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THE IMPACT OF THE COVID-19 PANDEMIC PROCESS ON THE INDUSTRIAL COMPANIES TRADED ON THE ISTANBUL STOCK EXCHANGE (BIST): A BAYER-HANCK COINTEGRATION ANALYSIS [1]

Covid-19 Pandemi Sürecinin BIST'de İşlem Gören Sanayi Şirketlerine Etkisinin Analizi: Bayer-Hanck Eşbütünleşme Analizi

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ABSTRACT

In Turkey, great importance has been attached to industrialization since the proclamation of the Republic, and the industrial sector has been considered as the key to development. The driving force of the Turkish economy is composed of the largest 500 companies and the following 500 largest companies. Traded on the Istanbul Stock Exchange (BIST)-Industrial Index, and predominant in number, these companies meet a large part of the domestic demand while also realizing a significant proportion of Turkey's exports. Besides, their shares in industrial employment are quite large. For such reasons, the experiences of these firms regarding the new coronavirus (COVID-19) pandemic process and the ways they are affected have a considerable bearing on the Turkish economy. Therefore, revealing the ways these large-scale companies are affected by different structural changes has importance from the viewpoint of policymakers. The purpose of this study is to determine the effects of the number of COVID-19 cases on the BIST Industrial Index based on the daily data of the period 16.03.2020-30.06.2020, through the Bayer-Hanck (2013) cointegration analysis for long-term and an error correction model for short-term relationships. As a result of the analysis, it was observed that the number of COVID-19 cases had a 3.4% reduction effect on the BIST Industrial Index in the long term and a 4.8% reduction effect for the short term.

Keywords: BIST-Industrial Index, The number of COVID-19 cases, Cointegration Analysis

JEL Code: C50, D24, E01

ÖZET

Türkiye'de Cumhuriyetin ilanından itibaren sanayileşmeye büyük önem verilmiş ve sanayi sektörü, kalkınmanın anahtarı olarak görülmüştür. Türkiye ekonomisinin itici gücünü en büyük 500 firma ve ikinci en büyük 500 firma oluşturmaktadır. BIST-Sanayi Endeksi içinde işlem gören ve sayıca ağırlıklı olan bu firmalar, yurtiçi talebin büyük bir kısmını karşılarken, Türkiye ihracatının da önemli bir oranını gerçekleştirmektedir. Ayrıca, sanayi istihdamındaki payları da oldukça yüksektir. Bu gibi nedenlerle, bu firmaların yeni tip koronavirüs (COVID-19) pandemi süreci deneyimleri ve etkilenme biçimleri Türkiye ekonomisini de derinden etkilemektedir. Dolayısıyla, bu büyük ölçekli firmaların farklı yapısal değişimlerden etkilenme biçimlerinin ortaya konulması politika üretenler açısından önem taşımaktadır. Bu çalışmanın amacı, [16.03.2020-30.06.2020] günlük veriler için, COVID-19 vaka sayılarının BIST-Sanayi Endeksi üzerindeki etkilerini, uzun dönem için Bayer-Hanck (2013) eşbütünleşme analizi ve kısa dönem ilişkiler için hata düzeltme modeli yardımıyla belirlenmesidir. Analizler sonucunda, uzun dönemde COVID-19 vaka sayılarının BIST-Sanayi Endeksi üzerinde %3.4 azaltıcı etkisi olduğu ve kısa dönem için %4.8 azaltıcı etkisi olduğu görülmüştür.

Anahtar Kelimeler: BIST-Sanayi Endeksi, COVID-19 Vaka Sayısı, Eşbütünleşme Analizi

Jel Kod: C50, D24, E01

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1. INTRODUCTION

The industrial sector is the key sector of economic growth in terms of both its connection with other sectors and the added value and employment it creates. The development of the industrial sector positively affects the agriculture and services sectors as well. The industrial sector continues to play a determining role in the development of agriculture and services since it has demand and supply relationships with all other sectors of the economy for substantial amounts of intermediate inputs due to its wide range of subsectors (İyidoğan, 2012). Agricultural and services sectors greatly benefit from the high-income consumers, more advanced equipment and inputs, and more improved storage and transportation facilities created by the industrial sector. The growth trend in the services sector is largely shaped by the activation in the industrial sector (Eşiyok, 2013). In addition to these, the industrial sector plays a key role in the development of new service sectors such as finance, technical education, design, maintenance-repair, and logistics, and in creating technical and administrative skills in these sectors. The agricultural sector has to get input from the industrial sector in order to continue its development and increase its productivity; at the same time, it provides raw materials to the industrial sector (Kepenek, 2014). Therefore, the companies in the key industrial sector, and how these companies are affected in times of structural change and crisis periods are of great importance for all policymakers.

The driving force of the Turkish economy is composed of the largest 500 companies and the following 500 largest companies. These companies meet a large part of the domestic demand while also realizing a significant proportion of Turkey's exports. Besides, their shares in industrial employment are quite large. For these reasons, the experiences of these firms regarding crisis years and the ways they are affected influence the Turkish economy deeply (Terzioğlu and Dişbudak, 2017). On the other hand, overcoming the crisis and moderating structural change brings along a long and painful process. However, it is thought that the adaptation process in crisis periods could be even more severe and apparent.

It can be enlightening to analyze the effects of structural change and crisis in developing countries through large companies that accomplish the majority of production, employment, and exports. Therefore, it is believed that the sectoral distribution numbers, employment rates, and exports of the companies in the list of the largest 500 industrial companies may provide insight in terms of structural change, and the reactions of these companies during crisis years will also help us understand the reactions to different crises. Despite the comments that the industrial sector has lost its significance, it continues to maintain its importance. The analysis of change and transformation in the industrial sector is of paramount importance as its contribution to the economy, particularly in terms of income and employment, has become even more vital.

The objective of this study is to determine the long and short-term relationships of the number of COVID-19 cases with the BIST Industrial Index. Since the data of the number of cases was daily, the BIST Industrial Index, which was workable with daily data, was chosen to represent the industrial sector in the relationship analysis.

2. THE IMPACT OF THE COVID-19 PANDEMIC PROCESS ON THE INDUSTRIAL COMPANIES TRADED ON THE BIST

Health and economy are inseparable and integral parts of the system for the maximization of social welfare. The risks posed on world economies by the pandemic, as well as its medical dimensions, is one of the most talked-about agenda topics these days. Production activities have slowed down worldwide due to the pandemic, and many sectors have been severely damaged. As at the global level, Turkey's economy is also affected by the outbreak negatively (Arısoy, 2008). Countries are facing both a fatal pandemic and an economic crisis of unprecedented depth that will negatively affect the welfare of billions of people. Therefore, in addition to the medical and public

health measures to be taken to control the pandemic, the economic impacts of these measures should also be taken into account.

The new coronavirus COVID-19 brought along economic uncertainties as in major financial crises and caused very sharp declines in the markets. The measures and prohibitions imposed because of the virus affected many sectors. Some enterprises decreased the production volume, while others paused the production. The spread of the coronavirus led to stock market crashes, increased financial volatility, declining nominal interest rates, and the contractions in real economic activities as reflected in the real gross domestic product (GDP) (Barro, Ursua, and Weng, 2020). In summary, due to the pandemic, it may be possible to experience a decrease in the growth rate, an increase in the unemployment rate, an increase in the inflation rate, deterioration in the balance of payments, deterioration in the budget balance, and difficulties in external financing. In summary, due to the pandemic, it is possible to experience a decrease in the growth rate, an increase in the unemployment rate, an increase in the inflation rate, deterioration in the balance of payments, deterioration in the budget balance, and difficulties in external financing.

Besides, these shocks have caused many economists to express their concerns about the impending global recession. Like its effects in many areas of life, the impacts of the coronavirus on the financial system are being monitored, felt, and investigated anxiously (Fetzer et al., 2020). The impact of the virus on the financial system depends on how much further the virus will spread across the world, its impact on economic activities, fiscal and monetary policy reactions to the shocks, and regulatory responses to possible bank vulnerabilities (Beck, 2020). While many market watchers decrease their economic growth forecasts this year, financial market participants expect an easier monetary policy for alleviating the shock (Cecchetti and Schoenholtz, 2020).

Although the global economic impacts of the coronavirus have not been seen with certainty yet, financial markets have responded to the virus dramatically. The impact of the coronavirus in international capital markets was clearly seen on March 9, 2020, when important stock indices lost about 10% of their values in one day. That was the highest daily decrease since September 11, 2001 (Daube, 2020). In the last few trading days of February, there was a decrease of approximately 10% in all three main US stock indices, and the FED lowered the interest rates (Feng et al., 2020). Looking at the overall effects of the coronavirus, an extraordinary drop of 30% was observed in the equity markets of the European Union and the USA (Gormsen and Koijen, 2020).

In many financial crises experienced around the world, it is seen that the effects of crises on economic and financial activities are generally negative. However, when analyzed on the basis of sectors, it can be said that the negative effects are much higher in some sectors, and the level of impact is lower in others. It is even possible to observe that the effect of the crisis is positive for some sectors (McKibbin and Fernando, 2020).

Total production in the economy is mainly performed in the sectors of services, industry, construction, and agriculture. The economic slowdown caused by COVID-19 does not affect all the sectors in the same way. Some sectors might slow down and incur serious losses; others, on the other hand, might show an increase. For example, while many sectors based on tourism such as air transportation, land transportation, entertainment, and lodging sector will suffer serious damage, there will be an increase in sectors such as cleaning agents, mask making, online shopping, and distance education systems. These changes will also affect imports and exports accordingly. Overall, there will be a net macroeconomic loss, as there is a serious slowdown in economic activities (Ayittey et al., 2020).

With a short-term calculation, assuming that the GDP loss will be 10% in the first quarter of 2020 due to COVID-19, the estimated 30-day GDP loss is 31.7 billion TL. Considering the long-term economic impacts of the pandemic, this amount shows that at least 31.7 billion TL of medical,

economic precautionary, and administrative expenses to be made to shorten the pandemic by 30 days will well be "worth" it. Considering the GDP loss calculation made with simplifying assumptions, the continuously increasing negative effects of the pandemic on the economy, and the long-term impacts of the crisis, an economic support package of 100 billion TL may not be sufficient (ULISA, 2020).

Table 1: Sectors and COVID-19

Sector	% Share in GDP (2018)	Contribution to Growth (% point, 2018)	COVID-19 Impact Rate	Reactivation Process*
Agriculture, Forestry, and Fishing	**5.82**	**0.11**	Low	Rapid
Industry	**22.30**	**0.29**	High	Slow
Mining and quarrying	1.00	0.05	High	Slow
Manufacturing Industry	19.05	0.20	High	Slow
Electricity, gas, steam and air conditioning production and distribution	1.35	0.03	High	Rapid
Water supply, sewerage, waste management, and remediation activities	0.90	0.00	Low	Rapid
Construction	**7.17**	**-0.15**	High	Slow
Services	**54.26**	**2.49**	High	Slow
Wholesale and retail trade	12.09	0.39	High	Rapid
Transportation and storage	8.19	0.44	High	Rapid
Accommodation and food service activities	3.12	0.47	High	Slow
Information and communication	2.47	0.12	Low	Rapid
Financial and insurance activities	3.00	0.00	Low	Rapid
Real estate activities	6.79	0.20	High	Slow
Professional, scientific, and technical activities	2.33	0.05	Low	Rapid
Administrative and support service activities	2.85	-0.19	High	Slow
Public administration and defense; compulsory social security	4.85	0.78	High	Slow
Education	4.17	0.24	Low	Rapid
Human health and social work activities	2.49	0.21	Low	Moderate
Cultural, art, and social service activities	0.91	0.06	High	Slow
Other service activities	0.95	0.03	Uncertain	Uncertain

Note: It was calculated by the data obtained from the TR Ministry of Treasury and Finance. The total GDP is not 100% as taxes and subsidies are not included, and the sum of growth contribution points does not give the growth rate.
* The reactivation process of the sector was evaluated with precautions such as masks and gloves.
Source: ULİSA (2020).

It is clear that the epidemic will put pressure on companies with respect to comparing the efficiency of a global supply chain with the robustness of the local supply chain. It is, of course, possible to localize the supply chain to some extent in some branches of the manufacturing industry. However, adhering to the local supply principle, especially for products consisting of hundreds of components/parts, will decrease the possibility of benefiting from economies of scale above all (Luo and Tsang, 2020). There is an economics of scale advantage provided by global integration; any loss here will mean the creation of additional idle capacities for every country, which means cost.

The prices in a country's equity markets reflect investors' expectations about the future profitability of companies as well as their expectations about the financial and political stability of the country. Therefore, changes in prices are shaped by the risk perception of the investor (Wagner, 2020). On the other hand, unforeseen events like pandemics are expected to affect the financial assets of countries directly. The panic environment caused by the exit of the investors looking for safer investment instruments from the country's stock markets can cause prices to decrease and volatility to increase (Estrada et al., 2020).

3. ECONOMETRIC ANALYSIS

3.1.Data Description

In the study, the long-run and short-run relationships between the number of COVID-19 cases and BIST Industrial Indices were analyzed based on the daily data of 5 weekdays in the period 16.03.2020-30.06.2020. The data were obtained from the databases at https://www.tcmb.gov.tr and https://COVID19.saglik.gov.tr/. The analyses were performed through EViews version 10.0 and STATA version 15.0. The variables included in the model are given in Table 2.

Tablo 2: Description of the Variables Examined in the Analysis

Variable	Indication	Description
Number of COVID-19 cases	COVID_NO	Independent variable
BIST Industrial Index	BIST_IND	Dependent variable

The courses of the variables during the given period is shown in Figure 1.

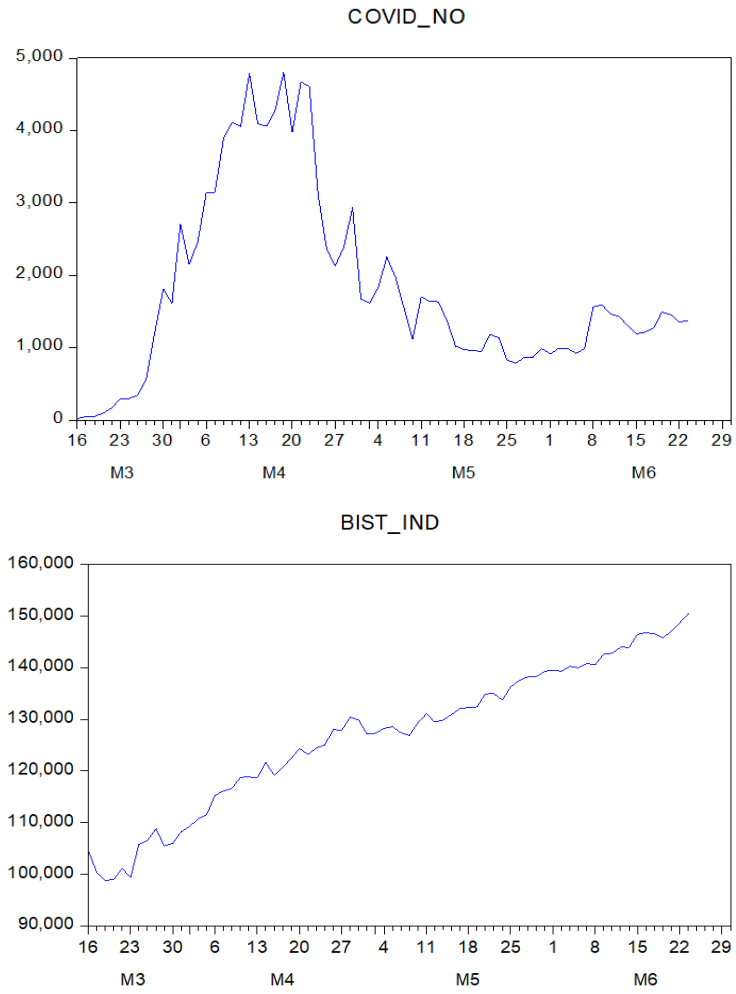

Figure 1: The Time Courses of the Variables

Descriptive information about the data is given in Table 3.

Table 3: Descriptive Information about the Data

Statistics	COVID_NO	BIST_IND
Mean	1816.389	126781.0
Median	1462.500	128381.6
Maximum	4801.000	150438.8
Minimum	18.00000	98836.90
Std. Dev.	1284.475	14148.05

3.2.Econometric Method

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were employed for stationarity examinations. There are specific criteria frequently used in the literature to determine the common lag length for the variables in an equation system. These criteria are Final Prediction Error (FPE), Hannan-Quinn (HQ), Schwarz (SW), Likelihood Ratio (LR), and Akaike Information Criteria (AIC). The lag length was determined according to these criteria. The Bayer and Hanck (2013) Cointegration Analysis was employed to investigate the long-run relationship. An error correction model was applied for the short-run relationships.

3.3.Results and Discussion

In the first stage, stationarity tests for the data were analyzed. For each test, "constant" and "constant + trend" options were used. The logarithm of the variables was taken to eliminate seasonality.

Table 4: ADF and PP Unit Root Test Results of the Variables

Variables	ADF		PP	
	Constant	Constant + Trend	Constant	Constant + Trend
LogCOVID_NO	-0.856(0.115)	-0.924(0.121)	-0.952(0.127)	-1.054(0.135)
LogBIST_IND	-1.145(0.118)	-1.188(0.124)	-1.182(0.129)	-1.248(0.131)
ΔLogCOVID_NO	-7.442(0.000)*	-7.677(0.000)*	-7.349(0.000)*	-7.521(0.002)*
ΔLogBIST_IND	-8.455(0.005)*	-8.901(0.006)*	-8.673(0.009)*	-8.957(0.000)*

* Stationary variable for 0.05

Note: Values in parentheses are (p) values, and Δ denotes the first-order difference.

According to the results in Table 4, all variables had unit roots. The variables were stationary for the first-order difference; there was stationarity at the I(1) level. Lag lengths were determined for the cointegration analysis.

Table 5. Criteria Used to Determine Lag Levels of the Variables

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1271.308	NA	1.96e+14	38.58508	38.65144	38.61130
1	-1066.606	390.7934	**4.48e+11***	**32.50322***	**32.70228***	**32.58188***
2	-1064.129	4.579506	4.69e+11	32.54936	32.88113	32.68046
3	-1061.357	4.956340	4.87e+11	32.58657	33.05104	32.77010
4	-1057.904	5.964613	4.96e+11	32.60314	33.20032	32.83911
5	-1057.056	1.412668	5.48e+11	32.69867	33.42855	32.98708
6	-1049.606	11.96580*	4.95e+11	32.59411	33.45670	32.93496

As can be seen from Table 5, the majority were suitable for criterion "1" lag. In that case, the cointegration analysis would be performed with the first-order differences of the variables and 1 lag length.

3.4.Bayer-Hanck (2013) Cointegration Analysis

The Engle-Granger (1987) cointegration test, estimated based on the residuals of a long-run regression model, is a test that can reveal the long-run relationship between series, without making the series that have unit roots stationary. However, the Engle-Granger cointegration test is considered to be weak in models with more than one explanatory variable (Govindaraju and Tang, 2013). The Johansen (1991) cointegration test, which was developed later, is highly sensitive to lag length (Kızılgöl, 2006). In the following years, Boswijk (1994) introduced a new cointegration test, which was based on the error correction model and applied with F-statistic. As for the Banerjee, Dolado, and Mestre (1998) test, it is based on the error correction model and t-statistic. None of the mentioned cointegration tests are perfect or completely strong. Based on the fact that the cointegration tests in the literature delivered contradictory results, Bayer & Hanck (2013) developed a new test that interpreted the Engle & Granger (1987), Johansen (1991), Boswijk (1994), and Banerjee, Dolado, & Mestre (1998) cointegration tests together. Combining the probability values (significance levels) of the said tests and reaching a stronger cointegration test,

the cointegration test in Bayer & Hanck's (2013) study is applied by analyzing the probability values of Engle-Granger's (1987) single-equation test, Johansen's (1991) multi-equation test, Boswijk's (1994) test based on the error correction term, and Banerjee, Dolado and Mestre's (1998) tests (Aktürk, Yılancı, and Bozoklu, 2014; Shahbaz, Farhani, and Öztürk, 2013). Bayer & Hanck (2013) cointegration test combined individual probability values by following Fisher's chi-square distribution formula (Arı, 2016):

$$EG - JOH = -2[\ln(P_{EG}) + \ln(P_{JOH})] \quad (1)$$

$$EG - JOH - BO - BDM = -2[\ln(P_{EG}) + \ln(P_{JOH}) + \ln(P_{BO}) + \ln(P_{BDM})] \quad (2)$$

P_{EG}, P_{JOH}, P_{BO}, P_{BDM} in Equation (1) and Equation (2) expresses the probability values of the Engle-Granger (1987), Johansen (1991), Boswijk (1994), and Banerjee, Dolado, & Mestre 1998) cointegration tests. If the calculated test statistic is greater than the critical value found by Bayer and Hanck (2013), the null hypothesis that there is no cointegration relationship is rejected, and it is decided that there is a cointegration relationship between the series. The results of the Bayer-Hanck cointegration test are given in Table 6.

Table 6: Bayer-Hanck (2013) Cointegration Test Results

Model	**EG-JOH**	**EG-JOH-BO-BDM**	**Cointegration**
FBIST_ind = f (FCOVID_no)	18.445*	29.102*	Yes
Significance Level	**Critical Values**	**Critical Values**	
1 %	16.372	31.445	
5 %	11.251	21.754	
10 %	9.764	15.051	

Note: * and ** notations indicate cointegration at 1% and 5% significance levels. "F" notation represents the first-order difference.

When the results of the Bayer and Hanck (2013) cointegration test was examined, it was seen that there was a cointegration relationship between BIST_IND and COVID_NO since the two calculated Fisher Test statistic values were greater than the critical value for BIST_IND. Thus, the existence of a long-run relationship was determined between these variables.

The long-run cointegration coefficient estimates for the model analyzed in terms of a cointegration relationship were made by the Fully Modified Ordinary Least Squares (FMOLS) Method.

Table 7. FMOLS Long-Run Cointegration Coefficient Estimates

Model	**F(COVID-NO)**
FBIST_ind = f (FCOVID_no)	-0.034*

* Statistically significant variable for 0.05; the Newey-West method was used to try to overcome the autocorrelation and heteroscedasticity problems in the estimations.

When conducting analyses by the FMOLS method, the Newey-West method was adopted with the aim of overcoming the autocorrelation and heteroscedasticity problems in the estimates. As a result of the assumption tests, there was no case of assumption deviation. According to Table 7, the number of COVID-19 cases reduces the BIST Industrial Index by 3.4%.

A vector error correction model (VECM) was estimated to investigate the short-run dynamics of the variables acting together in the long run. The information obtained as a result of this estimation is given in Table 8:

Table 8: Short-Run Error Correction Model Estimation Results

Dependent Variable: $\Delta LBIST\_IND_t$	**Coefficient**	**Diagnostic Tests**
$\Delta LCOVID\_NO_t$	-0.048*	R^2 = 0.715, *Adj.* R^2 =0.709, *F(p)*= 0.000*****, ***Breusch-Godfrey LM Test*** *(p)*= 0.128*****, ***White Test*** *(p)*=0.144*, ***Ramsey RESET Test*** *(p)*= 0.139***** , **JB Test** (p)= 0.287
ECT_{t-1}	-0.427*	
Constant	1.905*	

Note: The * sign indicates statistical significance at the 5% significance level, and JB indicates the Jarque-Bera normality test probability value. The Newey-West method was utilized in order to eliminate the autocorrelation and heteroscedasticity problems in the estimations.

In Table 8, significant results were obtained for the model, and the number of COVID cases and the BIST industrial index were found to be interrelated in the short run. The coefficient of the error correction term is negative and statistically significant. In other words, the error correction mechanism of the models works. 42.7% of the short-run deviations between the series moving together in the long run disappear and the series converge again to the long-run equilibrium value. In other words, deviations occurring in the short run are eliminated, and the variables get close to the equilibrium value in the long run again. The impact of a shock entering the system will disappear after 1/0.427= 2.34 period (days).

4. CONCLUSION

The industrial sector creates positive externalities throughout the economy due to its characteristics mentioned before and accelerates economic growth through these externalities. According to Kaldor, the growth of the industrial sector increases the level of productivity not only in itself but also in other sectors by means of its wide division of labor opportunities. Kaldor, therefore, regards the industrial sector as the engine of growth. Since the experiences of the companies operating in the industrial sector regarding crisis periods and the ways they are affected will have a significant impact on Turkey's economy, it is worth examining in terms of policymakers.

In the fight to control COVID-19, the most important problem for Turkey, as for all countries, is the lack of data and information and the uncertainty. In order to overcome these problems, different academic studies are needed within the framework of a systematic econometric analysis and with an interdisciplinary approach. Hence, the purpose of the study is to determine the effects of the number of COVID-19 cases on the BIST Industrial Index based on the daily data of the period 16.03.2020-30.06.2020, through the Bayer-Hanck (2013) cointegration analysis for long-term and an error correction model for short-term relationships. According to the Bayer and Hanck (2013) cointegration test results, the two calculated Fisher Test statistic values were greater than the critical value; therefore, it was determined that there was a cointegration relationship between BIST_IND and COVID_NO, and the two variables were correlated in the long run. The Newey-West method was utilized to eliminate the autocorrelation and heteroscedasticity problems in the estimation of the cointegration equation coefficient according to the FMOLS method. As a result of the analysis, the number of COVID-19 cases decreases the BIST Industrial Index by 3.4% in the long run. An error correction model was estimated for the short-run relationships; since the coefficient of the error correction term was negative and statistically significant, it was determined that the error correction mechanism was operative. In the short run, the number of COVID-19 cases reduces the BIST Industrial Index by 4.8%. The reduction effect is larger in the short run; as the period extends, the reduction effect shows a decrease.

As can be seen from the results, the index of industrial firms traded in BIST has decreased during the pandemic process. Although the declines in the markets are mainly due to economic and financial variables, investors' fear of losing also fuels the negativities in the markets. It was revealed in many studies that larger companies in the industrial sector of Turkey's economy were more resilient to crises and managed to turn crises into opportunities or at least maintained their positions in times of crisis. However, the pandemic created an unexpected external effect, and financial markets began to decline globally. In case the pandemic process lengthens, permanent policies should be produced for fragile sectors, and certain programs such as agricultural support packages should be implemented urgently. It should not be forgotten that the most critical threshold in this process is the continuity of the production chain; for this to continue, measures should be taken urgently to isolate and protect the working population. When considering the dimensions of the pandemic and its long-term economic impacts, it is obvious that the measures put into practice, such as income transfers, debt postponements, tax/credit concessions, direct funding, guaranteed debts, should be further increased. If there is no confidence in the markets, the

first striking effect will be reflected in financial markets. Unpredictable events such as pandemics are expected to affect countries' financial assets directly. The panic environment caused by the exit of the investors looking for safer investment instruments from the country's stock markets can cause prices to decrease and volatility to increase.

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