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Research Article

Investigation of Causality Relationships among COVID-19 Cases, ISE100 Index, Dollar, Euro, Gram Gold Prices and 2 Years Bond Rates: The Case of Turkey

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ABSTRACT

The purpose of this research is to analyze such economic data during the outbreak of the COVID-19 in Turkey. The variable rates were taken from COVID-19 situations, ISE-100 index, Turkish lira dollar (TRY), TRY euro prices, TRY gram Gold and two year bond rates. General COVID-19 information was provided and certain financial indicators were investigated in COVID-19 (47 days). First of all, these variables were used as descriptive statistics and correlation matrix. For the purposes of stationarity testing, the first variables were stationary with Augmented Dickey-Fuller and Phillips-Terron Tests. The lag duration of the deployment model VECM was then calculated as the fourth lag with the highest information requirement. The co-integration relationship between the variables was calculated by the Johansen Cointegration Test. Thanks to this relationship, the variables have a long-term correlation. The Vector Fix Model (VECM) was chosen because it is co-integration. Inverse roots, autocorrelation and normality have been developed, which are essential assumptions to use the VECM (4) model; Therefore, the Granger Causality / Block Exogeneity Wald Test was applied to the variables of the VECM(4) model to define causality relationships between these variables. The results of this test have identified causalities for Turkey 2 years of government bond rates, Euro in TRY, Dollar prices in TRY and Gram in TRY

Keywords: COVID-19, COVID-19 Turkey, Euro, Dollar, Gold, Bonds, ISE100

1. Introduction

The 2019-2020 coronavirus pandemic (COVID-19) is an incessant pandemic caused by extreme coronavirus acute disease (SARS-CoV-2). The pandemic was reported in 2019-2020. The first outbreak in December 2019 was recorded in Wuhan, China (World Health Organization, 2020a). On 11 January 2020, the first death was reported (Pharmaceutical Technology, 2020). The World Health Organization (WHO) on 30 January 2020 called the epidemic an International Public Health Emergency (PHEIC) and on 11 March 2020 it recognized it as a pandemic [(World Health Organization, 2020b; World Health Organization, 2020c]. Other signs of COVID-19 include acute infection of the air (ARI), exhaustion, rage, fever, or temperature level of 0.01 ° C and cough. Contacting with COVID-19 confirmed patients in particular (within 2 meters for more than 15 minutes) triggers COVID-19 disease (World Health Organization, 2020d).

After April 2020, COVID-19 does not occur in countries other than small countries / regions that receive data. Countries have taken stringent steps to tackle the COVID-19 outbreak, such as curfews and education disturbances. COVID-19 has spread, with several financial, political and social implications, in particular in the United States (USA) and numerous European countries. As at 25 April 2020 in the nation, COVID-19 had 2.868.539 cases, 201.502 cases, and the number of patients treated was 811.660. Although the overall death rate is 7.02% worldwide, 14.16% of the top 10 countries are the highest in France. However, although the average rate recovered is 28.30% globally, it is 93.13% among the top 10 countries in China with the highest recovered rate. The U.K., however. This has a recovery rate of 0.52 percent that is the lowest.

107,773 COVID-19 cases have been confirmed in Turkey which will be examined in this report. Among these, 25582 is recuperated, while 2,706 died. Turkey is the second lowest-fatality country in the top ten countries with 2.51 percent. Nevertheless, this is slightly below global average at a recovered rate of 23.74 percent. This may be one of the reasons that Turkey is one of the countries with the most recent (47 days) COVID-19 outbreak. The rate of recovery in other countries can increase over time (Johns Hopkins University, 2020).

	Confirmed Cases	Deaths	Recovered People	Mortality Rate (per 100)	Recovered Rate (per 100)	Days since the first case
WORLD	2,868,539	201,502	811,660	7.02%	28.30%	147 days
U.S.A.	924,865	53,070	99,346	5.74%	10.74%	101 days
Spain	223,759	22,902	95,708	10.24%	42.77%	85 days
Italy	195,351	26,384	63,120	13.51%	32.31%	85 days
France	159,952	22,648	45,372	14.16%	28.37%	89 days
Germany	155,782	5,819	109,800	3.74%	70.48%	92 days
U.K.	149,556	20,381	774	13.63%	0.52%	85 days
Turkey	107,773	2,706	25,582	2.51%	23.74%	47 days
Iran	89,328	5,650	68,193	6.33%	76.34%	66 days
China	83,901	4,636	78,138	5.53%	93.13%	147 days
Russia	74,588	681	6,250	0.91%	8.38%	60 days

Source: Johns Hopkins University, 2020

Table 1. Top 10 COVID-19 Countries (25 April 2020).

2. Turkey Economy with COVID-19 Disease

In most countries economic stagnation can occur, especially during epidemics or wars, and economic crises can also occur after these stagnations. The main purpose of the analysis was to analyze the relationship of some of the economic indicators in Turkey during COVID-19. In this link, daily (CASES), COVID-19 is considered as the ISE 100, which holds the 100 highest shares in market value and volume traded in Borsa Istanbul, Turkish Lira dollar prices (USD / TRY), Turkish Lira euro prices (EUR / TRY), Turkish Lira gold price per gram (GAU / TRY) and Turkey bond prices for 2 years (2-years Bond) were analyzed daily. Their findings include:

A recent report in the Wall Street Journal notes that a decline of more than 12% in the Dow Jones industrial average on 16 March 2020 was the second-worst of 124 years. The phenomenal volatility is not entirely explained by these factors. "In general, cycles of high volatility are correlated with economic and political instability (Gormsen & Koijen, 2020). In the case of Figure 1 after the first appearance of COVID-19 in Turkey, ISE 100 values were analyzed based on this example. In the first 2 weeks, COVID-19 was seen to have decreased considerably. But the index almost returned to its former level later on.

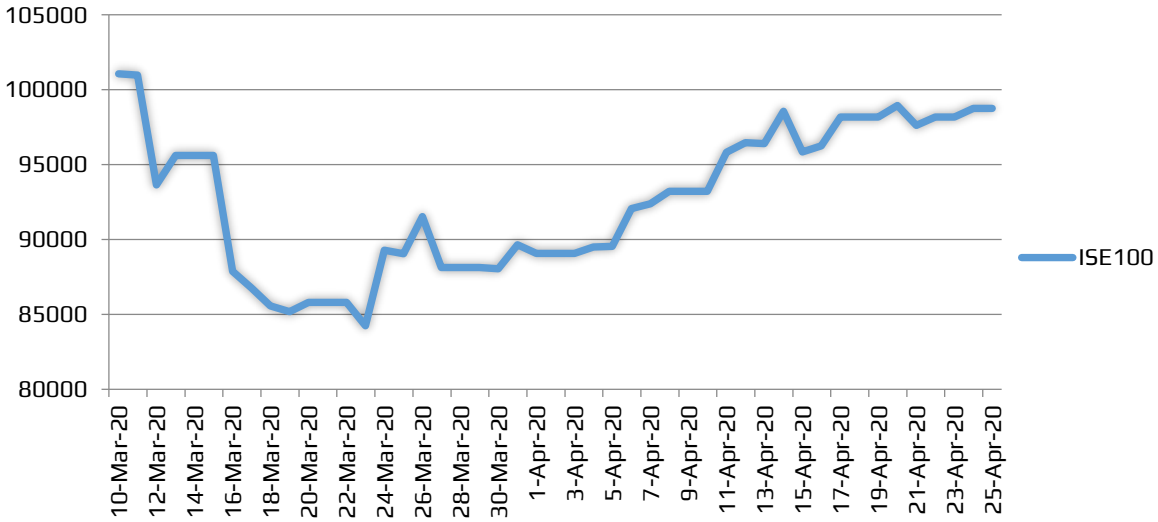

Figure 1. ISE100 Index.

The exchange rate is a conventional vector of crisis contagion. In the late 90s, for example, the Asian crisis involved companies and countries that borrowed in one currency and received income in another. For example, a sudden currency exchange rate devaluation almost immediately bankrupted several Thai companies. The value of the dollar's profits does not meet the interest and loan servicing dollar cost criteria. No indication of this mechanism has been given to date (Baldwin & Mauro, 2020). In addition, the lessons from this crisis led to considerably lower cross-currency borrowing. In Turkey, the parity of USD / TRY and EUR / TRY is examined on the basis of this quotation. The upward trend has been observed in the USD / TRY and EUR / TRY since the first COVID-19 appeared on March 10th.

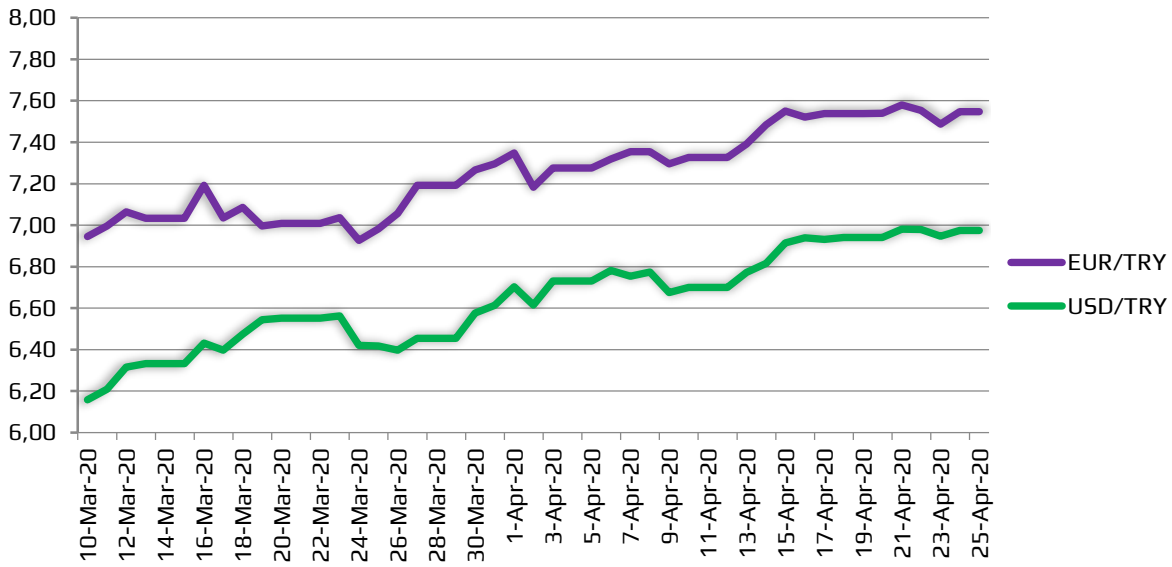

Figure 2. Euro and Dollar Prices.

"This is a more widely-desired currency, as the volumes grow and gold markets worldwide will be trading more than one of the world's most liquid currencies. In the short term the volatility in gold will remain extremely volatile in light of the uncertainties surrounding cu, the Chairper and Chief Executive Officer at GoldSeek.com told MarketWatch. Another element under consideration in this analysis is gold, which reached its highest value in the epidemic since February 2013 (the most recent increase in gold prices). The Gold Price per gram has risen in value against the Turkish Lira, provided that the first COVID-19 case has been identified.

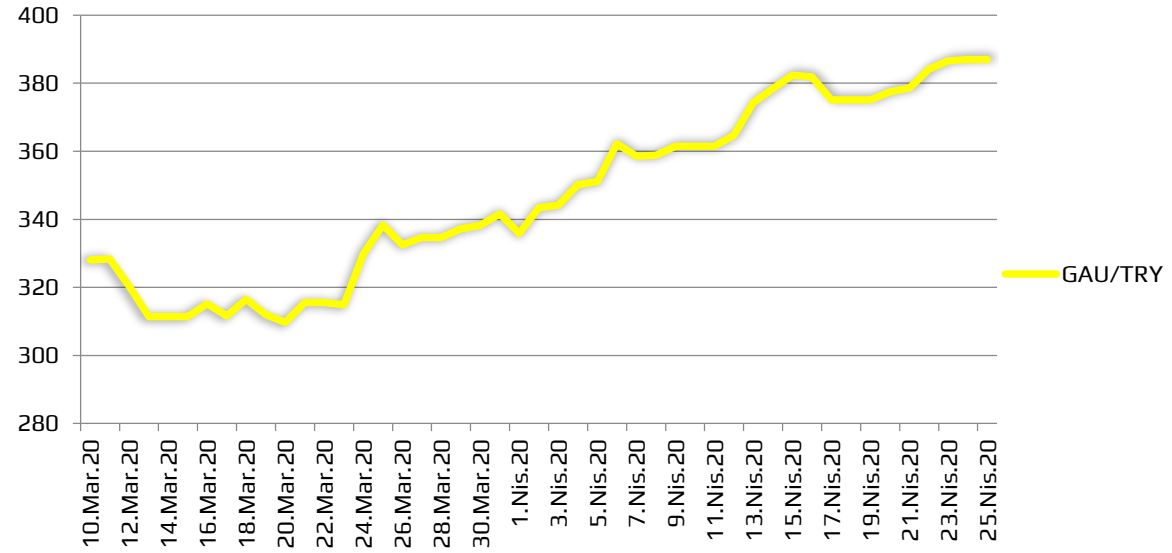

Figure 3. Gram Gold Prices

GDS denotes bonds issued by the Treasury Undersecretariat on the domestic market for domestic borrowing. Upon the completion of the payment period and on maturity, the borrowed state shall pay the GDS holder of the balance owed. Such GDS are considered government bonds with a maturity of 1 year and more (Borsa İstanbul, 2020). As of March 10, Figure 4 indicates the 2-year bonds' interest rate. It is noted that, particularly after 20 April, interest rates decreased.

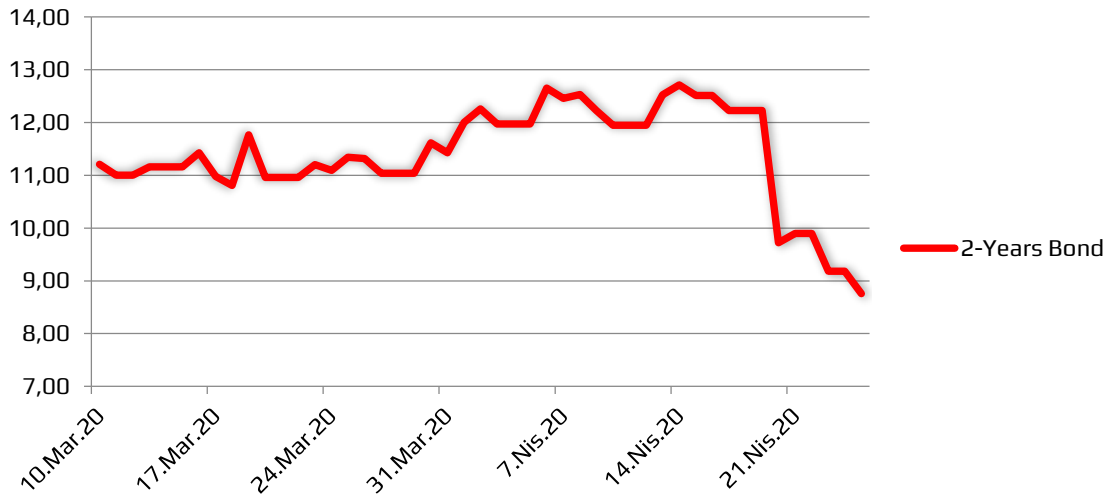

Figure 4. Turkey 2-Years Bond

3. Material

Data were collected regularly between 10 March 2020 and 25 April 2020 when COVID-19 was first detected. Data is obtained from the official website of the Turkish Ministry of Health (Turkish Ministry of Health, 2020). The Eviews 9 Software carried out all the analyzes applied to these 47-day results. Eviews is a Windows Statistics Package developed by Quantitative Micro Software (QMS). Eviews is the most important statistical package. This can be used for data processing, drawing, statistical analysis [Agung, 2008; Agung, 2011], modeling analysis (Ju et al., 2009), forecasts and simulations as econometric software. Often commonly used in political, macroeconomic and simulatory analysis and sales. Eviews is primarily used for time series-oriented econometric analysis in contrast to other applications, such as EXCEL, SAA, SPSS.

4. Statistical Analysis and Findings

Table 2 offers some concise statistics of 6 variables used in the study. Such descriptive statistics are mean, median, low value, high value, standard deviation and number of observations providing information on variable distribution of data. The first case of COVID-19, 10 March, was observed after fourty-seven days. During this time, the ISE100 mean is 92,686.81, its maximum is 101,062.5 and its minimum is 84,246.17. During that period. Different statements can be made in Table 2 for other variables. In addition, for each variable there are 47 observations.

	2-Years_Bond	CASES	ISE100	EUR/TRY	USD/TRY	GAU/TRY
Mean	11.386	2293.043	92,686.81	7.2565	6.6421	346.91
Median	11.340	2704	93,225.22	7.2760	6.6750	343.38
Maximum	12.715	5138	101,062.5	7.5802	6.9812	386.98
Minimum	8.755	0.000	84,246.17	6.9270	6.1580	309.73
Std. Dev.	0.952	1788.245	4903.005	0.2077	0.2307	26.122
Observations	47	47	47	47	47	47

Table 2. Descriptive Statistics

The relationship between the m variables, where the cross members in the matrix are equal, is described by a matrix correlation. It is a rectangular, symmetrical mxm dimension matrix derived from the covariance matrix of variance. The same data is present in both matrices but since it is clearer and straightforward to compare the variables in the matrix (Horn & Johnson, 1985). The corresponding matrices are simpler.

The results of the matrix for the correlation in Table 3 show that between EUR / TRY and GAU / TRY variables the most positive correlation was 92,77 percent. The highest negative relationship among the ISE100 and the 2-year Bond variables was 13.64%; however, in Table 3, the relationship levels of all the variables can be interpreted in the same way.

	2-Years_Bond	CASES	ISE100	EUR/TRY	USD/TRY	GAU/TRY
2-Years_Bond	1.0000	0.2697	-0.1364	-0.0017	-0.0125	-0.0066
CASES	0.2697	1.0000	0.4811	0.8692	0.8277	0.8887
ISE100	-0.1364	0.4811	1.0000	0.5623	0.3809	0.6573
EUR/TRY	-0.0017	0.8692	0.5623	1.0000	0.9248	0.9277
USD/TRY	-0.0125	0.8277	0.3809	0.9248	1.0000	0.8794
GAU/TRY	-0.0066	0.8887	0.6573	0.9277	0.8794	1.0000

Table 3. Correlation Matrix

Dickey-Fuller (ADF) test is one of the many common ones. The ADF test (Dickey and Fuller, 1979) means the first difference between a variable y, the exogenous variable(s) and k, the first differences that were lagged at their lagging level:

$$\Delta Y_t = a + \beta T + pY_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Where Y_t is the variable in the t cycle, T refers to the time trend, while the Δ is the operator of the differences, ε_t is an error disturbance with the zero mean and variance 2, and k represents a lag in ADF equation. The number of lags of the ADF test is reduced. Due to the increased number of lags, the power of this test to reject the null of a unit root is decreased and additional parameters must be estimated and freedom loss must be reduced (Hosseini et al., 2011). The Phillips-Perron test is another root test process. The following equation (Günaydın, 2004) is used to evaluate the PP test:

$$\Delta y_t = a_0 + a_1 t + a_2 y_{t-1} + \sum_{i=1}^{N} \phi_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

In equation 2, the word Δ refers to the initial processor of the difference, t any time pattern, ε_t error time term, y_t series, and N refers to the delay factor defined by the criterion of knowledge to solve the consequent dependence of the error conditions. The PP test is a test that allows for poor dependency and heterogeneity between the Error Conditions for the Dickey and Fuller tests (Öztürk & Pehlivan, 2020). The negative side of the PP test is that the sample diameter is error skewed (Egeli H.A. & Egeli, H., 2008).

Stationarity of variables was examined through increased Dickey-Fuller and Phillips-Perron tests among the root unit tests. Stationarity of the variables As in Table 3 and Table 4, the results of these tests are. All experiments indicate that the variables were not stationary. The outcome was the same. For this reason all variables have first differences in order to ensure stationary variables. When all p-values are less than

0.05, the hypothesis of H_{1a} null has been dismissed. Convenient terminology for the use of variables were therefore given.

- H1a: The variable is non-stationary and has a unit root.
- H1b: The variable isn't non-stationary and hasn't a unit root.

Variables	No Difference		1st Difference	
	t-Statistics	p-value	t-Statistics	p-value
2-Years_Bond	-0.684209	0.8405	-7.656983	0.0001
CASES	-1.298348	0.6226	-6.510943	0.0001
ISE100	-1.625081	0.4617	-7.530842	0.0001
EUR/TRY	-1.111023	0.7037	-8.930652	0.0001
USD/TRY	-1.589188	0.4799	-4.596086	0.0006
GAU/TRY	0.148803	0.9661	-6.346942	0.0001

Note: With Schwarz Info Criterion with max lags:9, and model type is intercept model.

Table 3. Augmented Dickey-Fuller Test

Variables	No Difference		1st Difference	
	t-Statistics	p-value	t-Statistics	p-value
2-Years-Bond	-0.817419	0.3564	-7.614542	0.0001
CASES	-0.084782	0.6491	-6.472312	0.0001
ISE100	-0.257195	0.5880	-7.613126	0.0001
EUR/TRY	3.217710	0.9995	-8.563004	0.0001
USD/TRY	2.372950	0.9951	-6.860479	0.0001
GAU/TRY	1.798681	0.9812	-6.015150	0.0001

Note: Model has no intercept and no trend.

Table 4. Phillips-Perron Test

The correct lag period for the VECM model was created in table 5. The fourth lag time with LR test statistics, FPE, and Akaike Information Criterion (AIC) were picked. Since the criterion indicated by "*" is the 4th lag duration. All exams on VECM(4) were carried out in accordance with this test.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-699.7328	NA	26805411	33.60633	33.85456*	33.69731*
1	-677.8307	36.50364	31617499	34.27765	36.01532	34.91457
2	-647.1176	42.41328	45266835	34.52941	37.75651	35.71227
3	-611.8339	38.64403	63083129	34.56352	39.28005	36.29232
4	-543.9525	54.95161*	15856933*	33.04536*	39.25132	35.32009

1.Note: LR: Sequential modified statistical LR, FPE: final error of estimation, AIC: Akaike criterion of information, SC: black criterion of information, HQ: Hannan Quinn criterion of information.
2.Note: * lag order choice criteria.

Table 5. Determination of Lag Length

The co-integrated relations were calculated in the 4th and 5th models according to the findings in Table 6. Since the lowest-error model should be selected from the defects, the lowest AIC (30.62101) value has been selected. The quadratic fifth model is therefore ideal for research with intercept and pattern. Cointegration relationships have been investigated using this model.

Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	33.42158	33.42158	33.53893	33.53893	33.27085
1	32.39197	32.13921	32.21398	32.23426	31.91788
2	31.98949	31.35565	31.45807	31.07959	31.00775
3	31.75265	31.05336	31.10824	30.70065	30.62101*
4	31.95408	31.30131	31.30799	30.89143	30.76624
5	32.33308	31.69574	31.65857	31.29048	31.14403
6	32.88824	32.23970	32.23970	31.71894	31.71894
Schwarz Criteria by Rank (rows) and Model (columns)					
0	39.43998	39.43998	39.80810	39.80810	39.79078
1	38.91190	38.70094	38.98468	39.04675	38.93934
2	39.01095	38.46071	38.73030	38.43541*	38.53075
3	39.27565	38.70174	38.88201	38.59980	38.64554
4	39.97862	39.49302	39.58329	39.33390	39.29230
5	40.85914	40.43078	40.43540	40.27628	40.17163
6	41.91584	41.51807	41.51807	41.24807	41.24807

Note: * denotes selected models.

Table 6. Information Criteria by Rank and Model

Engle and Granger (1987) claimed that the co-integration between the variables was sufficient to apply the error correction model (Engle & Granger, 1987) . The structure of equation in the model is:

$$Y_t = \sum_{i=1}^{p} A_i Y_{t-1} + \beta X_t + u_t \quad (3)$$

Here values of X_t and Y_t are not stationary, but the series that is stationary once the first difference, i.e. I(1) series, has been made. When you take and rearrange the 1st difference of the equation,

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{p-1} \tau_i Y_{t-1} + \beta X_t + v_t \quad (4)$$

takes the form in Formula (4). Where,

$$\pi = \sum_{i=1}^{p} A_i - I \,,\ \tau_i = -\sum_{j=i+1}^{p} A_j \quad (5)$$

It is expressed as $\pi = a\beta'$. It expresses two matrices with a and β' $(k\ x\ r)$ dimensions and rank r (Göçer et al., 2013) . a represents the adaptation rate, that is, the coefficient of error correction term, β' is the long-term cointegration coefficient matrix and r is the rank of the matrix (Tarı ve Yıldırım, 2009). If the rank is equal to 1, it is concluded that there is 1 cointegration relationship between the variables and if it is greater than 1, there is a cointegration relationship as much as the value of rank. Trace and maximum eigenvalue statistics are checked to see if there is a cointegrated relationship between the series (Akpolat & Altıntaş, 2013).

Table 7 shows the Johansen Cointegration Test results under the value of trace statistics. 'At most 2', the Trace statistic and eigenvalue statistics are greater than their respective critical value at 0.05 level and its probability is also less than 0.05 level, which over again leads to the rejection of the null hypothesis relating with one cointegration equation. At most 2 shows two cointegration equations in the selected

variables, which indicates the Trace statistics value and eigenvalue statistics value are lesser than their critical values at 0.05 level. In addition, due to cointegration, there is a long-term relationship among variables.

Hypothesized No.of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p-value
None	0.856057	207.6281	107.3466	0.0001*
Atmost1	0.775861	128.1563	79.34145	0.0001*
Atmost2	0.621717	66.84129	55.24578	0.0034*
Atmost3	0.356051	26.98472	35.01090	0.2767
Atmost4	0.187449	8.939136	18.39771	0.5863
Atmost5	0.010396	0.428483	3.841466	0.5127

Note: * denotes rejection of the hypothesis at the 0.05 level

Table 7. Unrestricted Cointegration Rank Test (Trace)

A VECM (Vector Error Corrigation Model), which adapts to short term fluctuations of variables and deviations from balance (Andrei, D.M. & Andrei, L.C., 2015), is a suitable estimation technique if one or more of the cointegrating vectors is detected. VECM analysis will remove the question of fake regression between dependent and explicative variables. The VECM is therefore the following (Sevüktekin & Nargeleçekenler, 2010):

$$\Delta Y_{nt} = a_0 + \sum_{j=1}^{k} a_{1j}\Delta Y_{1t-j} + \cdots + \sum_{j=1}^{k} a_{nj}\Delta Y_{nt-j} + \lambda_n ECT_{t-1} + \varepsilon_{nt} \quad (6)$$

In the model, ECT_{t-1} refers to error correction term, λ refers to correction coefficient and n represents the number of equations. The statistical significance of the error correction coefficient (λ) indicates the deviation from the long-term balance. The size of the coefficient shows the speed of approaching long-term equilibrium (Gujarati, 2004).

In addition to the VECM(4) model review, whether the model has a stationary structure should be considered. It must be evaluated if the reverse roots of the AR function are in the circle of the array. The results of this study are provided in Figure 5 for a stationary structure evaluation and the own values of the obtained coefficient matrix have to be in the unit circle in order to use the VECM(4) model. Based on this information, the VECM(4) model is determined to be stationary since all reverse roots are in the circle of units in Figure 5. In other words, there is no root beyond the circle of the unit.

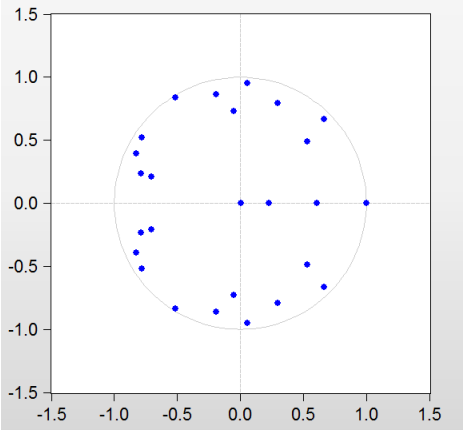

Figure 5. Inverse Roots of Characteristic Polynomial

One conclusion that the VECM(4) model would be suitable is that the sequence does not pose a problem with autocorrelation. Whereas the LM test results of Table 8 have been reviewed, it has been determined that the 2nd 3rd and 4th p-values are above 0.05. The H_{2a} null assumption can not therefore be refused. It is concluded that the VECM(4) series does not have an autocorrelation problem.

- H_{2a}: There is no lagging serial association at the 95% confidence stage.
- H_{2a}: There is a lagging serial correlation at a trust point of 95%.

Lags	LM-Statistics	p-value
1	67.86225	0.0010
2	35.68679	0.4834
3	35.14199	0.5092
4	31.27963	0.6926

Table 8. Autocorrelation LM Test

Recently, the model VECM(4) must be believed to be distributed according to the normal distribution. Table 9 and Table10 contain the results of the VECM Residual Standardization Test used to check this distribution. The H_{3a} null hysperthesis could not be dismissed, and this assumption was also made, as p-values for skevity, Kurtosis, and test statistics of Jarque-Bera (joint) are higher than 0,05 point. The causality of these variables has been investigated in the VECM(4) model.

- H_{3a}: Residuals are multivariate normal at 95% confidence level.
- H_{3b}: Residuals are not multivariate normal at 95% confidence level.

Component	Skewness	Chi-sq	df	p-value
1	0.104108	0.085596	1	0.7699
2	0.250059	0.493824	1	0.4822
3	-0.555772	2.439382	1	0.1183
4	0.177177	0.247913	1	0.6185
5	0.121936	0.117423	1	0.7318
6	0.512459	2.073980	1	0.1498
Joint		5.458117	6	0.4865
Component	**Kurtosis**	**Chi-sq**	**df**	**p-value**
1	2.367389	0.587248	1	0.4435
2	2.575997	0.193521	1	0.6600
3	3.590139	1.315434	1	0.2514
4	2.428853	0.449099	1	0.5028
5	2.746576	0.029931	1	0.8626
6	3.587470	1.305874	1	0.2531
Joint		3.881106	6	0.6928

Table 9. VECM Residual Normality Tests

Component	Jarque-Bera	df	p-value
1	0.672844	2	0.7143
2	0.687345	2	0.7092
3	3.754816	2	0.1530
4	0.697012	2	0.7057
5	0.147353	2	0.9290
6	3.379854	2	0.1845
Joint	202.8381	182	0.1384

Table 10. VECM Residual Normality Tests (Jarque-Bera)

In addition to the explanatory power of the lag of such variables (Ahmed, 2011) the Granger Causality / Bloc Wald Test is used to evaluate whether the lagged value is sufficient to describe the dynamics of certain variables within the multivariate system. The regression of Y is monitored in the Granger Test by its own delays and X delays. It also monitors a regression in conjunction with X own delays and Y delays. Y is the dependent variable and X is the stand-alone p lag variable. Therefore it is possible to decide whether the causality is unilateral, where either X Granger causes Y but Y does not cause X, X Granger causes Y or Y causes X bi-directionally. The H5a null hypothesis is introduced for every variable to be evaluated as a dependent variable. The regression of vector Y, for example, (Garcia & Rodrigues, 2019) has been used.

$$\Delta Y_t = \emptyset + \delta t + \lambda e_{t-1} + \gamma_1 \Delta Y_{t-1} + \cdots + \gamma_p \Delta Y_{t-p} + \omega_1 1 \Delta X_{t-1} + \cdots + \omega_q \Delta X_{t-q} + \varepsilon_t \quad (7)$$

The term λe_{t-1} represents $Y_{t-1} - \alpha - \beta X_{t-1}$.

- H_{4a}: $\omega_1 = \omega_q = \lambda = 0$, which implies that X does not Granger cause Y.
- H_{4b}: $\omega_1 \neq \omega_q \neq \lambda = 0$, which implies that X does Granger cause Y.

The Exogeneity Forest Test of Granger Causality / Block was carried out to explore relationships of causality between variables. The test results are as shown in Table 11. Since other p-values in the table are below 0.05, the above hypothesis of H_{4a} can be dismissed. Many causal associations were also found. For a model in which the dependent variable 2-Years Bond 1 is, the causes of the 2-years Bond 1 is the variable ISE100 1 and the variable GAU / TRY 1. CASES 1 and ISE100 1 are the sources of the EUR / TRY 1 dependent variable in the model with the EUR / TRY 1 dependent variable. CASES 1 and ISE100 1 are the sources of the EUR / TRY 1 dependent variable in the model with the EUR / TRY 1 dependent variable. In the model where the variable USD / TRY 1 depends, the variable USD / TRY 1 is affected by 2-Years Bond 1, CASES 1, and ISE100 1. The GAU / TRY 1 dependent variable triggers once and for all in the model that it is dependent on the GAU / TRY 1, CASES 1 or ISE100 1 variable.

Dependent Variable: 2-Years_Bond_1			
Excluded	Chi-sq	df	p-value
CASES_1	9.380767	4	0.0523
ISE100_1	20.92229	4	0.0003*
EUR/TRY_1	5.754044	4	0.2183
USD/TRY_1	7.270098	4	0.1223
GAU/TRY_1	11.86826	4	0.0184*
All	42.78327	20	0.0022*
Dependent Variable: CASES_1			
Excluded	Chi-sq	df	p-value
2-Years_Bond_1	6.619597	4	0.1574
ISE100_1	5.311031	4	0.2568
EUR/TRY_1	2.263560	4	0.6874
USD/TRY_1	5.675978	4	0.2247
GAU/TRY_1	5.181860	4	0.2691
All	22.27990	20	0.3255
Dependent Variable: ISE100_1			
Excluded	Chi-sq	df	p-value
2-Years_Bond_1	6.057377	4	0.1949
CASES_1	3.994115	4	0.4068
EUR/TRY_1	2.818603	4	0.5886
USD/TRY_1	2.001457	4	0.7355
GAU/TRY_1	1.975797	4	0.7402
All	12.87561	20	0.8827
Dependent Variable: EUR/TRY_1			
Excluded	Chi-sq	df	p-value
2-Years_Bond_1	4.210256	4	0.3783
CASES_1	10.53084	4	0.0324*
ISE100_1	12.32985	4	0.0151*
USD/TRY_1	1.447200	4	0.8360
GAU/TRY_1	1.311971	4	0.8593
All	28.10731	20	0.1069
Dependent Variable: USD/TRY_1			
Excluded	Chi-sq	df	p-value
2-Years_Bond_1	17.93002	4	0.0013*
CASES_1	25.77720	4	0.0001*
ISE100_1	17.07199	4	0.0019*
EUR/TRY_1	1.061465	4	0.9003
GAU/TRY_1	8.411910	4	0.0776
All	53.87936	20	0.0001*
Dependent Variable: GAU/TRY_1			
Excluded	Chi-sq	df	p-value
2-Years_Bond_1	9.247442	4	0.0552
CASES_1	35.23002	4	0.0001*
ISE100_1	11.87816	4	0.0183*
EUR/TRY_1	2.632150	4	0.6211
USD/TRY_1	10.41573	4	0.0340*
All	75.05575	20	0.0001*

Table 11. VECM Granger Causality/Block Exogeneity Wald Tests

5. Conclusion

This research analyzed the relationship between economic data in Turkey during the COVID-19 epidemic. On 10 March 2020, the first detection of COVID-19 was achieved for 47 days. The data is till 25 April 2020 daily. The six variables produced from these daily data are the number of cases of COVID-19 perday, the ISE100 stock index in the Turkish Lira, Turkish Lira dollar prices, Turkish Lira gram gold prices and the 2-year bonds. The following variables are the number of cases of COVID-19 per day. Such variables were initially investigated by descriptive statistics and correlation matrix. The maximum correlation between Turkish Lira and Turkish Lira gold Gram prices was found in the correlational matrix at 92.77 percent. Because of the time series of all variables, their standardity has been checked. The 1st variable differences were found

to be stationary, according to the findings of both Augmented Dickey-Fuller and Phillips-Perron experiments. Variables suitable for causality analysis were therefore achieved through VECM.

The deficiency duration of the mounted VECM model has been calculated to be the fourth deficiency with the most knowledge criterion. For the VECM(4) model, reverse roots of the AR polynomial are analyzed in the unit circle. As a consequence of this analysis, the unit circle held all the reverse roots. And it is important to test certain theories. Due to the Autocorrelation LM Test the VECM(4) model was found to have no autocorrelation problem. In addition, as a result of VECM residual normality checks, the model was found to show Normal distribution. The VECM(4) model guaranteed these premises, thus testing causality relations.

The Granger Causality / Block Exogeneity Wald Test was applied to variables in the VECM(4) model for evaluating causality relationships between the variables. As a consequence of this study, causalities were calculated for dependent variables, including government bond rates for Turkey for two years, TRY euro prices, TRY dollar prices, and TRY gram gold prices. Turkey 2 years of government bond rates have causalities that are ISE100 and gram gram gold prices at Seek, with two different variables. Seek Euro prices have causalities that are ISE100 stock index and COVID-19 cases a day with two independent variables. TRY dollar prices have cause-related causalities of ISE100, COVID-19 cases per day, and Turkey, 2 years government bond rates with three independent variables. And ultimately, TRY's gold prices are causal, with 3 different variables, ISE100 inventory index, COVID-19 cases per day and TRY dollar values. In such causality relationships the independent variables affect the dependent variables. During the COVID-19 era, although no variables affect the regular number of cases and ISE100 stock index, causalities affecting other variables have been reported.

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