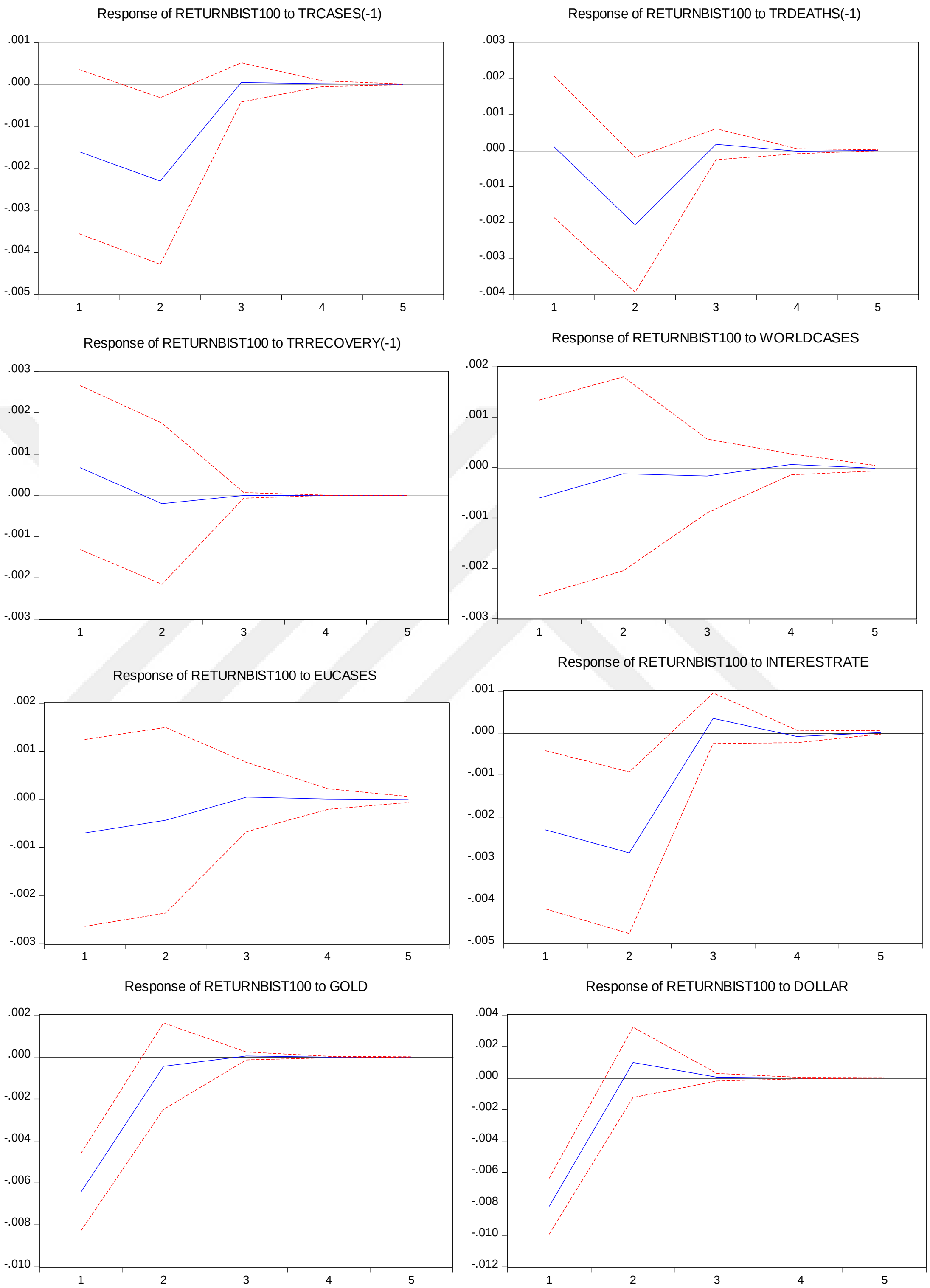
Null Hypothesis	F-Statistic	Prob.	Decision
trcases(-1) does not Granger Cause *returnbist100*	5.850**	0.016	Reject
trdeaths(-1) does not Granger Cause *returnbist100*	4.821**	0.030	Reject
trrecovery(-1) does not Granger Cause *returnbist100*	0.027	0.869	Not reject
worldcases does not Granger Cause *returnbist100*	0.037	0.848	Not reject
eucases does not Granger Cause *returnbist100*	0.123	0.726	Not reject
interestrate does not Granger Cause *returnbist100*	9.354*	0.003	Reject
gold does not Granger Cause *returnbist100*	0.145	0.704	Not reject
dollar does not Granger Cause *returnbist100*	1.066	0.303	Not reject
vix does not Granger Cause *returnbist100*	0.473	0.492	Not reject

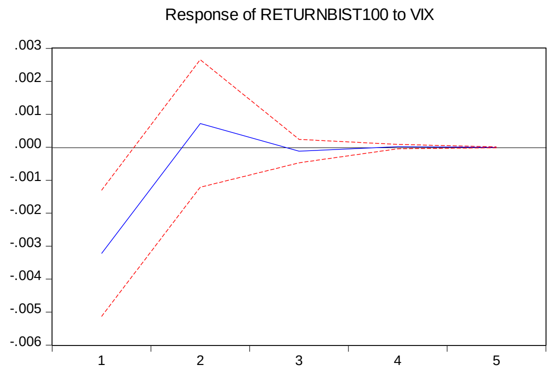
Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively.

Table 7 shows the result of the Pairwise Granger Causality Test, in which *returnbist100* is used as the dependent variable. As seen in the table, the causality test result of *trcases(-1), trdeaths(-1),* and *interestrate* variables were statistically significant. The null hypothesis of all three variables was rejected, and it was concluded that there is a significant causality relationship between *trcases(-1), trdeaths(-1), interestrate,* and *returnbist100* variables. In summary, *trcases(-1), trdeaths(-1), interestrate* Granger causes movement in the *returnbist100* variable. The test results of other variables were not statistically significant.

Then we analyze the response of the BIST-100 return series when a shock is given to each of the independent variables. The solid line in the graphs represent the point estimates, and the dashed lines represent the %95 percent confidence intervals. The time interval we used in the study is divided into 5 equal periods to better understand the Impulse-Response graphs.

Figure 1: Impulse-Response Graphs for returnbist100





It is seen that when a one-unit shock is given to the growth of a number of cases in Turkey, *returnbist100* is negatively affected until the 3rd period, and then becomes ineffective. When one unit shock is given to the increase in the number of deaths, the first two periods indicate a negative reaction, and from the middle of the 3rd period, the effect disappears. When a one-unit shock was given to a lagged value of the increase rate in the number of recovered patients, a positive response was observed in the 1st period, while a negative response was observed in the 2nd period. These results indicate that negative news (i.e. new cases and deaths) about the pandemic have a longer impact on the BIST-100 return than the positive news (recoveries).

When a shock is given to the interest rate, *returnbist100*'s reaction was negative in the 1st and 2nd periods, and positive in the 3rd period. The effect started to disappear from the 4th period. When a one-unit shock is given to the gold yield, the effect disappears after the first two periods of negative reaction. Against the shock to the TL/US Dollar return, *returnbist100* reacted negatively in the 1st and 2nd periods, and then the effect was over. In the face of the shock given to the increase in the number of cases in the world, it is seen that the reaction was negative until the end of the 3rd period and then ended. When a one-unit shock was applied to the increase in the number of cases in Europe, *returnbist100*'s response was negative for the first two periods and then did not respond. Finally, when we look at the VIX index return, a negative reaction was observed in the first period and a positive reaction in the second period. If we look at the graphs collectively, the variables that *returnbist100* gives strong responses are *trcases(-1)*, *trdeaths(-1)*, *interestrate*, *gold*, *dollar*, *vix*. Responses to the variables *trrecovery(-1)*, *worldcases*, and *eucases* are weak.

The graphs support the VAR analysis results. Differently, the *returnbist100* series gave strong responses to the shocks in *trcases*(-1). The variable *trdeaths*(-1), whose coefficient was positive in the VAR analysis, caused the dependent variable to give a negative response in the Impulse-Response graph.

Second, we use, returnbist30 a dependent variable and estimate the following five models:

Model 1: $returnbist30_t = \alpha_0 + \alpha_1 t + \alpha_2 trcases_{t-1} + \alpha_3 interestrate_t + \alpha_4 vix_t + \alpha_5 gold_t + \varepsilon_t$

Model 2: $returnbist30_t = \beta_0 + \beta_1 t + \beta_2 trdeaths_{t-1} + \beta_3 interestrate_t + \beta_4 vix_t + \beta_5 gold_t + \varepsilon_t$

Model 3: $returnbist30_t = \theta_0 + \theta_1 t + \theta_2 trrecovery_{t-1} + \theta_3 interestrate_t + \theta_4 vix_t + \theta_5 gold_t + \varepsilon_t$

Model 4: $returnbist30_t = \gamma_0 + \gamma_1 t + \gamma_2 trcases_{t-1} + \gamma_3 interestrate_t + \gamma_4 worldcases_t + \gamma_5 dollar_t + \gamma_6 vix_t + \varepsilon_t$

Model 5: $returnbist30_t = \phi_0 + \phi_1 t + \phi_2 trcases_{t-1} + \phi_3 interestrate_t + \phi_4 eucases_t + \phi_5 dollar_t + \phi_6 vix_t + \varepsilon_t$

Table 8: VAR Models for *returnbist30*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
trcases(-1)	-0.006**			-0.005	-0.005***
	(0.003)			(0.003)	(0.003)
trdeaths(-1)		0.020**			
		(0.009)			
trrecovery(-1)			0.002		
			(0.003)		
worldcases				-0.002	
				(0.006)	
eucases					0.003
					(0.004)
interestrate	-0.039	-0.048**	-0.044***	-0.032	-0.029
	(0.025)	(0.024)	(0.025)	(0.023)	(0.023)
dollar				-0.762*	-0.763*
				(0.077)	(0.077)
vix	-0.038*	-0.039*	-0.037*	-0.023*	-0.023*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
gold	-0.465*	-0.476*	-0.459*		
	(0.058)	(0.058)	(0.058)		
constant	0.006*	0.006*	0.005*	0.005*	0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
trend	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.274	0.278	0.265	0.353	0.354
Adj. R-squared	0.258	0.261	0.248	0.335	0.337
F-statistic	16.927*	17.207*	16.131*	20.236*	20.373*
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Diagnostic Tests					
Serial Correlation LM	2.370	0.089	0.835	0.441	0.414
	[0.125]	[0.766]	[0.362]	[0.507]	[0.521]
Heteroskedasticity	2.363*	2.923*	2.815*	1.961	2.376*
	[0.031]	[0.009]	[0.012]	[0.062]	[0.023]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses. Probability values are in brackets The Breusch-Godfrey LM test null hypothesis “no serial correlation at lag 1” cannot be rejected at the 5 percent level. The Harvey test for heteroskedasticity has a null hypothesis of homoskedasticity that can not be rejected at the 5 percent level.

Table 8 shows the 5 VAR models installed for *returnbist30*. All of these models were statistically significant. *interestrate*, *vix*, and *gold* variables were used in the first three models. The coefficient values calculated in all three models are approximately equal to each other. A 1% change in the rate of increase in interest rates causes the BIST-30 return to decrease by 4% in all three models. A 1% increase in the *vix* variable causes a 4% decrease, while a 1% increase in the *gold* variable causes a 46% decrease. The difference in the models is the COVID-19 data. The 1 percent increase in the number of cases in Turkey in the 1^{st} model provides a decrease of 6 per thousand in the return of BIST-30. In the second model, it was determined that a 1 percent increase in the *trdeaths(-1)* variable caused a 2 percent positive change. For Model 3, the coefficient of the *trrecovery(-1)* variable was not statistically significant. When Model 4 and Model 5, which are created more comprehensively, are examined, the *trcases(-1)* coefficient in the 4^{th} model is insignificant, while in the 5^{th} model it is negative and significant. A 1% increase in the *trcases(-1)* variable causes the *returnbist30* variable to decrease by 5 per thousand. Interestingly we find that *dollar* has the greatest negative impact on the BIST-30 return. Other variables included in the models were statistically insignificant.

It is understood that the interpretations made in the BIST-100 VAR analysis results can also be made for the BIST-30 return series. It can be thought that investors are afraid of the volatility of stock markets during the COVID-19 pandemic and prefer different investment tools. It is an expected result that there is an inverse relationship between the VIX index and BIST-30 return series. As with the *returnbist100* series, the impact of COVID-19 statistics is weak for *returnbist30*.

The ARDL model estimation results are reported in Table 9 below:

Table 9: ARDL Models for *returnbist30*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
returnbist30(-1)	-0.014 (0.063)	-0.022 (0.063)	-0.023 (0.063)	-0.044 (0.059)	-0.040 (0.060)
trcases(-1)	-0.006** (0.003)			-0.004 (0.003)	-0.004*** (0.003)
trdeaths(-1)		0.019** (0.009)			
trrecovery(-1)			0.002 (0.002)		
worldcases				0.002 (0.006)	
eucases					0.003 (0.004)
interestrate	-0.039 (0.025)	-0.048** (0.024)	-0.045** (0.025)	-0.032 (0.023)	-0.030 (0.023)
dollar				-0.768* (0.077)	-0.768* (0.077)
vix	-0.038* (0.010)	-0.039* (0.010)	-0.037* (0.010)	-0.023* (0.009)	-0.023* (0.009)
gold	-0.466* (0.058)	-0.478* (0.059)	-0.461* (0.059)		
constant	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.005* (0.002)	0.005* (0.002)
trend	-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.274	0.278	0.265	0.354	0.355
Adj. R-squared	0.255	0.258	0.245	0.334	0.335
F-statistic	14.053* [0.001]	14.304* [0.001]	13.412* [0.001]	17.385* [0.001]	17.483* [0.001]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses.

Table 9 shows 5 different ARDL models established for *returnbist30*. All of the established models were found to be statistically significant. It is observed that the increase in the daily number of new cases in Turkey has a negative impact on BIST-30 companies. The effect of the number of recovered patients was found to be positive, but not statistically significant. When we look at gold, another financial investment instrument, it is seen that the returns of BIST-30 have been affected negatively. The increase in the exchange rate dramatically reduces the BIST-30 return series. This shows that BIST-100 companies are directly related to the exchange rate. It is not surprising that the effect of the interest rate is negative and significant. VIX also has a negative and significant coefficient implying that greater volatility and fear of risk translate into lower returns for BIST-30 firms. Considering the statistical significance and coefficients, it is seen that ARDL results are in line with VAR analysis.

Table 10: Pairwise Granger Causality Tests for *returnbist30*

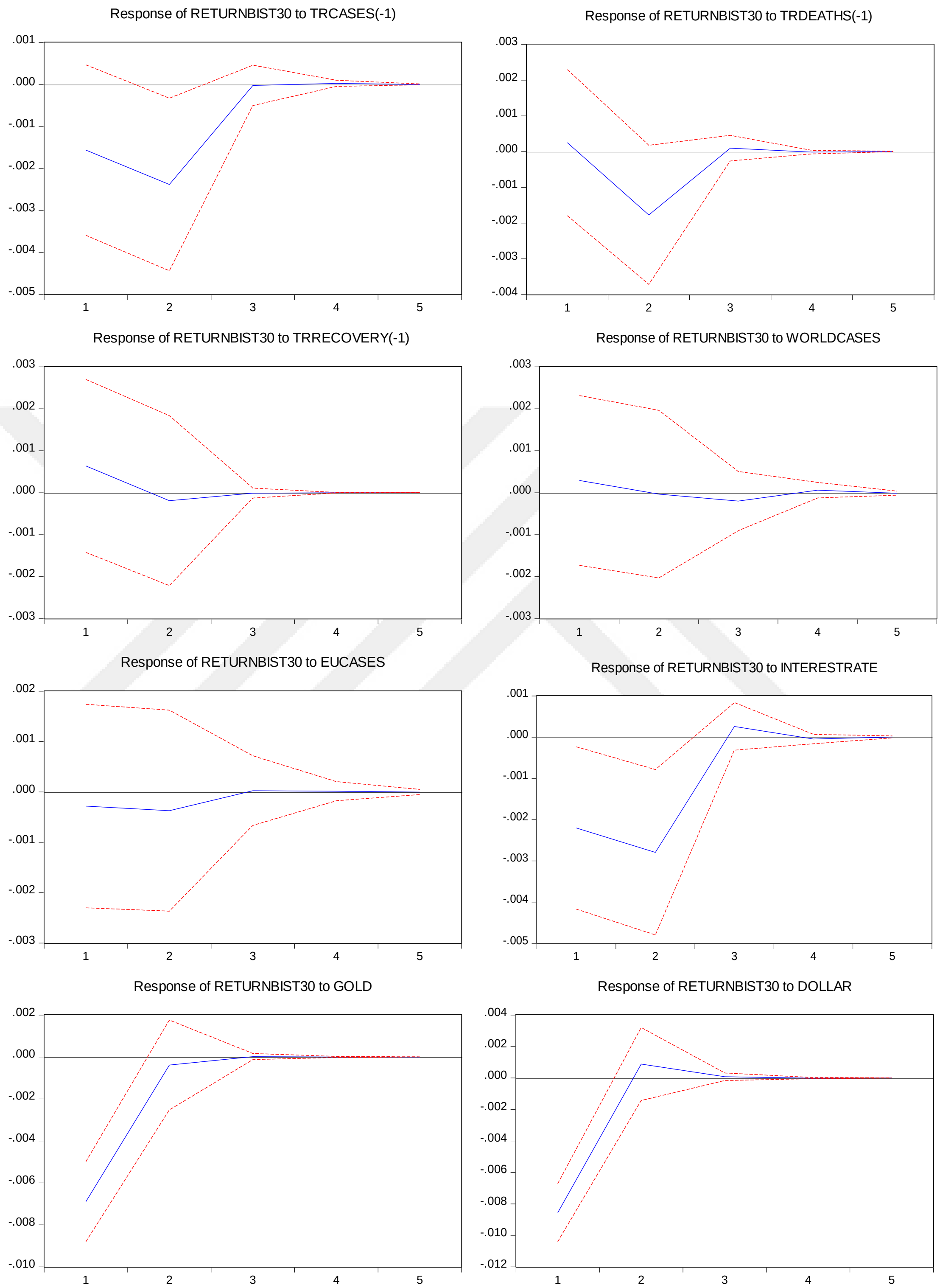
Null Hypothesis	F-Statistic	Prob.	Decision
trcases(-1) does not Granger Cause *returnbist30*	5.609**	0.019	Reject
trdeaths(-1) does not Granger Cause *returnbist30*	3.284***	0.071	Reject
trrecovery(-1) does not Granger Cause *returnbist30*	0.027	0.870	Not reject
worldcases does not Granger Cause *returnbist30*	0.100	0.752	Not reject
eucases does not Granger Cause *returnbist30*	0.047	0.828	Not reject
interestrate does not Granger Cause *returnbist30*	7.843*	0.006	Reject
gold does not Granger Cause *returnbist30*	0.013	0.911	Not reject
dollar does not Granger Cause *returnbist30*	1.277	0.260	Not reject
vix does not Granger Cause *returnbist30*	0.317	0.574	Not reject

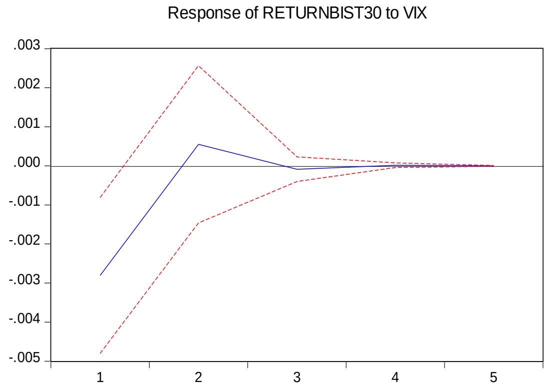
Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively.

Table 10 shows the results of the Pairwise Granger Causality Test, in which *returnbist30* was used as the dependent variable. According to the results, the test statistics of *trcases(-1)*, *trdeaths(-1)*, and *interestrate* variables were significant. The null hypothesis was rejected for all three variables, and it was concluded that there is a significant causality relationship between *trcases(-1)*, *trdeaths(-1)*, *interestrate*, and *returnbist30* variables. In summary, *trcases(-1)*, *trdeaths(-1)*, *interestrate* Granger causes movement in the *returnbist30* variable. The test results of other variables were not statistically significant.

Then we analyze the response of the BIST-30 return series when a shock is given to each of the independent variables. The solid line in the graphs represent the point estimates, and the dashed lines represent the %95 percent confidence intervals. The time interval we used in the study is divided into 5 equal periods to better understand the Impulse-Response graphs.

Figure 2: Impulse-Response Graphs for *returnbist30*





When a standard error shock is given to the *trcases(-1)* variable, the *returnbist30* variable reacts negatively in the 1st and 2nd periods, while this response is extinguished later. When shocked to the *trdeaths(-1)* variable, *returnbist30*'s response was negative in the first two periods, but slightly positive in the 3rd period and disappeared. While the shock in the *trrecovery(1)* series had a positive reaction in the first period and a negative reaction in the second period, this reaction became stable later on. When looking at another variable, *interestrate*, the response of *returnbist30* was negative in the 1st and 2nd periods and positive in the 3rd period. When a standard error shock is given to the *gold* and *dollar* variables, the response of the *returnbist30* variable to the *gold* variable is negative in the first two periods, while the reaction to the *dollar* variable is negative in the first period and positive in the second period. The *returnbist30* variable has a very weak response to *worldcases* and *eucases* variables. While its reaction to the *worldcases* variable was positive in the 1st period and negative in the 2nd period, its reaction to the *eucases* variable was negative in both periods. The effect of a one-unit shock given to the variable *vix* disappears as negative in the first period and positive in the second period.

When Impulse-Response graphs are examined, the variable that the dependent variable responds most to a one-unit shock is the *interestrate* series. When we look at the graphs related to COVID-19, they caused the *returnbist30* series to give strong reactions, although their effects were seen statistically weak.

Third, we use, *returnindustry* a dependent variable and estimate the following five models:

Model 1: $returnindustry_t = \alpha_0 + \alpha_1 t + \alpha_2 trcases_{t-1} + \alpha_3 interestrate_t + \alpha_4 vix_t + \alpha_5 gold_t + \varepsilon_t$

Model 2: $returnindustry_t = \beta_0 + \beta_1 t + \beta_2 trdeaths_{t-1} + \beta_3 interestrate_t + \beta_4 vix_t + \beta_5 gold_t + \varepsilon_t$

Model 3: $returnindustry_t = \theta_0 + \theta_1 t + \theta_2 trrecovery_{t-1} + \theta_3 interestrate_t + \theta_4 vix_t + \theta_5 gold_t + \varepsilon_t$

Model 4: $returnindustry_t = \gamma_0 + \gamma_1 t + \gamma_2 trcases_{t-1} + \gamma_3 interestrate_t + \gamma_4 worldcases_t + \gamma_5 dollar_t + \gamma_6 vix_t + \varepsilon_t$

Model 5: $returnindustry_t = \phi_0 + \phi_1 t + \phi_2 trcases_{t-1} + \phi_3 interestrate_t + \phi_4 eucases_t + \phi_5 dollar_t + \phi_6 vix_t + \varepsilon_t$

Table 11: VAR Models for *returnindustry*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
trcases(-1)	-0.005*** (0.003)			-0.004 (0.003)	-0.005 (0.003)
trdeaths(-1)		0.015 (0.009)			
trrecovery(-1)			0.002 (0.003)		
worldcases				-0.013** (0.006)	
eucases					0.001 (0.004)
interestrate	-0.031 (0.025)	-0.040 (0.025)	-0.037 (0.025)	-0.029 (0.024)	-0.026 (0.025)
dollar				-0.564* (0.080)	-0.556* (0.080)
vix	-0.047* (0.010)	-0.048* (0.010)	-0.046* (0.010)	-0.037* (0.010)	-0.037* (0.010)
gold	-0.330* (0.059)	-0.337* (0.060)	-0.324* (0.059)		
constant	0.007* (0.002)	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)
trend	-0.001 (0.001)	-0.001*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
R-squared	0.199	0.197	0.190	0.264	0.248
Adj. R-squared	0.182	0.179	0.172	0.244	0.227
F-statistic	11.165* [0.001]	10.975* [0.001]	10.526* [0.001]	13.345* [0.001]	12.236* [0.001]
Diagnostic Tests					
Serial Correlation LM	3.063 [0.082]	0.108 [0.743]	0.996 [0.319]	0.134 [0.714]	0.114 [0.736]
Heteroskedasticity	1.592 [0.151]	2.257* [0.039]	1.557 [0.161]	1.630 [0.128]	1.276 [0.263]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses. Probability values are in brackets. The Breusch-Godfrey LM test null hypothesis "no serial correlation at lag 1" cannot be rejected at the 5 percent level. The Harvey test for heteroskedasticity has a null hypothesis of homoskedasticity that cannot be rejected at the 5 percent level.

Table 11 shows the result of models in which the *returnindustry* variable is used as a dependent variable. The test statistics of all models are significant. The coefficient of the *interestrate* variable for the first three models was found to be statistically insignificant. In all three models, when the *vix* variable increases by 1 percent, the *returnindustry* variable decreases by 5 percent, and when the *gold* variable increases by 1 percent, it decreases by 33 percent. In the first model, the 1 percent increase in the *trcases(-1)* variable, the coefficient of which is statistically significant, causes the dependent variable to decrease by 5 per thousand. The coefficient of *trdeaths(-1)* and *trrecovery(-1)* independent variables were statistically insignificant. Considering Models 4 and 5, the coefficients of the COVID-19 data and the coefficients of the *interestrate* variables were found to be significant. In Model 4, when the rate of increase in the number of cases in the world increases by 1 percent, the *returnindustry* variable decreases by 1 percent. The coefficient of the *eucases* variable was found to be insignificant. In both models, when the *dollar* variable increases by 1 percent, the dependent variable decreases by 56 percent, and when the *vix* variable increases by 1 percent, it decreases by 4 percent.

It should not be overlooked that the *worldcases* variable is statistically significant here. Since industrial activities will be directly affected by all world markets, the increase in the number of COVID-19 cases in the world has negatively affected the *returnindustry* variable. The exchange rate has many effects on the assets, resources, income and, expenses of companies in micro terms, and on the general economy in macro terms. The increase in the exchange rate causes firms to lose value and increase their external debt liabilities. Considering the companies operating in the BIST-Industry index, it is inevitable that they will be negatively affected by this situation.

The ARDL model estimation results are reported in Table 12 below:

Table 12: ARDL Models for *returnindustry*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
returnindustry(-1)	-0.109 (0.066)	-0.112 (0.066)	-0.112 (0.066)	-0.120 (0.063)	-0.126 (0.064)
trcases(-1)	-0.005*** (0.003)			-0.004 (0.003)	-0.004 (0.003)
trdeaths(-1)		0.014 (0.009)			
trrecovery(-1)			0.002 (0.002)		
worldcases				-0.013** (0.006)	
eucases					0.001 (0.004)
interestrate	-0.034 (0.025)	-0.042 (0.025)	-0.039 (0.025)	-0.031 (0.024)	-0.029 (0.024)
dollar				-0.582* (0.079)	-0.565* (0.079)
vix	-0.046* (0.010)	-0.047* (0.010)	-0.046* (0.010)	-0.036* (0.009)	-0.036* (0.009)
gold	-0.337* (0.059)	-0.345* (0.059)	-0.332* (0.059)		
constant	0.007* (0.002)	0.007* (0.002)	0.006* (0.007)	0.007* (0.002)	0.007* (0.002)
trend	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.209	0.207	0.201	0.276	0.261
Adj. R-squared	0.188	0.186	0.179	0.253	0.237
F-statistic	9.842* [0.001]	9.711* [0.001]	9.327* [0.001]	12.093* [0.001]	11.175* [0.001]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses.

Table 12 shows 5 ARDL models using *returnindustry* as a dependent variable. The increase in the number of COVID-19 cases in Turkey adversely affects companies in the industrial sector. This situation was also reflected in the BIST-Industry return. At the same time, the effect of the number of new cases in the world was found to be negative and significant. The fact that many countries took pandemic measures and closed their country entrances and exits directly affected the companies in BIST-Industry as we expected. The effect of interest on BIST-Industry return was found to be negative but insignificant. The negative and significant coefficient of the VIX index shows that the fear and high volatility in the markets negatively affect the stocks. The two factors that most negatively affect the BIST-Industry return are the exchange rate and gold prices. Looking at the ARDL and VAR models established for *returnindustry*, it is seen that the results support each other.

Table 13: Pairwise Granger Causality Tests for *returnindustry*

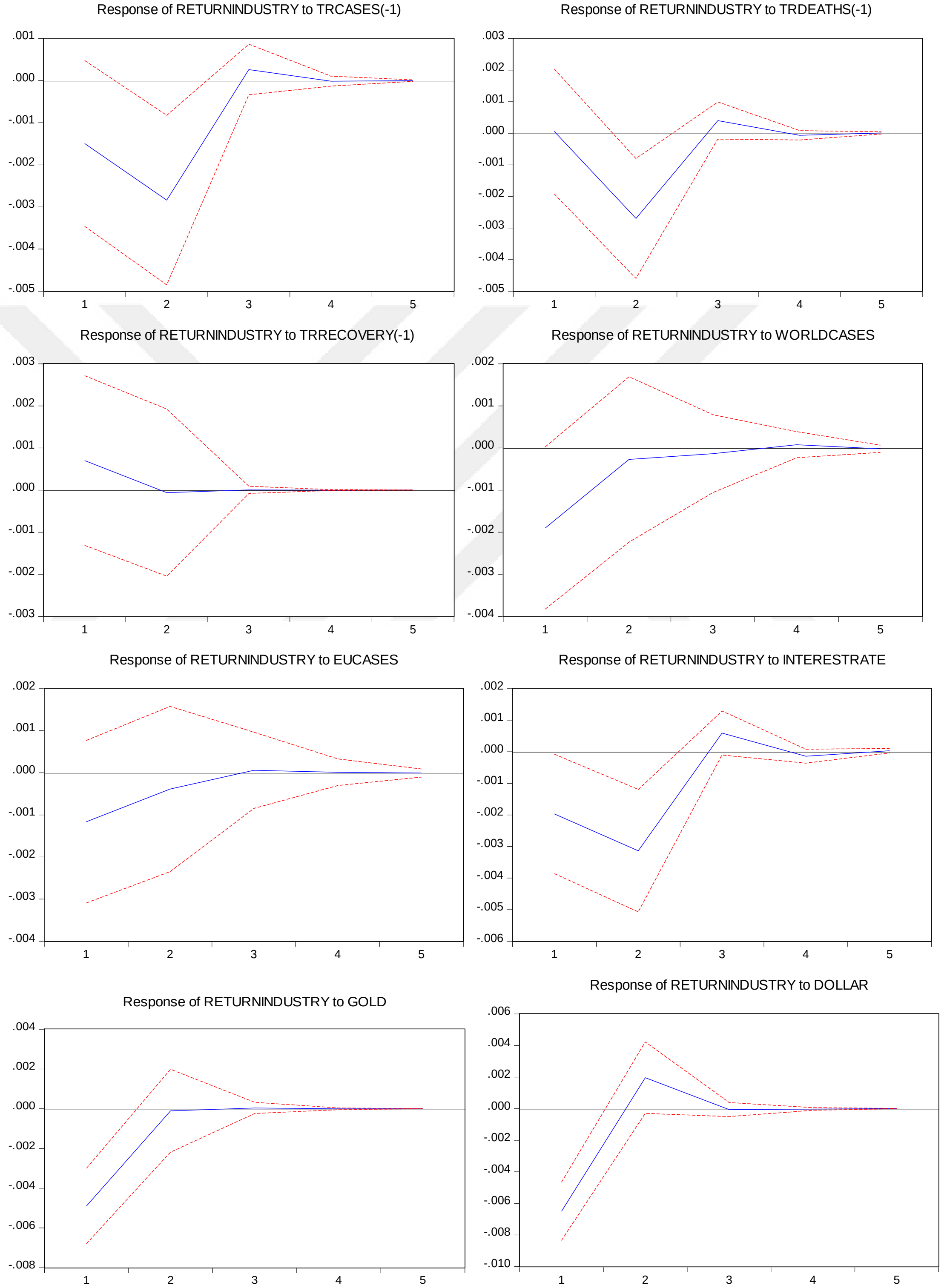
Null Hypothesis	F-Statistic	Prob.	Decision
trcases(-1) does not Granger Cause *returnindustry*	9.268*	0.003	Reject
trdeaths(-1) does not Granger Cause *returnindustry*	8.139*	0.005	Reject
trrecovery(-1) does not Granger Cause *returnindustry*	0.001	0.978	Not reject
worldcases does not Granger Cause *returnindustry*	0.023	0.880	Not reject
eucases does not Granger Cause *returnindustry*	0.184	0.668	Not reject
interestrate does not Granger Cause *returnindustry*	12.175*	0.001	Reject
gold does not Granger Cause *returnindustry*	0.134	0.714	Not reject
dollar does not Granger Cause *returnindustry*	2.172	0.142	Not reject
vix does not Granger Cause *returnindustry*	0.923	0.338	Not reject

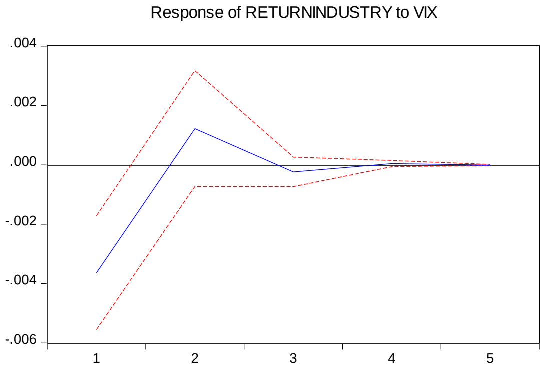
Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively.

Table 13 shows the result of the Pairwise Granger Causality Test, in which *returnindustry* is used as a dependent variable. According to the results, the test statistics of *trcases(-1)*, *trdeaths(-1)*, and *interestrate* variables were significant. The null hypothesis of all three variables was rejected, and it was concluded that there is a significant causality relationship between *trcases(-1)*, *trdeaths(-1)*, *interestrate* variables, and *returnindustry* variable. In summary, *trcases(-1)*, *trdeaths(-1)*, and *interestrate* Granger cause movement in the *returnindustry* variable. The test results of other variables were not statistically significant.

Then we analyze the response of the BIST-Industry return series when a shock is given to each of the independent variables. The solid line in the graphs represent the point estimates, and the dashed lines represent the %95 percent confidence intervals. The time interval we used in the study is divided into 5 equal periods to better understand the Impulse-Response graphs.

Figure 3: Impulse-Response Graphs for *returnindustry*





When we look at the Impulse-Response graphs of the BIST-Industry return when a standard error shock is given to the variables *trcases(-1)* and *trdeaths(-1)*, the response of the *returnindustry* variable is negative in the 1st and 2nd periods, and positive in the 3rd periods. When the *trrecvery(-1)* variable was shocked, the *returnindustry* variable gave a positive response in the first period and did not respond afterward. In the face of a one-unit shock given to the *interestrate* variable, the dependent variable reacted negatively in the 1st, 2nd, and 4th periods, while it gave a positive response in the 3rd period. When a one-unit shock is given to the *gold* variable, the first period is negative and then stabilized. The *returnindustry* variable reacted negatively in the first period to the shock given to the *dollar* variable and positively in the second period. *returnindustry*'s response to the variables *worldcases* and *eucases* is negative until the end of the 3rd period. When a standard error shock was given to the *vix* variable, a negative response was observed in the 1st and 3rd periods, while a positive response was observed in the 2nd period.

When Impulse-Response graphs are examined, the variable that the dependent variable responds most to a one-unit shock is *trcases(-1)*, *trdeaths(-1)*, and *interestrate* variables. When we look at the graphs related to COVID-19, they caused the *returnindustry* series to give strong reactions, although their effects were seen statistically weak.

Fourth we use, *returnfinancial* a dependent variable and estimate the following five models:

Model 1: $returnfinancial_t = \alpha_0 + \alpha_1 t + \alpha_2 trcases_{t-1} + \alpha_3 interestrate_t + \alpha_4 vix_t + \alpha_5 gold_t + \varepsilon_t$

Model 2: $returnfinancial_t = \beta_0 + \beta_1 t + \beta_2 trdeaths_{t-1} + \beta_3 interestrate_t + \beta_4 vix_t + \beta_5 gold_t + \varepsilon_t$

Model 3: $returnfinancial_t = \theta_0 + \theta_1 t + \theta_2 trrecovery_{t-1} + \theta_3 interestrate_t + \theta_4 vix_t + \theta_5 gold_t + \varepsilon_t$

Model 4: $returnfinancial_t = \gamma_0 + \gamma_1 t + \gamma_2 trcases_{t-1} + \gamma_3 interestrate_t + \gamma_4 worldcases_t + \gamma_5 dollar_t + \gamma_6 vix_t + \varepsilon_t$

Model 5: $returnfinancial_t = \phi_0 + \phi_1 t + \phi_2 trcases_{t-1} + \phi_3 interestrate_t + \phi_4 eucases_t + \phi_5 dollar_t + \phi_6 vix_t + \varepsilon_t$

Table 14: VAR Models for *returnfinancial*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
trcases(-1)	-0.006** (0.003)			-0.005 (0.003)	-0.005*** (0.003)
trdeaths(-1)		0.023** (0.010)			
trrecovery(-1)			0.001 (0.003)		
worldcases				-0.007 (0.006)	
eucases					0.001 (0.004)
interestrate	-0.065** (0.028)	-0.070* (0.027)	-0.066* (0.028)	-0.053** (0.026)	-0.051** (0.026)
dollar				-0.884* (0.086)	-0.877* (0.086)
vix	-0.046* (0.011)	-0.048* (0.011)	-0.046* (0.011)	-0.030* (0.011)	-0.030* (0.011)
gold	-0.548* (0.065)	-0.562* (0.065)	-0.541* (0.065)		
constant	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.005* (0.002)
trend	-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.301	0.305	0.290	0.374	0.371
Adj. R-squared	0.285	0.290	0.274	0.357	0.354
F-statistic	19.295* [0.001]	19.675* [0.001]	18.280* [0.001]	22.190* [0.001]	21.915* [0.001]
Diagnostic Tests					
Serial Correlation LM	2.815 [0.095]	0.589 [0.443]	1.409 [0.236]	0.005 [0.947]	0.003 [0.955]
Heteroskedasticity	1.049 [0.395]	2.115* [0.042]	1.055 [0.390]	0.716 [0.658]	0.595 [0.760]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses. Probability values are in brackets. The Breusch-Godfrey LM test null hypothesis “no serial correlation at lag 1” cannot be rejected at the 5 percent level. The Harvey test for heteroskedasticity has a null hypothesis of homoskedasticity that cannot be rejected at the 5 percent level.

In Table 14, the 5 VAR models, in which the BIST-Financial return is considered as the dependent variable, are presented. In the first model, it was determined that when the *trcases(-1)* variable increased by 1 percent, the dependent variable decreased by 6 per thousand. In the second model, it was observed that when the *trdeaths(-1)* carriable increased by one percent, the *returnfinancial* variable increased by 2 percent. The coefficient of the *trrecovery(-1)* variable was statistically insignificant. In the first three models, when the *vix* variable increases by 1 percent, the *returnfinancial* variable decreases by approximately 46 percent, while the *gold* variable decreases by 55 percent and the *interestrate* variable by 7 percent. In Model 4, the coefficient of the *trcases(-1)* variable was insignificant. In Model 5, when the *trcases(-1)* variable increases by 1 percent, the dependent variable decreases by 5 per thousand. The coefficients of the *worldcases* and *eucases* variables were statistically insignificant. In the last two models, when the *dollar* variable increases by 1 percent, the *returnfinancial* variable decreases by 88 percent, and when the *vix* variable increases by 1 percent, it decreases by 3 percent. In the 4th and 5th models, it was concluded that when the *interestrate* variable increased by 1 percent, the dependent variable decreased by 5 percent.

As a result, when we look at Table 14, the comments we made for BIST-100, BIST-30, and BIST-Industry indices are valid. The increase in the interest rate reduces the BIST-Financial return more than other return series. The reason for this may be that investors are more afraid of the COVID-19 risks in the BIST-Financial index. Considering the effect of the exchange rate, it is observed that the effect is quite high. This can be explained by the fact that the exchange rate plays an important role in many decision stages of companies in the financial sector.

The ARDL model estimation results are reported in Table 15 below:

Table 15: ARDL Models for *returnfinancial*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
returnfinancial(-1)	-0.006 (0.059)	-0.009 (0.059)	-0.012 (0.060)	-0.034 (0.057)	-0.033 (0.057)
trcases(-1)	-0.006** (0.003)			-0.005 (0.003)	-0.005*** (0.003)
trdeaths(-1)		0.023** (0.010)			
trrecovery(-1)			0.001 (0.003)		
worldcases				-0.007 (0.006)	
eucases					0.001 (0.004)
interestrate	-0.060** (0.028)	-0.070** (0.027)	-0.066** (0.028)	-0.053** (0.026)	-0.051** (0.026)
dollar				-0.890* (0.087)	-0.882* (0.087)
vix	-0.046* (0.011)	-0.048* (0.011)	-0.046* (0.011)	-0.029* (0.010)	-0.029* (0.011)
gold	-0.548* (0.065)	-0.562* (0.066)	-0.542* (0.066)		
constant	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)	0.006* (0.002)
trend	-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.301	0.305	0.290	0.375	0.372
Adj. R-squared	0.282	0.287	0.271	0.355	0.352
F-statistic	16.009* [0.001]	16.329* [0.001]	15.175* [0.001]	19.017* [0.001]	18.775* [0.001]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses.

Table 15 shows 5 different ARDL models using *returnfinancial* as the dependent variable. The effect of the number of new cases in Turkey on the BIST-Financial return was found to be negative and significant. Compared to other index returns, it has been concluded that the negative effect of interest rate on the *returnfinancial* series is greater. It is understood that firms in the financial sector are more fragile in terms of interest rates. Just like in other index returns, the negative and significant coefficient of *vix* variable shows that fear and anxiety are dominant in the market. Among other financial variables, gold and the dollar are the factors that most negatively affect the BIST-Financial return. When the results are compared with VAR models, it is seen that they support each other.

Table 16: Pairwise Granger Causality Tests for *returnfinancial*

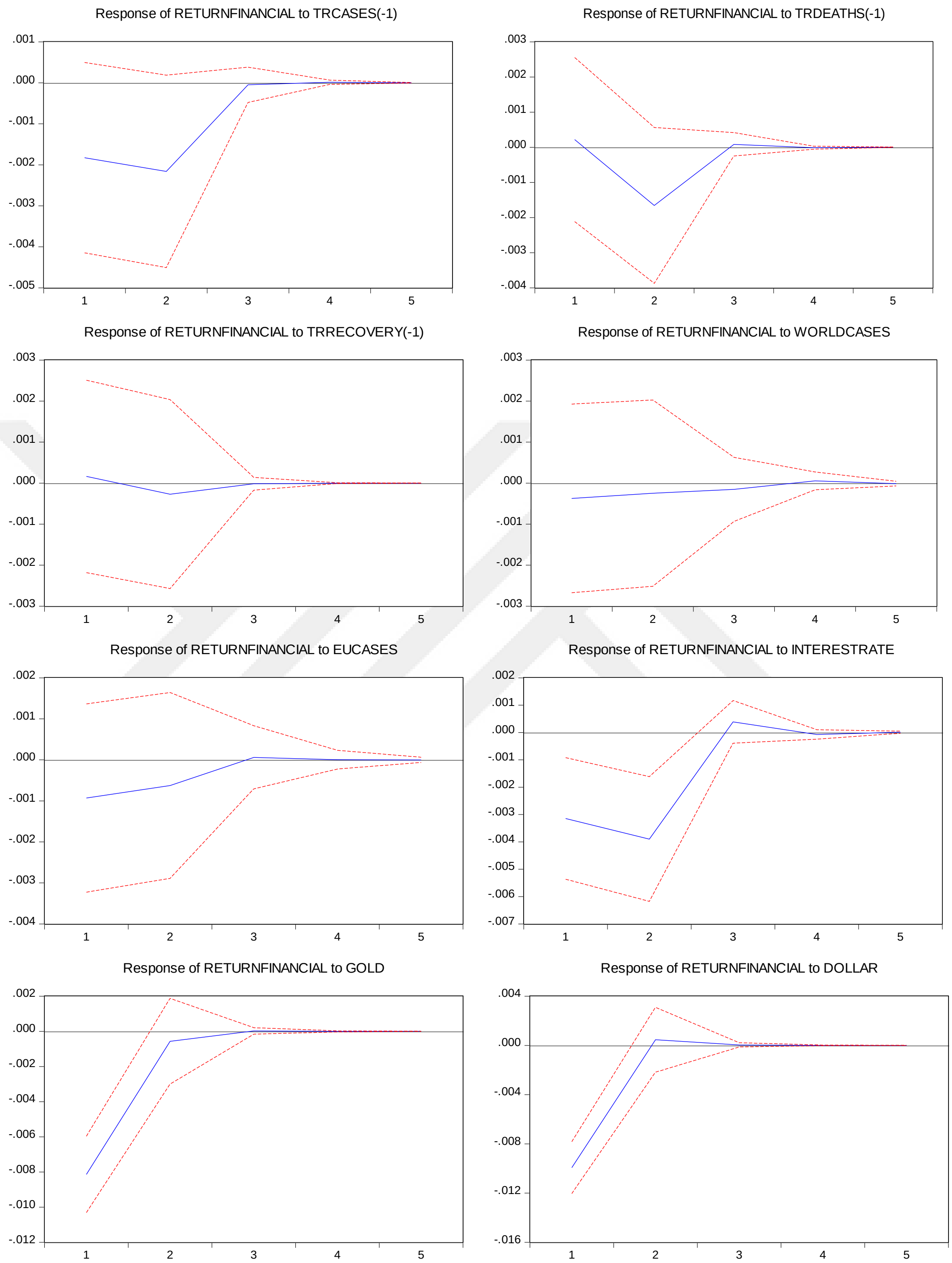
Null Hypothesis	F-Statistic	Prob.	Decision
trcases(-1) does not Granger Cause *returnfinancial*	3.447***	0.065	Reject
trdeaths(-1) does not Granger Cause *returnfinancial*	2.215	0.138	Not reject
trrecovery(-1) does not Granger Cause *returnfinancial*	0.045	0.832	Not reject
worldcases does not Granger Cause *returnfinancial*	0.015	0.902	Not reject
eucases does not Granger Cause *returnfinancial*	0.146	0.702	Not reject
interestrate does not Granger Cause *returnfinancial*	11.874*	0.001	Reject
gold does not Granger Cause *returnfinancial*	0.029	0.864	Not reject
dollar does not Granger Cause *returnfinancial*	0.511	0.475	Not reject
vix does not Granger Cause *returnfinancial*	0.430	0.513	Not reject

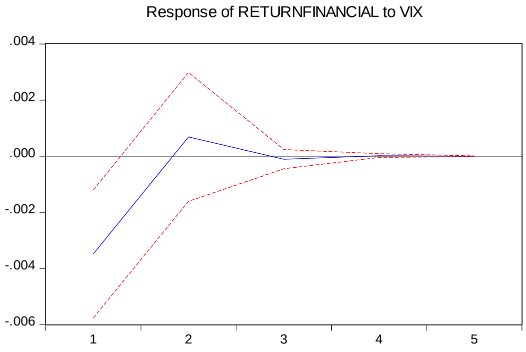
Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively.

Table 16 shows the results of the Pairwise Granger Causality Test, in which *returnfinancial* is used as a dependent variable. According to the results, only the test statistics of *trcases(-1)* and *interestrate* variables were significant. The null hypothesis of both variables was rejected, and it was concluded that there is a significant causality relationship between *trcases(-1)* and *returnfinancial* variables. In summary, *trcases(-1)* Granger causes movement in the *returnfinancial* variable. The test results of other variables were not statistically significant.

Then we analyze the response of the BIST-Financial return series when a shock is given to each of the independent variables. The solid line in the graphs represent the point estimates, and the dashed lines represent the %95 percent confidence intervals. The time interval we used in the study is divided into 5 equal periods to better understand the Impulse-Response graphs.

Figure 4: Impulse-Response Graphs for *returnfinancial*





When we examine the Impulse-Response graphs, the responses of the BIST-Financial return are shown when a standard error shock is given to each independent variable. The dependent variable gave a negative response to the variables *trcases(-1)* and *trdeaths(-1)* in the first two periods. The first two periods gave a negative reaction to the *trcases(-1)* and *trdeaths(-1)* variables, the 1st period gave a positive reaction to the *trrecovery(-1)* variable, the 2nd period gave a negative reaction, the first two periods gave a negative reaction to the *interestrate* variable, and it gave a positive reaction in the 3rd period. *returnfinancial* variable gave a negative reaction to the *gold* variable in the first two periods and a negative reaction to the *dollar* variable in the first period and positive in the second period. Until the end of the 3rd period, it gave negative reactions to the *worldcases* variable, negative reactions to the *vix* variable in the 1st period and positive in the 2nd period, and negative reactions to the *eucases* variable in the first two periods. After these periods, the response weakened and became zero.

When Impulse-Response graphs are examined, the variable that the dependent variable responds most to a one-unit shock is the *interestrate* series. When we look at the graphs related to COVID-19, they caused the *returnfinancial* series to give strong reactions, although their effects were seen statistically weak.

Fifth, we use, *returnservices* a dependent variable and estimate the following five models:

Model 1: $returnservices_t = \alpha_0 + \alpha_1 t + \alpha_2 trcases_{t-1} + \alpha_3 interestrate_t + \alpha_4 gold_t + \varepsilon_t$

Model 2: $returnservices_t = \beta_0 + \beta_1 t + \beta_2 trdeaths_{t-1} + \beta_3 interestrate_t + \beta_4 gold_t + \varepsilon_t$

Model 3: $returnservices_t = \theta_0 + \theta_1 t + \theta_2 trrecovery_{t-1} + \theta_3 interestrate_t + \theta_4 gold_t + \varepsilon_t$

Model 4: $returnservices_t = \gamma_0 + \gamma_1 t + \gamma_2 trcases_{t-1} + \gamma_3 interestrate_t + \gamma_4 worldcases_t + \gamma_5 dollar_t + \gamma_6 vix_t + \varepsilon_t$

Model 5: $returnservices_t = \phi_0 + \phi_1 t + \phi_2 trcases_{t-1} + \phi_3 interestrate_t + \phi_4 eucases_t + \phi_5 dollar_t + \phi_6 vix_t + \varepsilon_t$

Table 17: VAR Models for *returnservices*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
trcases(-1)	-0.004 (0.003)			-0.003 (0.003)	-0.003 (0.003)
trdeaths(-1)		0.009 (0.008)			
trrecovery(-1)			0.002 (0.002)		
worldcases				-0.008 (0.005)	
eucases					-0.001 (0.004)
interestrate	-0.029 (0.022)	-0.034 (0.022)	-0.033 (0.022)	-0.025 (0.021)	-0.023 (0.022)
dollar				-0.605* (0.071)	-0.595* (0.071)
vix	-0.032* (0.009)	-0.033* (0.009)	-0.032* (0.009)	-0.021* (0.009)	-0.021* (0.009)
gold	-0.365* (0.053)	-0.368* (0.053)	-0.361* (0.053)		
constant	0.007* (0.002)	0.007* (0.002)	0.007* (0.002)	0.007* (0.002)	0.006* (0.002)
trend	-0.001* (0.001)	-0.001* (0.001)	-0.001* (0.001)	-0.001* (0.001)	-0.001* (0.001)
R-squared	0.236	0.233	0.231	0.304	0.296
Adj. R-squared	0.219	0.216	0.214	0.285	0.277
F-statistic	13.833* [0.001]	13.621* [0.001]	13.440* [0.001]	16.228* [0.001]	15.604* [0.001]
Diagnostic Tests					
Serial Correlation LM	0.456 [0.500]	0.003 [0.953]	0.142 [0.707]	2.202 [0.139]	2.036 [0.155]
Heteroskedasticity	1.849 [0.091]	1.888 [0.084]	1.839 [0.093]	0.975 [0.450]	0.913 [0.497]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses. Probability values are in brackets. The Breusch-Godfrey LM test null hypothesis "no serial correlation at lag 1" cannot be rejected at the 5 percent level. The Harvey test for heteroskedasticity has a null hypothesis of homoskedasticity that cannot be rejected at the 5 percent level.

Table 17 shows 5 different VAR models in which the BIST-Services return series is used as the dependent variable. Although the test statistics of all models were significant, the coefficients of the COVID-19 data were statistically insignificant. In the first three models, when the *vix* variable increases by 1 percent, the dependent variable decreases by 3 percent, and when the *gold* variable increases by 1 percent, the dependent variable decreases by 36 percent. The *interestrate* variable was found to be statistically insignificant for the first three models. When we look at Models 4 and 5, when the *dollar* variable increases by 1 percent, the *returnservices* variable decreases by 60 percent, and when the *vix* variable increases by 1 percent, it decreases by 2 percent. The coefficients of the other variables included in the models were statistically insignificant.

When we look at Table 17, the insignificance of any statistics about COVID-19 may be due to the data set. These results may change when evaluated with a much larger data set after the pandemic is over. Our previous comments on the interest rate, gold price, exchange rate, and VIX index are also valid for the BIST-Services index.

The ARDL model estimation results are reported in Table 18 below:

Table 18: ARDL Models for *returnservices*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
returnservices(-1)	-0.066 (0.067)	-0.058 (0.067)	-0.057 (0.067)	-0.037 (0.064)	-0.036 (0.065)
trcases(-1)	-0.004 (0.003)			-0.003 (0.003)	-0.003 (0.003)
trdeaths(-1)		0.009 (0.008)			
trrecovery(-1)			0.002 (0.002)		
worldcases				-0.008 (0.005)	
eucases					0.001 (0.004)
interestrate	-0.026 (0.023)	-0.032 (0.022)	-0.030 (0.022)	-0.023 (0.022)	-0.022 (0.022)
dollar				-0.601* (0.071)	-0.590* (0.071)
vix	-0.033* (0.009)	-0.033* (0.009)	-0.032* (0.009)	-0.022* (0.009)	-0.021* (0.009)
gold	-0.362* (0.053)	-0.366* (0.053)	-0.358* (0.053)		
constant	0.007* (0.002)	0.007* (0.002)	0.007* (0.002)	0.006* (0.002)	0.006* (0.002)
trend	-0.001* (0.001)	-0.001* (0.001)	-0.001* (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
R-squared	0.239	0.236	0.233	0.305	0.297
Adj. R-squared	0.219	0.215	0.213	0.283	0.274
F-statistic	11.688* [0.001]	11.462* [0.001]	11.309* [0.001]	13.914* [0.001]	13.376* [0.001]

Note: *, **, *** denote significant at the 1%, 5% , 10% levels, respectively. Standard errors are in parentheses.

Table 18 shows the ARDL models established for the *returnservices* variable. When we look at the BIST-Services series, the coefficients of the variables related to COVID-19 were found to be statistically insignificant. Since it contains many different dynamics in the service sector, it is a subject that needs to be investigated with a more comprehensive data set. We understand that the companies included in the BIST-Services index are also negatively affected by the exchange rate, as the coefficient is negative and significant. The anxiety caused by the uncertainties in the market causes the VIX index to increase and the BIST-Services return to decrease. The fact that the coefficient of the *gold* variable is negative and significant indicates that investors' demand for the BIST-Services index has decreased during the COVID-19 pandemic. The ARDL and VAR models established for the *returnservices* variable support each other.

Table 19: Pairwise Granger Causality Tests for *returnservices*

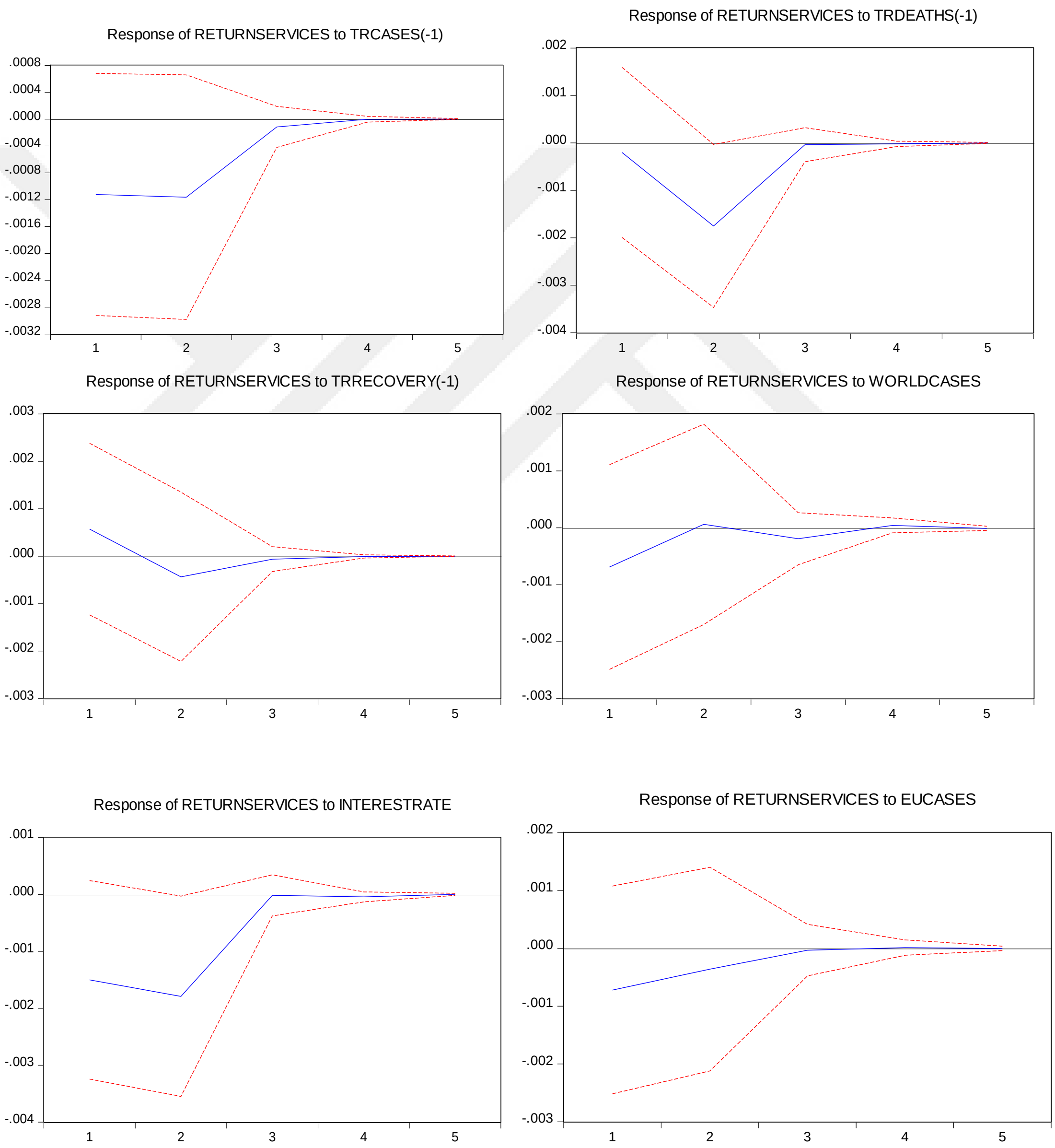
Null Hypothesis	F-Statistic	Prob.	Decision
trcases(-1) does not Granger Cause *returnservices*	1.545	0.215	Not reject
trdeaths(-1) does not Granger Cause *returnservices*	3.893**	0.050	Reject
trrecovery(-1) does not Granger Cause *returnservices*	0.228	0.633	Not reject
worldcases does not Granger Cause *returnservices*	0.231	0.631	Not reject
eucases does not Granger Cause *returnservices*	0.078	0.780	Not reject
interestrate does not Granger Cause *returnservices*	3.506***	0.062	Reject
gold does not Granger Cause *returnservices*	0.001	0.989	Not reject
dollar does not Granger Cause *returnservices*	1.842	0.176	Not reject
vix does not Granger Cause *returnservices*	0.106	0.745	Not reject

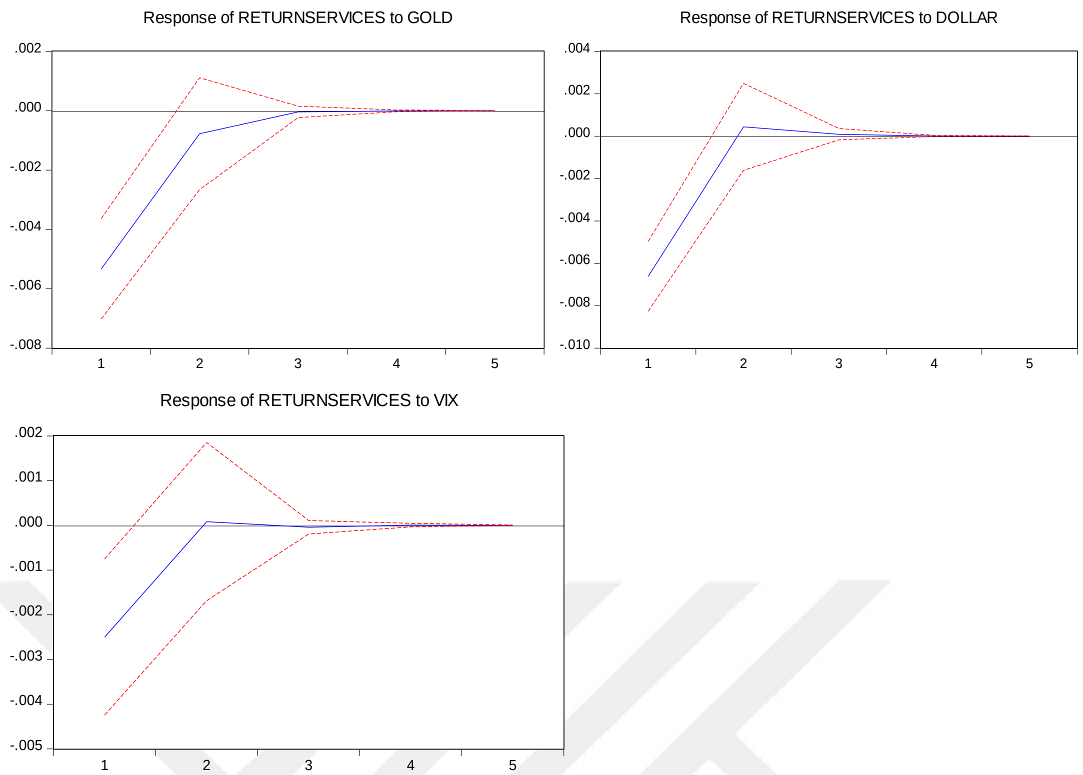
Note: *, **, *** represent statistical significance at 1%, 5%, 10% levels, respectively.

Table 19 shows the results of the Pairwise Granger Causality Test, in which *returnservices* is used as a dependent variable. According to the results, only the test statistics of *trdeaths(-1)* and *interestrate* variables were significant. The null hypothesis of both variables was rejected, and it was concluded that there is a significant causality relationship between *trdeaths(-1)* and *returnservices* variables. In summary, *trdeaths(-1)* Granger causes movement in the *returnservices*. The test results of other variables were not statistically significant.

Then we analyze the response of the BIST-Services return series when a shock is given to each of the independent variables. The solid line in the graphs represent the point estimates, and the dashed lines represent the %95 percent confidence intervals. The time interval we used in the study is divided into 5 equal periods to better understand the Impulse-Response graphs.

Figure 5: Impulse-Response Graphs for *returnservices*





When we examine the Impulse-Response graphs, the responses of the BIST-Services return are shown when a standard error shock is given to each independent variable. *returnservices* variable reacted negatively to *trcases(-1)* and *trdeaths(-1)* variables in the first three periods, positive in the first three periods to the *trrecovery(-1)* variable, negative in the second and third periods, and negative in the first three periods to the *interestrate* variable. The first two periods gave a negative reaction to the *gold* variable and a negative reaction to the *dollar* variable in the first period and a positive reaction in the second period. It gave negative reactions to the *worldcases* variable in the 1st and 3rd periods, positive for 2 periods, negative until the 2nd period to the *vix* variable, and negative reactions to the *eucases* variable until the 3rd period. After these periods, the response weakened and became zero. Later, these reactions ended.

CONCLUSION

This study aims to investigate the effects of the COVID-19 pandemic in the Turkish stock market in detail. For this purpose, the study used time series methods and different empirical estimates to better explain how the BIST-100, BIST-30, BIST-Financial, BIST-Industry, and BIST-Services indices traded on Borsa Istanbul were affected during the pandemic process. Our study covers the dates of 8 April 2020-22 March 2021. The number of studies in the literature analyzing the effects of the COVID-19 pandemic on Borsa Istanbul is limited and the date range on which these studies are based is narrow. In this sense, our study contributes to the literature thanks to the date range and many variables it covers.

According to the empirical results of our study, a number of new COVID-19 cases in Turkey have affected all BIST return series negatively. The negative impact of the number of COVID-19 cases on stock returns is in line with the Ashraf (2020) study. In general, there is an inverse relationship between the five index returns and the VIX index, TL/US Dollar exchange rate, and gram gold price. Except for the BIST-Services index, there is an inverse relationship between other indices and interest rates. It has been determined that only the BIST-Industry return is negatively affected by the number of cases in the world. The results show that the negative developments regarding the COVID-19 positively affect the index returns in some models. No such result was found in the literature. Death numbers have been used as a negative indicator, but their effects are positive. The fact that the coefficient of the number of COVID-19 cases is negative and the coefficient of the number of deaths is positive, Ben Ayed et al. (2020) is in the opposite direction of their study. They found that the number of cases has a positive effect on the stock returns and the number of deaths has a negative effect.

BIST-100 index represents the top 100 stocks in Borsa Istanbul in terms of trading volume and value. There are many important companies in the BIST-100 index, from manufacturing to construction, from technology to mining, from energy to financial institutions. So, it is not surprising that it was negatively affected by the pandemic. There are many banks in the BIST-30 index. With the rapid spread of the epidemic, the environment of trust decreased, and banks had difficulties in the collection of their loans. As a result of the decrease in transaction volumes, a decrease in revenues occurred. In such an environment, banks may experience liquidity and capital problems. As a result of all these developments, negativities were observed in the BIST-30 index. Overall, our findings indicate that even many of the results are similar, BIST-100, and BIST-30 indices seem to have been mostly affected by the COVID-19 cases in Turkey. Since the epidemic began, the problems and uncertainties experienced in the economies have increased and there has been a decrease in demand. As a result, the BIST-Financial index, whose trading area is financial activities, was adversely affected. Due to the decrease in employment and the illness of the employees with the pandemic, production slowed down and came to a standstill from time to time. BIST-Industry index, which mainly includes the manufacturing sector, was adversely affected by this situation. At the same time, the decrease in supply due to demand causes a decrease in the return of this index. The effect of COVID-19 data on the BIST-Services index was statistically insignificant. The reason for this may be that the education and health practices in the Services sector continue to increase.

According to our study, the COVID-19 outbreak, in general, has had negative effects on the sectors. While the process is still ongoing, policymakers have taken some measures to protect financial activities. These measures need to be revised carefully and separately for each sector. The state must retain control over fiscal and monetary policies. It is necessary to continue the incentives given to households and companies and to restructure the loan debts in banks. To increase investments, interest rates can be reduced in a controlled manner, as practiced by developed and developing countries. Since the interest rate to be determined by the government will affect the loan interest rates applied by the banks, it can be ensured that the companies reach the amount of capital they need to continue their activities. In the services sector, communication with the customer and product quality are the two most important things. By setting their targets in this direction, companies can provide demand-side increases after the epidemic. For the industry sector, financial incentives should be given for raw materials that may be needed more in the later stages of the epidemic, and access to these raw materials should be facilitated. In addition, considering that there may be an increase in the epidemic, controlled and supervised stocking should be done in the manufacturing sector. In general, the central government should cooperate with local governments to ensure cash flow in sectors whose business operations have been damaged by the COVID-19 pandemic. In these sectors, it is necessary to take measures to cover fixed costs.

From the moment the COVID-19 epidemic began to appear in our country, stock markets gave instant reactions. Under normal circumstances, financial markets are one of the long-term investment instruments for investors. With this in mind, investors need to remain calm during the momentary changes caused by the epidemic. In addition, it should not be forgotten that the epidemic may bring some opportunities as well as negative effects. Some sectors may be negatively affected, while others may react positively. Investors should analyze these opportunities well and make their plans accordingly.

As a result, this comprehensive study, which investigates the effects of the global epidemic on the Turkish stock market through selected sectors, is very important in terms of evaluating the financial effects caused by the epidemic. However, as the epidemic continues and the future is uncertain, it is difficult to determine the full financial impacts. To detect all the financial effects of the COVID-19 epidemic, this study can be developed by using data sets covering the whole process after the pandemic is over.

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