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THE SECTORAL IMPACT OF COVID-19 USING RALS-LM TESTS: EVIDENCE FROM BORSA ISTANBUL TURKIYE

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Abstract

The aim of the study is to examine the impact of the daily number of COVID-19 patients in Turkiye and the total number of COVID-19 cases in the world on selected sector indices on Borsa Istanbul. For that purpose, the daily data consisting of 204 observations for the period 17 March - 25 December 2020 was analyzed. Firstly, the stationary levels of the variables were examined with the unit root test. Since the analyzed variables did not meet the assumption of normal distribution, Augmented Least Squares (RALS) LM unit root tests were used. According to the results of RALS regression models, sector indices included in the analysis are different in terms of the total number of COVID-19 cases in the world and the daily number of patients in Turkiye. In this context, the most affected first three sectors by the total number of COVID-19 cases in the world are the technology, tourism, and insurance sectors. The three most affected sectors by the number of daily patients in Turkiye are the sports, transportation, and insurance sectors.

Keywords: COVID-19 Pandemic, BIST Sector indices, RALS tests

JEL Classification: C32, E44, G10, G12

COVID-19 SALGININ SEKTÖRLERE ETKİSİNİN RALS-LM TESTLERİYLE İNCELEMESİ : BORSA İSTANBUL TÜRKİYE ÜZERİNE BİR UYGULAMA

Özet

Çalışmanın amacı, Türkiye'deki günlük COVID-19 hasta sayıları ve dünyadaki toplam COVID-19 vaka sayılarının Borsa İstanbul'daki seçilmiş sektör endekslerine etkisinin incelenmesidir. Belirlenen amaçla 17 Mart 2020 - 25 Aralık 2020 periyodundaki 204 gözlemden oluşan günlük veri seti analiz edilmiştir. Analizin ilk aşamasında birim kök testi ile değişkenlerin durağanlık düzeyleri incelenmiştir. Analiz edilen değişkenler normal dağılım varsayımına uymadığı için analiz yöntemi olarak Genişletilmiş En Küçük Kareler (RALS) LM birim kök testleri kullanılmıştır. RALS regresyon modellerinin de kullanılmasıyla elde edilen sonuçlara göre, analize dahil edilen sektör endekslerinin dünyadaki COVID-19 toplam vaka sayısı ile Türkiye'deki günlük hasta sayılarından etkilenme düzeyleri birbirinden farklıdır. Bu kapsamda dünyadaki toplam COVID-19 vaka sayısından en çok etkilenen ilk üç sektör sırasıyla teknoloji, turizm ve sigortacılık sektörleridir. Türkiye'deki günlük hasta sayısından en fazla etkilenen üç sektör ise sırasıyla spor, ulaştırma ve sigortacılık sektörleridir.

Anahtar Kelimeler: COVID-19 Salgını, BIST Sektör Endeksleri, RALS Tests

JEL Sınıflandırması: C32, E44, G10, G12

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1. Introduction

Human history had experienced several infectious virus diseases. 1918 H1N1 virus, called Spanish flu which was denominated as the mother of all pandemics by Taubenberger and Morens (2006), 1957-1958 H2N2 virus, 1968 H3N2 virus, 2009 Swine Flu, 2012 MERS virus, 2014-2015 Ebola virus can be regarded as recent pandemics that impact the global economy (Belser & Tumpey, 2018; Salisu et al., 2020, p. 40; Taubenberger & Morens, 2006). But none of them caused closed borders, curfews, shuttered stores and restaurants or cancelled/postponed events such as olympic games, football matches, public examinations and face to face education in the world. In this sense the negative effect of COVID-19 is supposed to be more severe than previous pandemics. Thus, according to Baker et al. (2020, 755) even the Spanish Flu which is called as the mother of all pandemics, was less effective on the U.S economy than the COVID-19 outbreak.

Although the first coronavirus case emerged in China, it spread all over the world rapidly. Such that Europe had been the center of outbreak in March 2020 and USA had been the following center in April 2020 (Ozturk et al., 2020, pp. 57–58). Some principal international organizations warned about the destructive influence of COVID-19. For instance, the Organization for Economic Cooperation and Development (OECD) reported that the recovery from the COVID-19 would take years of the world and economic shock was already bigger than the 2008 financial crisis or during the September 11 terror attacks (Chan, 2020). International Monetary Fund (IMF) describes it as "the worst recession since the Great Depression and it would effect the emerging markets and developing countries more severe"(Shalal & Lawder, 2020). According to Lora, Daniele, and David (2021), the leading stock markets since the beginning of the outbreak is like Figure 1:

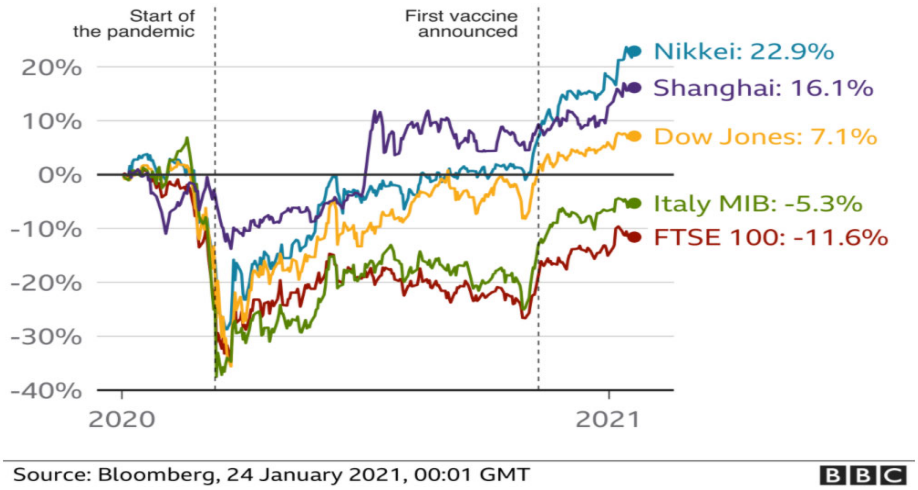

Figure 1: The Impact of Coronavirus on Stock Markets
Source: www.bbc.com

As is seen from Figure 1, by the start of the pandemic in the first quarter of 2020, all the leading stock markets dropped severely, especially the loss of Dow Jones, Italy MIB and FTSE approached % 40. But after the first vaccine announced in November of 2020, except Italy MIB and FTSE, other leading stock markets have reached to positive territory.

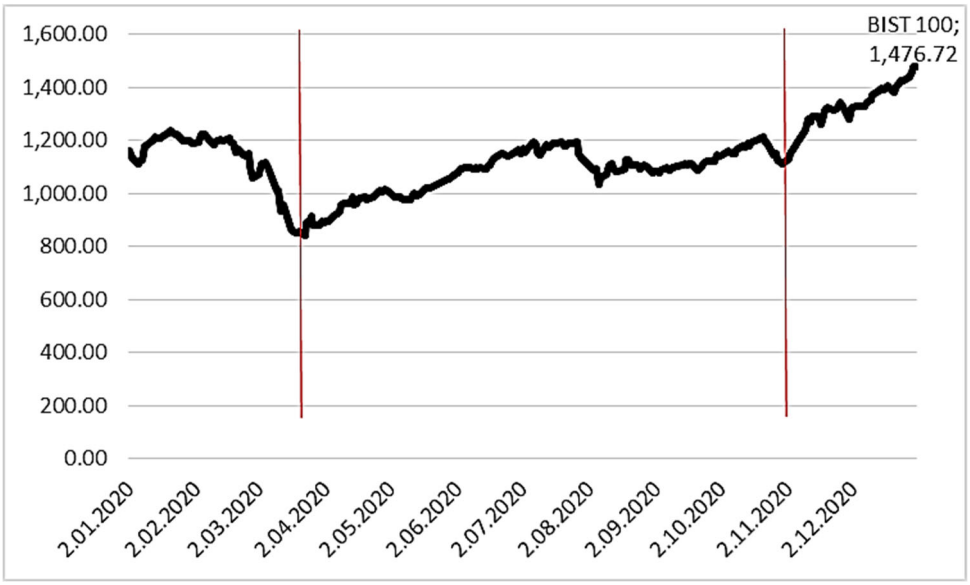

Figure 2: ISE 100 Index
Source: www.investing.com

As is seen in Figure 2, BIST 100 index also dropped in March 2020 severely by the start of pandemic like leading stock exchanges. The measures taken in the following period and other factors caused the index to rise from time to time. However with the worsening of the pandemic, the index may have been decreased at times, then it started to rise in November of 2020 during the announcement of the vaccine as leading stock exchanges. Based on the Turkish Statistical Institute (TURKSTAT); throughout the pandemic, Turkish economy has performed better than most countries. Turkiye's gross domestic product (GDP) increased at a level of 1.8% in 2020. It became one of 4 countries growing positively in the world while the world's economies were shrinking. However unemployment peaked at 12.7%.

According to the information from CBRT (2020), packages of measures were announced to limit the financial and economic effects of coronavirus on March 17, March 31 and April 17 2020. The measures taken focus on four main objectives:

1. Providing flexibility in TL and foreign currency liquidity management of banks and increasing predictability,
2. Ensuring continuous credit flow to the real sector and supporting exporter businesses,
3. Supporting exporter businesses' cash flow through rediscount credit agreements,
4. Supporting the liquidity of the government securities market.

As mentioned before, since COVID-19 has made all economies more vulnerable, volatile, and risky, some precautions have been taken in Turkiye as well as around the world. Pandemics and their negative consequences spread rapidly not only in Turkiye but also around the world, particularly in 2020. Because of the stated reason, this study focuses on the year 2020 and the impact of a pandemic on the Turkish stock market.

The main aim of this study is to explore the response of ISE sector indexes to COVID-19 in Turkiye. In this sense it is tried to find which sectors have been affected deeper and how. This study was postponed to year of 2021 since it is considered that if the data comprises longer term, the study would be more reliable.

The study consists of 18 listed sectors in BIST to gain a more comprehensive view of the outbreak's economic impact on the country's overall economy. Principally, the aim of the study is to reveal the empirical relationship between daily confirmed case numbers in Turkiye

and total confirmed case numbers in the world with stock prices for selected listed sector indices in BIST using RALS tests.

Primarily the studies in the literature on this topic are presented in the following section of the study. Then the data set of the study is explained. Finally, empirical findings are evaluated, and the study is completed with the conclusion.

2. Literature Review

There have been several studies analyzing the effect of previous outbreaks like HIV, SARS, MERS, H1N1 etc. Most of the studies (Beutels et al. 2009; Hai et al. 2004; Overby et al. 2004; Siu and Wong 2004) found that most industries had been affected by SARS for instance. Since the early beginning of 2020, when the COVID-19 virus first broke out and spread all over the world, many studies have also been carried out on COVID-19. The number of these studies increased after WHO declared COVID-19 as a pandemic on March 11, 2020. In this context, it is collected some national and international studies that work on COVID-19, especially focusing on stock markets in Table 1:

Table 1: Domestic Studies Literature Summary

Author, Year	Abstract
Al-Awadhi et al. (2020)	When they examined all the stocks in the Hang Seng Index and the Shanghai Stock Exchange Composite Index between January 10 and March 16, 2020, they discovered that market returns were significantly inversely related to both the daily expansion of the total number of confirmed cases and the daily increase in the of deaths attributed to COVID-19.
Ashraf (2020)	They analyzed the stock market reaction to the COVID-19 by using daily COVID-19 cases and deaths and stock market returns data from 64 different countries from January 22, 2020, to April 17, 2020. Their research demonstrates that the rising number of COVID-19 instances had a negative impact on stock markets, resulting in worse market returns as the cases rose.
Barut and Kaygin (2020)	They examined the impact of COVID-19 on markets in eleven of the nations with the highest incidence of cases. The results of the study showed that the total number of cases and the indexes of BIST100, FTSE MIB, IBEX35, AEX, and Shangai were cointegrated, whereas no cointegration was seen with the indices of DOW30, DAX, FTSE 100, CAC 40, SMI, BEL 20, SMI.
Göker, Eren, and Karaca (2020)	To investigate the effects of COVID-19, 26 areas in BIST were examined. They discovered that the majority of sectors exhibit negative cumulative non-normal returns (CAAR), with only a handful showing positive CAAR sometimes.

Table 2: Domestic Studies Literature Summary (Continue)

Author, Year	Abstract
Heyden and Heyden (2020)	They looked at how quickly supplies in the United States and Europe responded to the COVID-19. The outcome demonstrated that, even while the stock market's response to the first COVID-19 instance was insignificant, the revelation of the first COVID fatality had a considerable detrimental effect on stock markets.
Keleş (2020)	Using the daily prices in the BIST-30 Index of Borsa Istanbul between March and April 2020, this paper discovered that the market reacts negatively to announcements of the 100th case, the 1000th case, the 1000th death toll, and social measures. The results showed that businesses in the transportation, automotive, and component industries were particularly affected negatively.
Khan et al. (2020)	Using pooled OLS regression, the study looked at how the COVID-19 affected the stock markets of 16 different nations. Their findings indicate that the weekly increase in COVID-19 instances will have a detrimental impact on stock market returns. The findings show that at the early stages of the pandemic, investors do not react to media reports of COVID-19, but that after the confirmation of human-to-human transmissibility, all stock indices negatively responded to the news in the long- and short-event windows.
Kilic (2020)	They discovered negative anomalous returns for many of the indexes by applying the event research method. When they examined the various industries, they found that the trade sector had the largest positive returns while the textile and tourism industries had the highest negative returns.
Phan and Narayan (2020)	This essay examines the reactions of the stock price, the most active financial indicator, during various COVID-19 stages. For the top 25 countries most impacted by the COVID-19, they examine how the governments have responded. They were unable to conduct an empirical verification due to the short data period.
Özdemir (2020)	Using daily data from March 12, 2020 to August 31, 2020, the researchers utilized the Hatemi-J asymmetric causality test to examine the asymmetric relationship between COVID-19 case and death numbers and industry indexes. According to the test results, positive shocks in the number of COVID-19 cases caused both negative and positive shocks in the sector indices.
Öztürk et al. (2020)	They observed that the COVID-19 affects sectors in Turkiye at various levels. While metal products, machinery, and sports were the most adversely affected sectors, insurance and banking sectors, beverage and food, retail and wholesale trade, and real estate were the least affected.

Table 3: Domestic Studies Literature Summary (Continue)

Author, Year	Abstract
Tayar et al. (2020)	They utilized simple linear regression analysis to investigate the sectoral effects of the COVID - 19 outbreak in Turkiye. They discovered that COVID - 19 has a negative impact on the electricity, transportation, financial, industrial, and technology sector indices in Turkiye.
Zeren and Hizarci (2020)	The research aimed to shed light on the factors of the COVID-19 epidemic on stock markets. Maki (2012) cointegration test was used on daily data from January 23 to March 13, 2020. COVID-19 daily total death and case, the analysis results showed that in the long run, all stock markets move together with total death, and total cases have cointegration relationships with IBEX35, KOSPI, and SSE, but not with CAC40, DAX30, FTSE MIB.
Meral (2021)	The study analyzed the performance of Turkish insurance sector by using entropy-weighted TOPSIS method for non-life and life insurance branches. According to the result of the study, COVID-19 pandemic did not have any negative impact on the performance of the non-life branch in the Turkish insurance sector, and negatively affected the performance of the life insurance branch, but the effect was limited.

Source: Collected by Authors

As seen in Table 1, COVID-19 is a popular research area between academicians both in Turkiye and in the world like previous pandemics.

Some studies in the literature like Al-Awadhi et al. (2020) and Ashraf (2020) have concluded that number of COVID-19 cases and death has a negative effect on the index returns of different country stock markets. Some studies like Barut & Kaygin (2020) and Zeren & Hizarci, (2020) have identified a cointegration relationship between COVID-19 case and death numbers and different country stock market indices. When the studies conducted at the country level in the literature are examined, it shows that the trend of the stock markets to be affected by the pandemic is negative.

On the other hand, studies examining the effect of the number of COVID-19 cases and deaths on the prices or returns of sector indices have also been conducted. In the results of these studies, it was reported that different sectors were affected by the pandemic in different directions and levels. (Goker et al., 2020; Ozdemir, 2020; Ozturk et al., 2020).

In this regard it was tried to find that how the number of daily COVID cases in Turkiye and total COVID cases in the world affect Borsa Istanbul sector indices. Also it was aimed to compare the response levels of BIST sector indices to the COVID-19.

The study has two basic differences from the previous studies. First, none of them have examined the whole year from the outbreak of pandemic in Turkiye so it can be said that most studies examined a short-term effect of COVID-19 to stock prices. Second, the study used the RALS-LM unit root test and regression analysis, which are relatively a new and powerful model that considers non-normality.

3. Data Set of the Study

According to TUBITAK (COVID-19 Data Portal, 2021), as of 31 December 2020 there were 2.208.652 total cases, 2.100.650 recovered patients and 20.881 death due to COVID-19 in Turkiye. The situation of Turkiye since the beginning of COVID-19 is seen in the Figure 3:

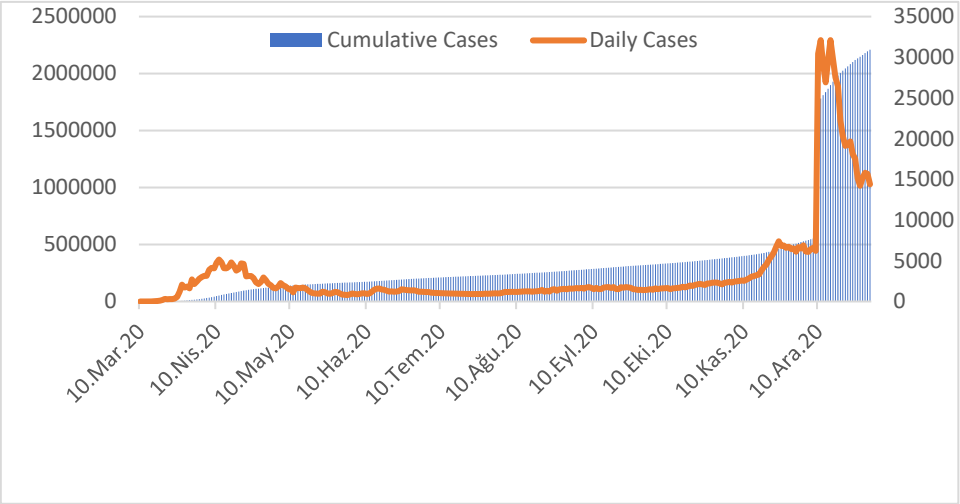

Figure 3: Situation in Turkiye
Source: https://COVID19.tubitak.gov.tr/turkiyede-durum

According to World Health Organization (WHO), globally as of 28 December 2020, there were 84.372.971 confirmed COVID-19 case including 1.837.969 deaths reported to WHO. The situation of the world since the beginning of COVID-19 in Turkiye is seen in the Figure 4:

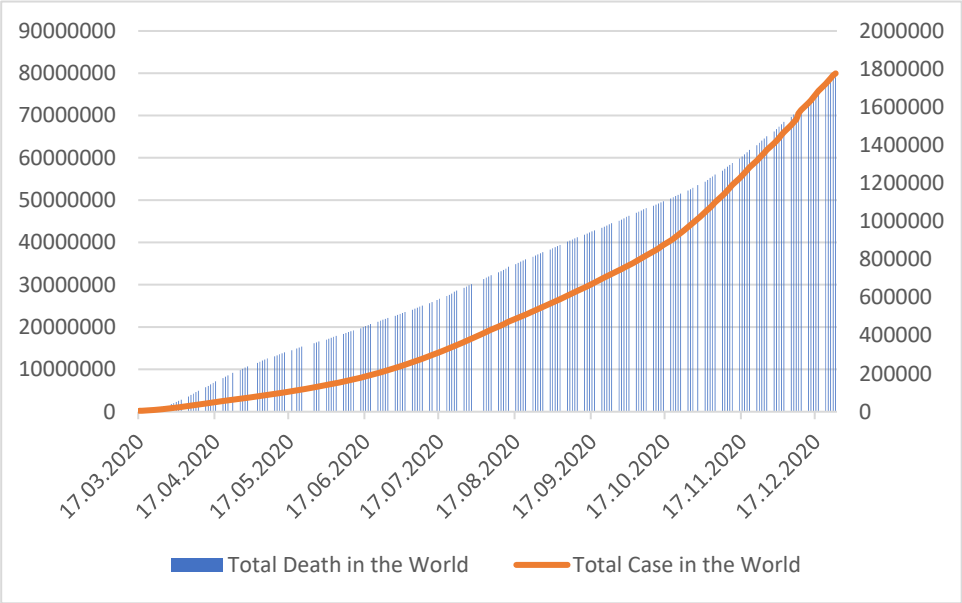

Figure 4: Situation in the World
Source: https:/ourworldindata.org/search?q=cumulative++deaths+and+cases+COVID+19

The aim of this study to analyze impact of the COVID-19 outbreak on 18 BIST sector indices for the period between 17 March 2020 and 25 December 2020. The analysis period began with the announcement of the onset of COVID-19 cases in Turkiye and lasted approximately nine months, during which the cases continued. During the time period studied, the number of cases reached a critical level, and the transmission rate and risk gradually increased. As a result, it became necessary to investigate the market impact of COVID-19.

The variables included in the analysis are reported in Table 2.

Table 2: Data Set

Dependent Variables BIST Sector Indices (y)	Code	Dependent Variables BIST Sector Indices (y)	Code
FINANCIALS	XUMAL	CHEM.PETROL PLASTIC	XKMYA
INDUSTRIAL	XUSIN	METAL PRODUCTS MACH.	XMESY
SERVICES	XUHIZ	MINING	XMADN
TECHNOLOGY	XUTEK	NONMETAL MIN.PRODUCT	XTAST
SPORTS	XSPOR	TEXTILE	XTEKS
TOURISM	XTRZM	FOOD BEVERAGE	XGIDA
TRANSPORTATIONS	XULAS	CONSTRUCTION	XINSA
LIQUID BANKS	XLBNK	ELECTRICITY	XELKT
INSURANCE	XSGRT	TECHNOLOGY CAPPED	XTKJS
Source: Borsa Istanbul Stock Exchange Data Store			
Independent Variables	Code	Source	
Turkiye-Daily Number of COVID-19 Patients	hastag	Republic of Turkiye Ministry of Health	
World-Total COVID-19 Cases	wocase	World Health Organization (WHO)	
Period : 17 March 2020 to 25 December 2020 (week daily data)			

4. Empirical Results

The variables are first analysed to detect the existence of the unit root to examine if the series are stationary or not. The detection of stationary is important. Because, in the presence of a unit root, it becomes difficult for the mean and variance of the variable to converge to a constant value since the series would not be stationary. Therefore, stationary properties of all variables were first examined by using Augmented Dickey-Fuller (ADF) unit root tests.

ADF unit root test was developed by Dickey-Fuller (1979) which is an extended version of the Dickey-Fuller (DF) tests and ADF works based on AR(1) process. The lagged values of the terms were added to the AR(1) process. It is aimed to make the error terms has no serial correlation by adding lagged values (Gujarati, 2016, p. 326). ADF test models are presented in Model 1, Model 2 and Model 3:

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta y_{t-i} + \varepsilon_t \quad \text{(no constant and trend)} \quad (1)$$

$$\Delta y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta y_{t-i} + \varepsilon_t \quad \text{(with constant)} \quad (2)$$

$$\Delta y_t = \mu + \varphi t + \delta y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad \text{(with constant and trend)} \quad (3)$$

In the ADF models above, μ is a constant, φ is the coefficient on a time trend, k is the lag order of the autoregressive process and ε is error term. Imposing the constraints $\mu = 0$ and $\varphi = 0$ corresponds to modelling a random walk. There are three main version of the test mentioned above (Gujaratı, 2016, p. 328).

H_o: $\delta = 0$, H_o accepted and series has a unit root.

H_1: $\delta < 0$, H_o rejected and series has not a unit root

The results of the ADF test are reported in Table 3. Following the previous literature, it was tested the null hypothesis of the unit root in the model.

Table 3: ADF Unit Root Test Results

Variables	T_{ADF}	JB	Variables	T_{ADF}	JB
XUMAL	-1.8 (0)	4.55	XMESY	-3.10 (0)	6.14**
ΔXUMAL	-14.7*(0)		ΔXMESY	-13.1*(0)	
XUSIN	-3.19 (0)	2.31	XMADN	-4.03*(0)	350.00**
ΔXUSIN	-14.22*(0)		XTAST	-2.57 (0)	10.31**
XUHIZ	-2.84 (0)	34.16**	ΔXTAST	-13.35*(0)	
ΔXUHIZ	-12.34*(0)		XTKJS	-5.26 (0)	29.64**
XUTEK	-4.14 (0)	46.57**	ΔXTKJS	-12.57*(0)	
ΔXUTEK	-14.69*(0)		XTEKS	-3.38 (0)	17.99**
XSPOR	-3.22 (1)	13.63**	ΔXTEKS	-13.78*(0)	
ΔXSPOR	-10.35*(0)		XGIDA	-2.94 (1)	5.11**
XTRZM	-3.39 (0)	17.85**	ΔXGIDA	-11.56*(0)	
ΔTRZM	-12.46*(0)		XINSA	-4.15*(0)	15.19**
XULAS	-2.81 (0)	41.13**	XELKT	-2.40 (0)	12.17**
ΔXULAS	-13.08(0)		ΔXELKT	-14.20*(0)	
XLBNK	-1.46 (0)	17.28**	HASTAG	-3.38 (0)	3.38
ΔXBNK	-13.69*(0)		ΔHASTAG	-13.21*(0)	
XSGRT	-2.24 (0)	30.32**	WOCASE	-2.222(5)	25.78**
ΔXSGRT	-13.99*(0)		ΔWOCASE	-7.827*(4)	
XKMYA	-3.37 (0)	1.63			
ΔXKMYA	-13.66*(0)				

Note: (1) * The existence of unit root with null hypothesis respectively at 5% and 10% level of significance are rejected. (2) ** The normal distribution assumption with null hypothesis at 5% significance level is rejected. (3) Values in parentheses indicate appropriate lag lengths.

According to ADF unit root test results, some variables are stationary while others are not. Moreover, Jarque Bera (JB) test results show that the residues of the co-regression models are non-normal distributed expect XUMAL, XUSIN, XKMYA, and HASTAG.

The basic assumption of all conventional unit root tests is that the residuals are normally distributed. When the residuals are not normally distributed, the accuracy of the results obtained using a method based on the normal distribution assumption is called into question. This study continues by applying RALS-LM unit root tests to eliminate non-normal distribution and for robust result. RALS unit root tests are suggested by (MENG et al., 2014, 2017).

Table 4 reports the result of RALS-LM unit root test applied to the variables used in the analysis.

Table 4: RALS-LM Unit Root Test Results

Variables	$T_{RALSLM(0)}$	ρ^2	$T_{RALSLM(1)}$	ρ^2	$T_{RALSLM(2)}$	ρ^2
XUMAL	-1.77 (5)	0.81	-1.94 (5)	0.81	-5.62*(5)	0.82
XUSINAI	-1.03 (12)	0.75	-4.41*(0)	0.79	-4.94*(3)	0.83
XUHIZ	-1.35 (0)	0.83	-3.88*(2)	0.86	-5.73*(0)	0.89
XUTEK	-0.41 (6)	0.79	-5.19*(0)	0.73	-4.73*(11)	0.83
XELKT	-2.54 (7)	0.83	-3.64*(7)	0.83	-5.46*(7)	0.80
XGIDA	-2.05 (1)	0.81	-3.40 (2)	0.83	-4.65*(1)	0.85
XINSA	-1.57 (9)	0.80	-6.16*(0)	0.77	-8.00*(0)	0.78
XKMYA	-1.30 (12)	0.88	-2.73 (0)	0.88	-4.46*(0)	0.87
XLBNK	-1.39 (5)	0.80	-2.44 (5)	0.83	-4.17*(12)	0.83
XMADN	-0.82 (13)	0.90	1.74 (13)	0.89	-6.72*(0)	0.80
XMESY	-1.26 (3)	0.84	-3.29 (0)	0.86	-6.07*(12)	0.94
XSGRT	-0.69 (0)	0.75	-3.66*(9)	0.86	-6.91*(9)	0.87
XSPOR	-2.15 (14)	0.98	-3.38 (14)	0.93	-4.42*(14)	0.98
XTAST	2.18 (0)	0.78	-3.04 (5)	0.82	-7.47*(0)	0.86
XTEKS	-0.23 (13)	0.69	-4.38*(0)	0.75	-5.28*(13)	0.74
XTKJS	0.06 (9)	0.84	-2.85 (13)	0.83	-5.29*(0)	0.73
XTRZM	-1.01 (4)	0.87	-3.04 (4)	0.87	-5.10*(4)	0.94
XULAS	-1.41 (12)	0.68	-3.46 (5)	0.73	-5.56*(5)	0.72
WOCASE	-1.95(10)	0.53	-0.988(13)	0.51	-3.38**(6)	0.48
HASTAG	-2.10 (8)	0.61	-3.19 (14)	0.60	-6.68*(14)	0.74

Note: (1) The existence of unit root with null hypothesis at 5% (*), 10% (**) significance level is rejected. (2) Values in parentheses indicate appropriate lag lengths

In the Table 4, reporting the RALS-LM test results, the BIST sector indexes were examined. According to the RALS-LM(0) (no-break) test result, the unit root with Ho null hypothesis was not rejected. RALS-LM(1) (one break), test result show that the unit root hypothesis was rejected for 7 sectors. Finally, according to RALS-LM(2) (two breaks) test result, the unit root hypothesis was rejected for 18 sectors. The findings show that RALS-LM unit root tests, which take into account the non-normal distribution of residuals, are more robust than other tests (Hepsağ and Akçalı, 2019:67).

The next step is to analyse the effect of the total number of cases in the World and the daily number of cases in Turkiye on BIST sector indices. The lagged values of indices were also added to the model as an independent value. By this way, it was aimed to determine the influence of lagged index values on current index values.

One of the most basic assumptions of OLS approach is compliance with normal distribution. If the errors in the equation have a non-normal distribution, the power of the OLS estimator decreases. When the residues of the co-regression in the model are not normally distributed, analysis results become controversial. The RALS procedure is first introduced by Im and Schmidt (2008). Meng et al. (2014) was adapted this idea test of stationarity that can use the additional high-moment information found in non-normal errors in linear model framework. If the residues of co-regression in the model are not normally distributed, the model is established by expanding the regression with high moments (μ2 and μ3). According to Im and Schmidt (2008) RALS-LM test result, which is created by increasing the residues, were found to be stronger compared to OLS test. It is possible to find more robust results using the RALS procedure when the error term has a non-normal distribution. In the RALS approach, the information in the residuals is also included in the model and the model is made more powerful.

RALS Regression Models form as follows :

$$lny_t = a_o + \delta_1 lny(-1)_t + \delta_2 lnwocase_t + \delta_3 lnhastag_t + \delta_4 w1_t + \delta_3 w2_t + \varepsilon_t \qquad (7)$$

In the Model 7 above, lny, the logarithmic daily values of the 18 sector indices trading in BIST were used for assessment to most business markets in Turkiye. lny(-1) is a delayed value of the lny. a_o is the constant. (δ_1, δ_2 *and* δ_3 are the elasticities of lny(-1), the logarithmic number of the COVID-19 cases in the world (lnwocase), the logarithmic daily number of patients in Turkiye (lnhastag) parameters for lny, respectively. $w1_t$ and $w2_t$ *high moments* and also ε_t is the error term. The delayed value of dependent variable (lny(-1)) was added to model as an explanatory variable in order to avoid the problem of serial correlation. In this context, one of the main assumptions is that sector indices are affected by their own lagging values.

Table 5: Regression Model Results with RALS

Lny	lny (-1)	lnwocase	lnhastag	w1	w2	F-statistic	Adj. R^2
XUMAL	0.9642*	0.0025*	0.0041*	-0.752	355.57*	3344.56*	0.988
XUSINAI	0.9463*	0.0024	0.0034*	2.302	413.15*	12491.24*	0.997
XUHIZ	0.9444*	0.0034*	-0.0005	8.843*	752.71*	6763.46*	0.994
XUTEK	0.7712*	0.0258*	-0.006	7.573*	224.54*	4589.93*	0.992
XELKT	0.9290*	0.0117*	0.0022	3.731*	318.48*	14170.98*	0.997
XGIDA	0.9486*	0.0045*	0.0023***	10.922*	473.74*	7940.28*	0.995
XINSA	0.9212*	0.0077*	-0.0013	-5.762*	347.57*	5181.76*	0.993
XKMYA	0.9614*	0.0027	0.0046*	-0.327	496.94*	8424.56*	0.995
XLBNK	0.9715*	0.0006	0.0049*	-4.831*	262.55*	1609.10*	0.977
XMADN	0.9162*	0.0011	-0.0023	-1.5303	205.63*	1576.80*	0.977
XMESY	0.9448*	0.0095*	0.0039**	5.546*	272.34*	13789.01*	0.997
XSGRT	0.8918*	0.0152*	-0.0053*	4.559*	392.37*	10814.35*	0.996
XSPOR	0.9230*	0.0064*	-0.0075*	-0.253	132.56*	6418.06*	0.994
XTAST	0.9275*	0.0146*	0.0041*	6.642*	235.70*	15918.19*	0.997
XTEKS	0.9387*	0.0090*	0.0029	5.123*	303.26*	13296.69*	0.997
XTKJS	0.8926*	0.0130*	0.0011	4.710*	283.15***	7276.83*	0.995
XTRZM	0.8998*	0.0219*	0.0044*	5.643*	234.72*	15264.64*	0.997
XULAS	0.9567*	-0.0017	0.0070*	-2.424**	202.72*	2291.97*	0.984

Note: 1% (*), 5% (**), 10% (***) respectively, represent the level of importance.

Before explaining the result of RALS regression analysis presented in Table 5, it should be done diagnostic tests as seen in the Table 6:

Table 6: Diagnostic Tests

	Breusch-Godfrey	Ramsey Reset	ARCH
XUMAL	1.4654 (0.1558)	0.2542 (0.6147)	1.2030 (0.2741)
XUSINAI	0.4060 (0.6669)	1.9916 (0.1394)	0.1348 (0.7139)
XUHIZ	0.7208 (0.4877)	2.0762 (0.1513)	2.025 (0.1348)
XUTEK	0.2070 (0.8132)	0.9987 (0.3189)	0.1674 (0.6829)
XELKT	0.3841 (0.6816)	0.4266 (0.5145)	0.1052 (0.7459)
XGIDA	0.7212 (0.4875)	1.8985 (0.1699)	2.1698 (0.1171)
XINSA	0.6341 (0.5316)	1.6564 (0.1997)	0.5174 (0.9560)
XKMYA	1.0343 (0.4165)	2.3036 (0.1028)	0.6576 (0.4184)
XLBNK	1.2295 (0.2360)	2.5179 (0.1143)	0.8454 (0.3590)
XMADN	1.4731 (0.2319)	2.1199 (0.1471)	0.6703 (0.7509)
XMESY	1.8896 (0.1540)	0.7036 (0.4026)	1.1287 (0.3434)
XSGRT	1.6959 (0.1863)	0.1738 (0.6772)	0.1018 (0.7500)
XSPOR	0.8714 (0.6232)	0.1245 (0.7246)	1.3955 (0.2390)
XTAST	1.9187 (0.1497)	0.0886 (0.7663)	2.3795 (0.0954)
XTEKS	1.4298 (0.1147)	0.0906 (0.7637)	2.1194 (0.1471)
XTKJS	0.7893 (0.4557)	1.8379 (0.1769)	1.2725 (0.2495)
XTRZM	1.2988 (0.2753)	1.3580 (0.2454)	1.5038 (0.2216)
XULAS	0.0119 (0.9881)	1.7054 (0.1845)	1.0485 (0.4102)

Note: 1% (*), 5% (**), 10% (***) respectively, represent the level of importance

Table 6 shows the result of RALS regression diagnostic tests revealing the serial correlation, and heteroscedasticity. Breusch-Godfrey Test is implemented to test the serial correlation problem, Ramsey Reset Test is implemented to test the misspesification problem and ARCH is implemented to test the heteroskedasticity problem. According to diagnostic test results there is no serial correlation and no heteroscedasticity effect. Also, there is no misspecified functional form as measured by Ramsey Reset (1969) test. Therefore, in the next step of the analysis, RALS regression results presented in Table 5 are explained.

According to the result of RALS regression analysis in the Table 5, looking at to the lagged values of indices (lny(-1)), it was determined that all coefficients included in the analysis (18 industry indices) are significant at the level of %1. It means that all the indices are significantly affected by their lagged values. Also, XUMAL, XUTEK, XGIDA, XMESY, XSGRT, XSPOR, XTAST and XTRZM are affected both by total number of cases in the world and by the daily number of patients in Turkiye.

XUMAL, XUHIZ, XUTEK, XELKT, XGIDA, XINSA, XMESY, XSGRT, XSPOR, XTAST, XTEKS, XTKJS, XTRZM are affected by the total number of cases in the world. In addition, XUSINAI, XKMYA, XLBNK, XMDN and XULAS are not affected by the total number of cases in the world. It has been found that there is a positive relationship between the selected sector indices and the total number of cases in the world.

This may be due to the fact that the increase in the cases number all over the world reduces the negative impact of current cases in Turkiye on local sectors and reduces people's concerns and sensitivity on this issue.

Looking at the effect of the daily number of patients in Turkiye, it has been found that XUMAL, XUSINAI, XUTEK, XGIDA, XKMYA, XLBNK, XMESY, XSGRT, XSPOR, XTAST, XTRZM, XULAS are affected by the daily number of patients in Turkiye while XUHIZ, XELKT, XINSA, XMADN, XTEKS, XTKJS are not affected. Looking at the direction of relationship, daily number of patients had negative effect on XUTEK, XSGRT, XSPOR sector and it had positive effect on XUMAL, XUSINAI, XGIDA, XKMYA, XLBNK, XMESY, XTAST, XTRZM, XULAS sectors. Positive impact may be unexpected, however it is thought that with the government's measures that started on March 17 and continued later, the sectors recovered, and this may reflected to index prices positively. This results are consistent with some studies that found both positive and negative relationship between COVID-19 and some sector indices such as Barut and Kaya (2020); Özdemir (2020); Öztürk et al. (2020); Peker and Demirhan (2020), Meral (2021).

5. Conclusion

In this study, the impact of the COVID-19 on BIST sector indices was examined between March 17 and December 25, 2020. During the time of the study, there have been several studies investigating BIST stock market indices. However, the study has two distinctive features. Firstly, it consists of daily data set covering the whole year since the outbreak of the pandemic in Turkiye so that it provides a broad perspective by examining 18 sector indices' daily data. Secondly, the econometric application is a relatively new and powerful estimation method (RALS, LM unit root tests, and regression analysis) that takes into account the non-normal distribution of residuals. The stationarity levels of the variables used in the study were first tested with the ADF unit root test. The basic assumption in unit root tests is that the residuals are normally distributed. However, the residuals of the variables in the analysis

were not normally distributed. Since the basic assumption is not fulfilled, the findings obtained have become controversial. For this reason, the analysis was continued with RALS-LM unit root tests that considers the non-normal distribution. Comparing the ADF unit root test results to the RALS-LM findings, RALS-LM was found that more sectors were stationary at the level. According to the RALS-LM unit root test with two structural breaks, all variables were stationary at level. The obtained results show that RALS-LM unit root tests are more powerful. The study is carried on with regression analysis. According to the results of the RALS regression analysis, all sector indices are affected by their lagged values. BIST sector indices were limited affected by the COVID-19 in the analyzed period. Considering the sectors individually, the finance, technology, food and beverage, metal goods, insurance, sports, nonmetals, and tourism sectors are affected by both the total number of cases in the world and the daily number of patients in Turkiye. Services, electricity, construction, textiles, and technology sectors are only affected by the total number of cases worldwide. Industry, chemical-petroleum, liquid banks, and transportation sectors are only affected by the number of daily patients in Turkiye. According to the results of the analysis, the top three sectors mostly affected by COVID -19 cases in the world are the technology, tourism, and insurance sectors, respectively. In Turkiye, the top three sectors that mostly affected from the changes in the number of patients are sports, transportation, and insurance, respectively. Since COVID-19 still continues, it was not possible to determine the impact level of COVID-19 thoroughly. In this context, the main purpose of the study is to compare the effects of COVID-19 on individual BIST sector indices rather than the level of impact of COVID-19 on BIST. When the results obtained are evaluated, technology is the most affected sector by COVID-19. Indeed, the COVID-19 interrupted face-to-face communication and so promoted digitalization. According to the analysis, the tourism and transportation are the most affected sectors by the COVID-19. Periods of restrictions, such as curfews, may negatively affect the transportation sector. In the tourism sector, restrictions have led to the new alternative vacation options. The insurance sector is also among the sectors expected to be most affected by the COVID-19. As stated by the results of the analysis, the daily patients in Turkiye had a negative but limited impact on the insurance sector. However the case number in the world had a positive influence on the insurance sector. The limitation of the study is that the analysis covers a short period (approximately 9 months from the date of the announcement of the COVID-19 in Turkiye. In this context, the information available is not sufficient to make a brief general evaluation. However, it was observed that the influence of COVID-19 on BIST sector indices remained limited in the analyzed period, and stock market sector indices

generally followed an upward trend in 2020. For further studies, some other variables such as vaccination, official announcements, incentive packages, and restrictions may be added to the model and the scope of the study can be expanded.

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Annex 1. Price Chart of BIST 100 Sector Indices (March-December 2020)