

COVID-19 AND NET FOREIGN EXCHANGE RESERVE RELATIONSHIP IN TURKEY: EVIDENCE FROM ARDL BOUNDS TESTING APPROACH

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ABSTRACT

Purpose- This work inquires whether there's a correlation between Covid-19 and the net foreign exchange reserve, which shows sensitivity to crises.

Methodology- For this purpose, the daily data on COVID-19 seen in Turkey (case taken from Republic of Turkey Ministry of Health, cumulative case and infection rate data from Public Health Experts Association (HASUDER) and daily net foreign exchange reserve data calculated with the data obtained from the Central Bank of Turkey (CBT) balance sheet for the period between 11 March-14 May 2020 were tested applying the ARDL Bounds Test Approach and analyzed within the framework of the Error Correction Model (VECM). And to query short-run relationship, Granger Test over the VECM Model has been applied.

Findings- According to the analysis result; There is a cointegration in the long-run between COVID-19 and the net foreign exchange reserve, and is statistically significant. Also, net foreign exchange reserve is a Granger cause for the quantity of cases, the cumulative quantity of cases, and the rate of infection in the short-run.

Conclusion- In the process of transformation of a health crisis caused by a pandemic into a global economic crisis, this study contributes to the formation of the literature and is noteworthy with its results. Especially in the short-run, net foreign exchange reserves were determined to be a Granger cause of COVID-19, and therefore it was determined empirically that the change in reserves escalated the pandemic. The study is a contribution to the literature.

Keywords: COVID-19, net foreign exchange reserve, bounds test, ARDL

JEL Codes: E58, I18, C01

1. INTRODUCTION

A new crisis period is being experienced across the world, with a total of 7.633.886 detected cases and 426.317 deaths (WHO) from December 31, 2019, to June 13, 2020. The process that started with a health crisis brought along losses of consumption and investment and mass unemployment cases due to the increased uncertainty, and promotion of isolation and social distance that caused financial markets and companies to close.

World Health Organization (WHO), stating that “A pandemic is the worldwide spread of a new disease. An influenza pandemic occurs when a new influenza virus emerges and spreads around the world, and most people do not have immunity,” declared COVID-19 an outbreak on March 11, 2020. According to the US, Centers for Disease Control and Prevention (CDC); “Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.”

In the historical process, various pandemic cases were recorded since the 14th century. In Europe of the 14th century, the bubonic plague caused the death of approximately 25 million people, roughly one-fourth of the population. The influenza pandemic in the period of 1918-1920 caused the death of 50 million or more people (Surico and Galeotti, 2020). In the 20th centenary, after the

Spanish Flu in 1918; two major outbreaks occurred, namely Asian Flu (H2N2) in 1957 and Hong Kong Flu in 1968. In the 21st century; there were four outbreaks: Bird Flu in 2009, Severe Acute Respiratory Syndrome(SARS) in 2002, Middle East Respiratory Syndrome(MERS) in 2012, and Ebola in 2013 (Baldwin and Weder di Mauro, 2020). Below are listed the death cases recorded in the aforementioned outbreaks;

1957 Asian Flu (H2N2): Although the total loss of life is uncertain, it is estimated that 1.1 million people died globally.

1968 Hong Kong Flu (H3N2): According to the CDC, one million people died worldwide, mostly over the age of 65.

2009 Avian Flu (N1H1): The CDC guess that 151,700 to 575,400 people died globally.

2002 SARS: 8096 cases were detected from November 2002 to July 2003, and 774 of them resulted in death. Although the mortality rate was 9.6%, it was recorded as less infectious than prior outbreaks.

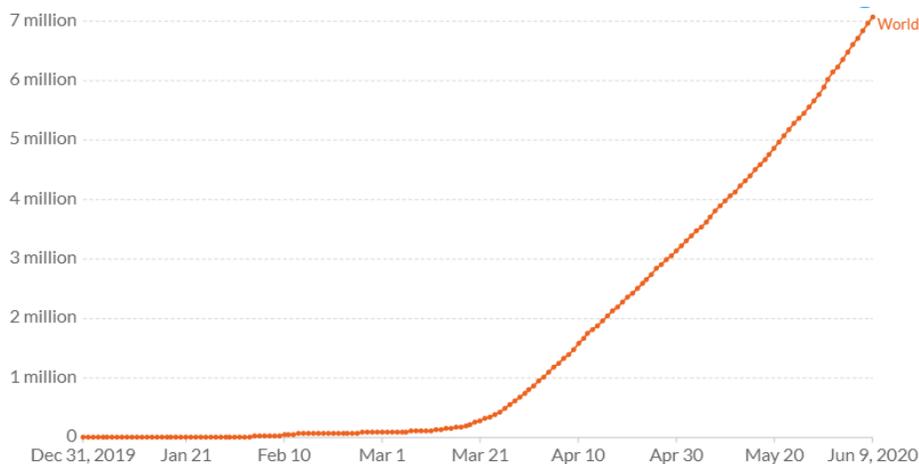
2012 MERS: The pandemic, which was first detected in Saudi Arabia, spread to 27 countries, but more than 80% of cases were concentrated in Saudi Arabia. It is estimated that 35% of those who contracted this highly lethal disease died.

2013 Ebola: The mortality rate of this deadly disease is 50%. First seen in Sudan and the Democratic Republic of Congo in 1976, the rate of mortality in these countries was 53% and 88%, respectively. The second wave started in West Africa in 2014-2016 and it was recorded with the mortality rate of 67% Guinea, 28% in Sierra Leone, 45% in Liberia, and 61% in the Democratic Republic of Congo in 2018-2019.

2018 HIV/AIDS: Approximately 32 million people died from the disease since the day it started, and it was found that 37.9 million people living with HIV worldwide (WHO) as of the end of 2018.

2019 COVID-19: This current pandemic started with various cases of acute respiratory syndrome detected in Wuhan, China on December 31, 2019. It is a type of coronavirus (ECDC) that has not been beforehand described in humans and it spread rapidly since its first detection.

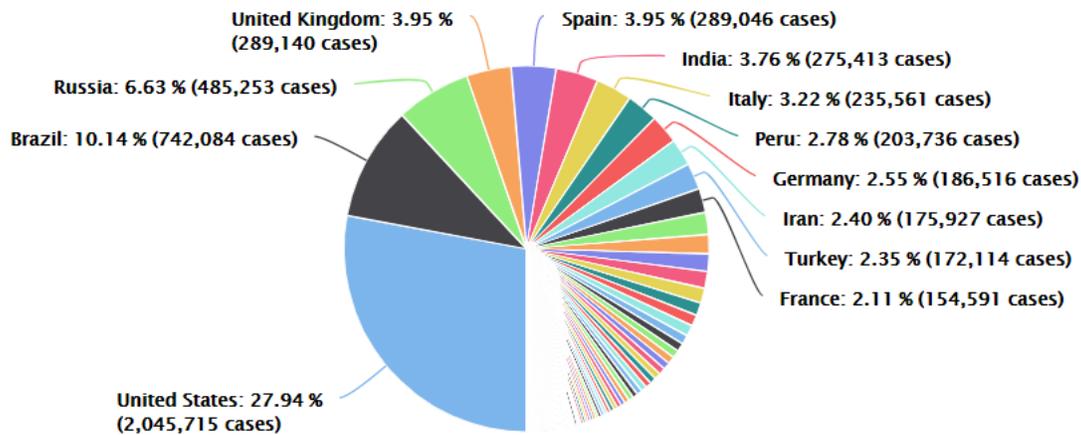
Figure 1: Total Confirmed COVID-19 Cases Worldwide (31th Dec 2019 -9th June 2020)



Source: European CDC.

Figure 1 shows the total confirmed COVID-19 cases worldwide. It is seen that the number of cases exceeding 100 thousand on March 7, 2020, has increased to over 200 thousand on March 18, and has started to increase rapidly. As of June 13, 2020, 10:00 a.m., the total number of cases in the world has reached 7.625.883 and the total quantity of deaths has reached 425.931 (ECDC). Within this global view, with a total of 172.114 cases (Ministry of Health), Turkey has a total of 2.35% of cases worldwide (Figure 2).

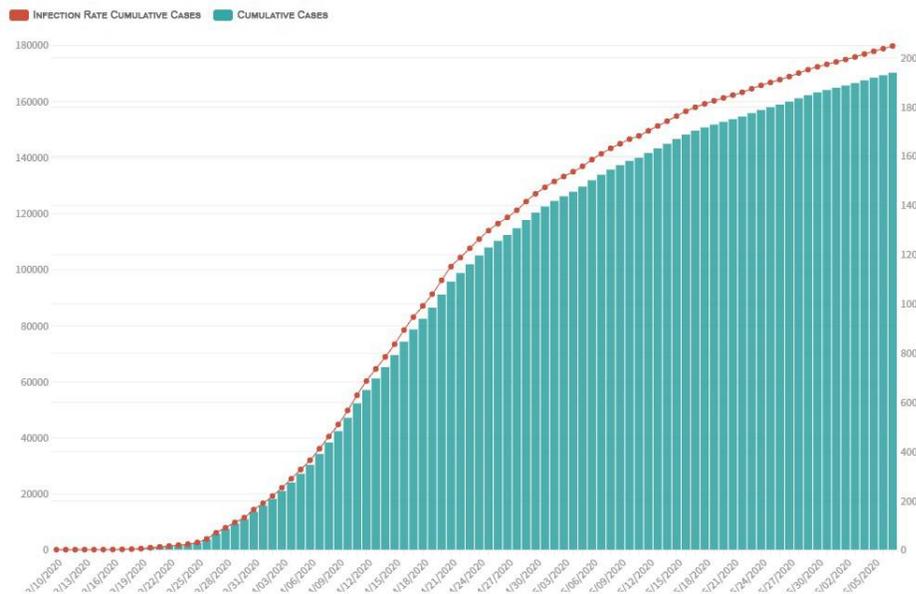
Figure 2: Countries Cases Distribution



Source: Worldometer.

The virus entered Turkey later thanks to the measures taken and showed the same trend as other countries. Based on the data obtained between March 11, 2020, which is the date when the first case was recorded, and May 17, 2020, the Figure 3 states the cumulative quantity of cases and the infection rate in Turkey, and the Figure 4 shows the number of new cases and the infection rate. Figure 5 graphically shows the current state of cases in Turkey in comparison with other countries.

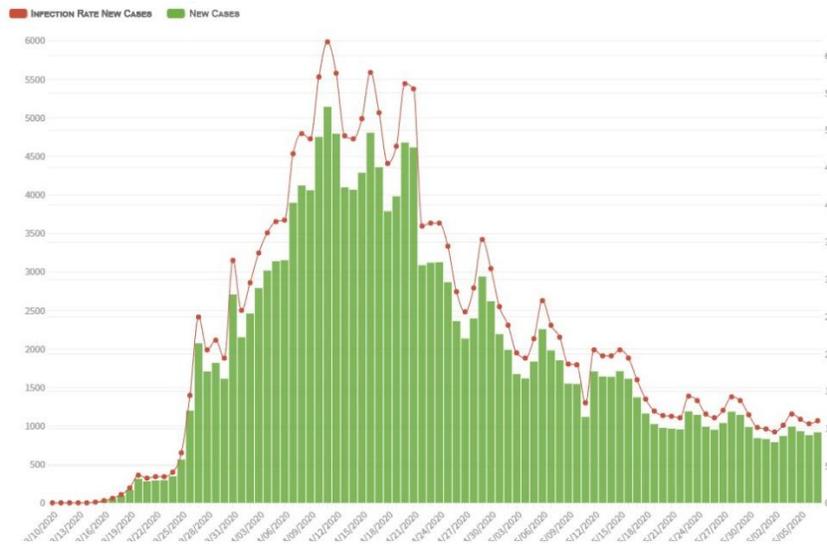
Figure 3: Cumulative Cases and Infection Rate, Turkey (10 March-8 June 2020)



Source: HASUDER.

The cumulative quantity of cases in Turkey on March 22, 2020, exceeded the figure of 1000, showing an increase of 77% and was recorded with 1236. The rate of infection, which reached 11.18% on 18 March, had a rapid rise with 20.20% on 19 March and 37.40% on 20 March (Figure 3). The number of new cases registered was 5138 on 11 March 2020. The new rate of Infection was 61.8% on the same date. The overall trend in both the quantity of new cases and the rate of infection - along with the leaps seen - was downward (Figure 4).

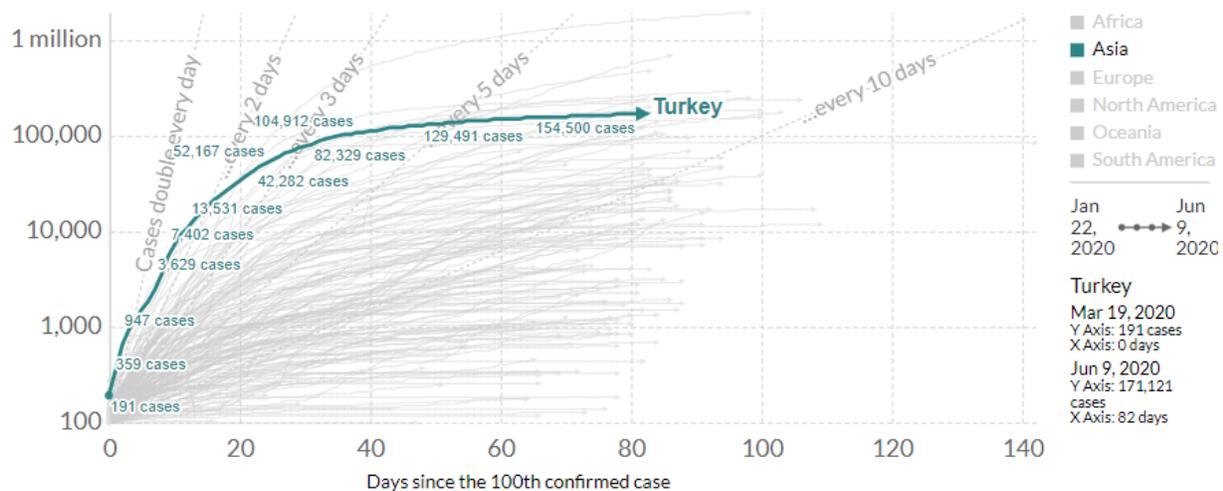
Figure 4: New Cases and Infection Rate, Turkey (11 March-8 June 2020)



Source: HASUDER.

The speed of the pandemic in Turkey up to 65.111 cases, remained higher than almost all countries (Figure 5). Then, as of June 9, 2020, the USA with the total quantity of 2.049.251 cases, it was in the first place as the new center of the pandemic, followed by Brazil with 743.047 cases, Russia with 493.657 cases, England with 289.140 cases, Spain with 289.046 cases, India with 284.322 cases, Italy with 235.561 cases, Peru with 203.736 cases, Germany with 186.525 cases, and Iran with 177.938 cases, respectively. Turkey ranks 11th with 172 114 cases (Worldometers) (Figures 2-5).

Figure 5: Total Confirmed COVID-19 Cases, Turkey (21 Jan.-9 June 2020)



Source: EUROPEAN CDC.

The multidisciplinary shock created by COVID-19 sparked a debate on this process where vital anxieties are combined with economic problems, as well as its consequences. This process, which started with a health crisis, is evolving into an economic crisis that will bring along a paradigm shift collapse, or even a global collapse that can be called slumpflation (Çiğdem, 2020). Initially, COVID-19 created a massive global uncertainty shock that was greater than the global crisis 2008 and it resembled the Great

Depression (Baker and Bloom et al., 2020) and triggered a new type of recession in the modern world, different from the triggers observed in the historical process (Ozili and Arun, 2020).

Any practice for limiting the spread of the pandemic and above all, saving human life comes at a "price". In the short run, focusing on emergency calls to defenseless populations and companies, measures are taken to prevent mass layoffs and insolvencies. In the medium-run, recovery packages containing monetary and fiscal measures should be introduced. In this critical process that requires international coordination, "a well-designed government management plan" is important (Loayza and Pennings, 2020).

The measures and actions were taken against COVID-19, and achievements in the fight against the pandemic vary by countries depending on the decision-makers and the financial power. The fight with a pandemic is carried on with the available resources in line with the decisions of the political authorities. COVID-19 has become a factor that causes all macro-economic targets to be put aside and depletes resources. From a different point of view, "lack of sufficient resources" can also be a cause of failure in the fight against COVID-19.

It is thought-provoking that COVID-19 coincided a period involving discussions about the changes experienced in the foreign exchange (fx) reserves of Turkey since alteration in the fx reserves of the countries is important in terms of showing sensitivity to the crises. *Foreign Exchange Market Pressure criterion*, which was created by Gorton and Roper (1977) to examine the changes in fx reserves and exchange rates, has been used as a leading indicator in financial crises and successful results were obtained. It is also noteworthy that during the first global financial crisis, many Developing Countries (DC) during 2008: Q4–2009: Q1 period experienced depreciation in their foreign exchange reserves and exchange rates. From this point of view, the objective of this study is to investigate whether there is a relationship between the change in net fx reserves of Turkey in the process of pandemic and COVID-19. The study starts with literature research questioning the impacts of COVID-19 on the economy. The next section will mention the empirical study conducted and describe and discuss its results.

2. LITERATURE REVIEW

After WHO notified COVID-19 as an "outbreak" on March 11, 2020, national emergency was acclaimed in many countries, especially in the USA. Also, the fact that Ben Bernanke and Janet Yellen stated that the public health crisis will turn into a deep and possibly long-run economic recession in the Financial Times increased the concerns about uncertainty shock (Bernanke and Yellen, 2020). To prevent this bad scenario, the studies for pandemics, which are still new, have accelerated. Due to the insufficient number of observations yet, past pandemics were analyzed and various policy inferences were made. Different applications of the countries and the results obtained were also the focus of researchers.

Among the studies, it is remarkable and essentially important to determine how many people actually get infected with COVID-19, actual death numbers and infection rate. Knowing the actual number of cases and deaths; it is particularly crucial for policy-makers to determine the appropriate scale to control the virus [Alvarez, Argente, and Lippi (2020); Eichenbaum, Rebelo, and Trabandt (2020)], as well as for public health policies to slow the outbreak.

The reported quantity of infected people is probably much lower than the actual number of cases [Andrei, (2020); Nishiura, Kobayashi, et al. (2020)]. Bendavid et al. (2020) reported in a research that only 956 people were reported in Santa Clara (California) as of April 1, although 48,000-81,000 people were infected. Berger, Herkenhoof, and Mongey (2020) and Stock (2020) investigated the importance of unreported COVID-19 cases in the context of the pandemic.

Li et al. (2020), Wu, Leu, and Leu (2020), Flaxman, Mishra, and Gandy (2020), Hortaçsu, Liu, and Schweig (2020), Korolev (2020), Liu, Magal, Seydi, and Webb (2020 a , b), Nishiura, Kobayashi, et al. (2020), Zhao et al. (2020) used various models and made recommendations to estimate the number of true infections not reported.

Almost all of the studies carried out consist of research on diagnosis, treatment, spreading prevention, and health policies to expand the limited information about the new virus, to rapidly prepare health systems for this unknown pandemic, and to find a global response. Some studies on this subject are given below;

Table 1a: Studies on COVID-19 (Health, Mortality, and Outbreak Modeling)

Ai et al. (2020)	Dong et al. (2020)	Liu et al. (2020)	Qin et al. (2020)	Sohrabi et al. (2020)
Alhazzani et al. (2020)	Gattinoni et al. (2020)	Livingston and Bucher (2020)	Remuzzi and Remuzzi (2020)	Sohrabi et al. (2020)
Arentz et al. (2020)	Gautret et al. (2020)	Mehta et al. (2020)	Richardson et al. (2020)	Tian et al. (2020)
Bai et al. (2020)	Guo et al. (2020)	Mizumoto et al. (2020)	Rothan and Byrareddy (2020)	Touret and Lamballerie (2020)
Chen and Guo et al. (2020)	Hu et al. (2020)	Musetti et al. (2020)	Ruan et al. (2020)	Touret and Lamballerie (2020)
Chen and Liu et al. (2020)	Klok (2020)	Nishiura et al. (2020)	Sanders et al. (2020),	Wang and Zhang (2020)
Chen and Xiong et al. (2020)	Lai et al. (2020)	Onder et al. (2020)	Shen et al. (2020)	Xu et al. (2020)
Chinazzi et al. (2020)	Lauer et al. (2020)	Pan et al. (2020)	Shi and Han et al. (2020)	Zhonghua (2020)
Chinazzi et al. (2020)	Lauer et al. (2020)	Peto (2020)	Shi and Qin et al. (2020)	Zhou (2020)
Cucinotta and Vanelli (2020)	Li et al. (2020)	Poyiadji et al. (2020)	Singhal (2020)	Zu et al. (2020)

In addition to these studies, Baker and Farrokhnia et al. (2020) examined the response of household expenditures to COVID-19. Pindyck (2020) tested the reduction of pandemic spreading and welfare effects.

Conducted studies on COVID-19-labor markets are given in Table 1b. As for the studies carried out for COVID-19-Asset Market; Caballero and Şimşek (2020), Alfaro et al. (2020), Baker and Bloom et al. (2020)'s studies can be given as an example.

Table 1b: Studies on COVID-19 (Labor Markets)

Alon et al. (2020)	Coibion et al. (2020, a)	Kahn et al. (2020)	Montenovo et al. (2020)
Alstadsæter(2020)	Dingel and Neiman (2020)	Mongey et al. (2020)	Rojas et al. (2020)

Studies questioning the effects of a pandemic on households and firms are as follows; Baker et al. (2020, a), Baker et al. (2020, b), Barrero, Bloom, and Davis (2020), Bartik et al. (2020), Coibion et al. (2020, b), Ding et al. (2020), Fahlenbrach et al. (2020), Hassan et al. (2020), Krueger et al. (2020).

Atkeson (2020), Avery et al. (2020), Goldstein and Lee (2020), Haris (2020), Hortaçsu et al. (2020), Kuchler et al. (2020), Lin and Meissner (2020), Manski and Molinari (2020), Fernández-Villaverde and Jones (2020), conducted studies on Health, Mortality, and Outbreak Modeling. There is a rapidly expanding literature on COVID-19 and its macroeconomic effects. Table 1c shows the studies conducted.

Table 1c: Studies on COVID-19 (Economy)

Author	Conclusion
Acemođlu et al. (2020)	To minimize both economic and life losses; targeted policies combined with measures such as reducing interaction, increasing testing, and isolation should be developed.
Baker, Bloom, Davis, and Terry	As a negative effect of the uncertainty caused by COVID, an 11% -20% contraction is foreseen in the US real GDP as of the 4th quarter of 2020.
Baldwin and Weder di Mauro (2020)	They offer various policy suggestions in their study.
Fornaro and Wolf (2020)	They examined COVID-19 as a negative impact on the growth rate of productivity.
Faria e Castro (2018)	COVID-19 is modeled as a major negative impact in favor of consumption.
Eichenbaum, Rebelo and Trabandt (2020)	"the best simple containment policy increases the severity of the recession but saves roughly half a million lives in the U.S."
Jorda et al. (2020)	They provide time-series evidence for the impact of historical pandemics on return rates, demonstrating that pandemics reduce real rates of return. Besides, it has been determined that the macroeconomic effects of outbreaks continue for approximately 40 years.
Gregory, Menzio and Wiczer (2020)	"The lockdown to prevent the spread of the novel coronavirus is shown to have long-las instituting negative effects on unemployment."
Guerrieri et al. (2020)	Their study suggests that, in the case of a pandemic, the most appropriate combination of policies should be the loose monetary policy and social insurance.
Ludvigson et al. (2020)	It has been determined that the effect of the pandemic will continue from 2 months to 2 years depending on the economy.
Ozili and Arun (2020)	It was found that increasing quarantine days, monetary policy decisions, and international travel bans have serious effects on i. economic activities, and ii. share prices. Internal movement and higher fiscal policy expenditures were found to have a positive effect on economic activities.

As can be seen from the tables, no sufficient empirical study in macroeconomic field could be conducted yet since the COVID-19 is a rather new shock with an insufficient number of observations. From this aspect, this study contributes to the literature.

3. DATA, METHODOLOGY AND EMPIRICAL RESULTS

In this section, the relationship between COVID-19 and the net foreign reserve has been tested empirically.

3.1. Data

Foreign assets and total foreign exchange liabilities data between March 11 and May 14, 2020, were obtained from the Balance Sheet of the Central Bank of the Republic of Turkey (CBRT) to test the relationship between the draining net foreign exchange reserve and COVID-19. *Net foreign exchange reserve* was calculated using the equation no 1 with the exchange rates taken from the CBRT.

$$\text{Net Foreign Exchange Reserve} = \frac{\text{Foreign Assets} - \text{Total Foreign Exchange Liabilities}}{\text{Exchange Rate}} \quad (1)$$

The quantity of COVID-19 cases detected in Turkey in the same date range was obtained from the Ministry of Health, and the cumulative cases and the infection rate data were taken from HASUDER (Association of Public Health Professionals) to include in the analysis. Daily data and E-Views10 were used in the analysis. Logarithms of the series were taken and analyzed for ease of interpretation and suppression of heteroscedasticity. Table 2 shows the variables used in the analysis.

Table 2: Variables

Variable Name	Code	Source
Net Foreign Reserve	NFR	Central Bank of Turkey (CBT)
Number of cumulative cases	CUM	HASUDER
Confirmed cases	CASE	Republic of Turkey Ministry of Health
Infection Rate	INF	HASUDER

3.2. Unit Root Tests

The obligatory first footstep when making these analyses is to issue the variables to unit root tests. The degree to which the time-series is stationary can be determined by unit root tests. Table 3 shows the ADF and PP test results.

Looking at the ADF and PP test results, the net foreign reserve (NFR) is found to be I_1 , and the number of cumulative cases (CUM), confirmed cases (CASE), and infection rate (INF) series I_0 . This shows that when the first difference of the net foreign reserve is taken, it becomes stationary and the other variables are stationary in level degree.

Table 3: ADF and PP Unit Root Test Results

	Variables	Test Statistic	Crucial (Critical) Values			
			%1	%5	%10	
1 Net Foreign Reserve	ADF	LOGNFR, <i>level</i>	-2.195797	-4.309824	-3.574244	-3.221728
		LOGNFR, <i>1st difference</i>	-5.388732	-4.205004	-3.526609	-3.194611
	PP	LOGNFR, <i>level</i>	-2.646625	-4.186481	-3.518090	-3.189732
		LOGNFR, <i>1st difference</i>	-5.301844	-4.205004	-3.526609	-3.194611
2 Number of Cumulative Cases	ADF	LOGCUM, <i>level</i>	-6.045428	-4.211868	-3.529758	-3.196411
	PP	LOGCUM, <i>level</i>	-14.82130	-4.170583	-3.510740	-3.185512
3 Confirmed cases	ADF	LOGCASE, <i>level</i>	-11.68746	-4.211868	-3.529758	-3.196411
	PP	LOGCASE, <i>level</i>	-3.267272	-4.165756	-3.508508	-3.184230
4 Infection Rate	ADF	LOGINF, <i>level</i>	-10.95878	-4.219126	-3.533083	-3.198312
	PP	LOGINF, <i>level</i>	-11.13940	-4.180911	-3.515523	-3.188259

Note: The quantity of lags in the ADF testing is identified per the Schwarz criteria which is a more powerful criterion and yields preferable outcomes than the other criteria. In the Philips Perron tests, the quantity of lags identified per Newey-West Bandwith is received. Maximum lag length is taken as nine.

3.3. ARDL Model

According to the results of the analysis, the series are not at the same level stationary. In the ARDL Bounds testing developed by Pesaran et al. (2001), it is sufficient if the series are I_0 or I_1 and the cointegration relationship can be investigated. Another important advantage is that healthy and effective results can be obtained in small samples. Also, short-run dynamics and long-run balance can be integrated through error correction (ECM).

The null hypothesis tested by the ARDL Bound Test is "There is no cointegration correlation between variables", thus, rejecting this hypothesis shows that such a cointegration correlation exists. If the F statistic from the test is greater than the critical upper bound, H_0 is rejected. When F statistic is less than the critical lower bound, H_0 is accepted. And when F statistic is between the upper and lower critical bounds, other cointegration tests should be considered as there is not sufficient data to reject or fail to reject the H_0 hypothesis (Pesaran, Shin, Smith, 2001).

Table 4: ARDL Bounds Test Results

Predicted Equality =DT=f(PI)		
F Statistic	4.214929	
Significance level	Critical Value	
	Lower Limit	Upper Limit
%1	3.65	4.66
%5	2.79	3.67
%10	2.37	3.2

Diagnostic tests	Statistics
R ²	0.755702
Adjusted R ²	0.568885
F Statistics	6.704611 (0.000612)
Breusch-Godfrey	0.7750 (0.9978)
Breusch-Pagan-Godfrey	0.3450 (0.3959)
ARCH LM	0.7108 (0.8760)

Note: The values in parentheses are the probabilities.

Data in Table 4 shows that there is a cointegration correlation between the variables as the calculated F statistic value (4.214954) is greater than the upper bound (3.67) at 5% significance level. In this case, there is a long-run correlation between LOGNFR, LOGCASE, LOGINF, and LOGCUM. The model has been analyzed with the 1st and 2nd order LM autocorrelation test and with Breusch-Pagan Godfrey (1979) test to address heteroscedasticity. The results obtained indicate that the model does not have heteroscedasticity or variance.

3.4. Error Correction Model (ECM) and Long-Run Coefficients

There are two important points showing whether the ECM works; EC parameter "CointEq (-1)" must take a negative value and be statistically significant. According to the results contained in Table 5, the error correction coefficient (CointEq (-1)) is negative and significant. Basic conditions are provided. A long-run correlation between series can be considered to be in existence in the case of a negative and significant error correction coefficient.

Table 5: Error Correction Model and Long-Run Coefficients

ECM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGNFR(-1))	0.482237	0.163071	2.957232	0.0111
D(LOGNFR(-2))	0.359638	0.172458	2.085364	0.0573
D(LOGNFR(-3))	0.413521	0.198942	2.078596	0.0580
D(LOGCUM)	3.285898	58.19338	0.056465	0.9558
D(LOGCUM(-1))	-343.3261	78.84683	-4.354343	0.0008
D(LOGCUM(-2))	-127.9802	37.18984	-3.441268	0.0044
D(LOGCUM(-3))	26.64521	7.228678	3.686042	0.0027
D(LOGINF)	0.906247	61.82117	0.014659	0.9885
D(LOGINF(-1))	356.3760	82.02099	4.344937	0.0008
D(LOGINF(-2))	127.5044	37.11036	3.435818	0.0044
D(LOGINF(-3))	-26.54874	7.222769	-3.675701	0.0028
D(LOGCASE)	-4.246000	4.536542	-0.935955	0.3664
D(LOGCASE(-1))	-13.43405	3.561120	-3.772423	0.0023
CointEq(-1)*	-0.874756	0.166630	-5.249691	0.0002
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGCASE	24.96807	14.27994	1.748471	0.1039
LOGCUM	694.7681	295.1702	2.353788	0.0350
LOGINF	-719.8989	308.6918	-2.332096	0.0364
C	-3163.982	1363.981	-2.319667	0.0373

Dependent Variable: LOGNFR.

According to the ECM results obtained, a 1% increase in LOGCASE will result in a 24.96807% increase in LOGNFR. A 1% increase in LOGCUM will result in a 694.7681% increase in LOGNFR. A 1% increase in LOGINF will lead to a 719.8989% decrease in LOGNFR (Table 5).

When interpreting ECC; It is possible to calculate the rebalance ratio of the system by dividing the ECC by "1" ($1 / 0.874756 = 1.143$). This value indicates that the system will take approximately 1,143 days to rebalance.

A negative correlation was found between LOGNFR and LOGINF, and a positive correlation was found between other variables. Surprisingly, when the model was re-estimated taking LOGCUM as the dependent variable to test a positive relationship; a negative relationship was found between LOGCUM AND LOGNFR. A 1% increase in LOGNFR will create a 0.000110% decrease in LOGCUM (Table 6).

Table 6: Long Run Coefficients (Dependent Variable: LOGCUM)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LOGNFR	-0.000110	0.000148	-0.743798	0.4645

Similarly, when LOGCASE is taken as a dependent variable; there seems to be a negative relationship between the variables. A 1% increase in LOGNFR will result in a 0.149984% decrease in LOGCASE (Table 7).

Table 7: Long Run Coefficients (Dependent Variable: LOGCASE)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LOGNFR	-0.000110	0.000148	-0.743798	0.4645

3.5. Granger Causality Test over VECM Model

Having identified the long-run correlation between the variables, Granger Causality Test over VECM Model has been applied to analyze the short-run correlation. As can be seen from Table 8, the null hypothesis H_0 is rejected since $\text{prob} < 0.05$ in the short-run, and therefore the alternative hypothesis is accepted. That is, LOGNFR is a Granger cause for the LOGCASE, LOGCUM, and LOGINF.

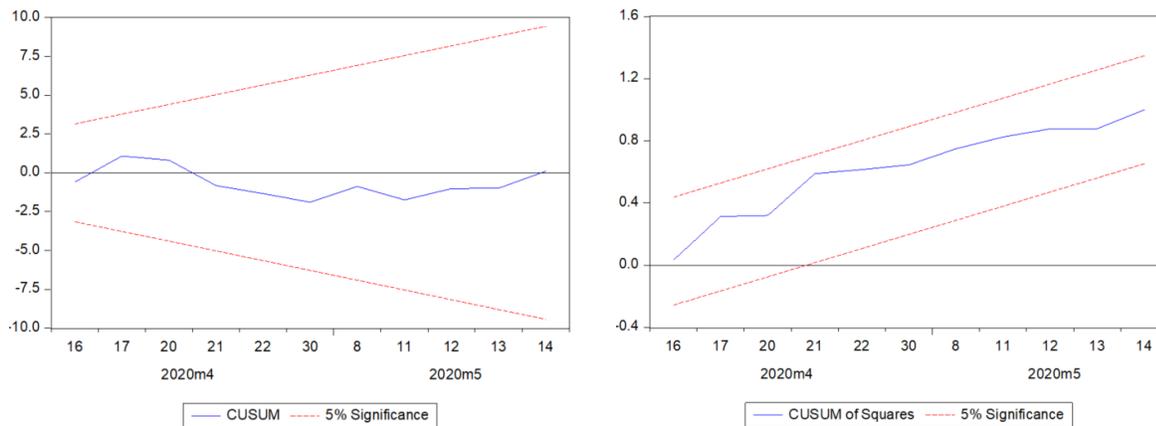
Table 8: Long Run Coefficients (Dependent Variable: LOGCASE)

Hypothesis	Prob.	Direction of Causality
LOGNFR does not (Granger) causes LOGCASE	0.0461	LOGNFR → LOGCASE
LOGNFR does not (Granger) causes LOGCUM	0.0462	LOGNFR → LOGCUM
LOGNFR does not (Granger) causes LOGINF	0.0462	LOGNFR → LOGINF

3.6. CUSUM Test and CUSUM SQUARE Test

The stability of the coefficients estimated in the ARDL model was investigated by CUSUM and CUSUM SQUARE (CUSUMQ) tests. The CUSUM test suggests that the estimated coefficients/parameters are stable if the related error terms are within the confidence interval. The CUSUMQ test is used to evaluate coefficients based on the squares of cumulative error terms (5% significance level (95% confidence band)) (Brown et al., 1975). Straight lines in Figure 6 show parameter estimates and red dashed lines show 95% confidence limits.

Figure 6: CUSUM and CUSUM SQUARE Test Results



As can be seen from Figure 6; residues remain within the confidence zone indicated by dashed lines. According to these tests, the coefficients appear to be stable.

4. CONCLUSION

COVID-19, another pandemic faced by human beings, emerged as an important factor triggering a global collapse in the modern world, unlike the previous ones. In today's world involving a struggle to save lives and slow down the transmission of the disease, the final scale of which is not yet predicted; countries have different practices to avoid mass layoffs and bankruptcies. Neither the loss caused by the global pandemic nor the losses of production, consumption (due to decreased demand), and investment resulting from the promotion of social distance and isolation could be calculated yet. Different practices in different countries brought along different success rates against the pandemic. The fight against COVID-19 and immediate support measures vary from country to country, with the influence of decision-makers and financial power.

Change in the net foreign exchange reserves of Turkey is also noteworthy among the macro-economic indicators that have deteriorated since the beginning of the pandemic. From this point of view, this study aims to investigate if there is a relationship between the net fx reserves of Turkey and COVID-19. For this purpose, daily data is obtained regarding COVID-19 cases in Turkey by receiving case data from the Turkish Ministry of Health and cumulative cases and infection rate data from the Association of Public Health Professionals (HASUDER), and daily net foreign exchange reserves were calculated using the data from the balance sheet of the CBRT, and then tested by ARDL Bounds Test Approach, and analyzed within the framework of the Vector Error Correction Model (VECM). Once a long-run relationship was detected between the variables, a Granger Test was performed through the VECM Model to question the presence of a short-run relationship. Then, the stability of the coefficients was tested by CUSUM and CUSUMQ tests. As a result of the analyzes carried out;

- It was found that the number of COVID-19 cases detected, the cumulative number of cases and the rate of infection are cointegrated with the net foreign exchange reserves in the long run.
- It was found that the net foreign exchange reserve is a Granger cause of the cumulative number of cases, rate of infection, and the number of detected cases. It was empirically determined that the increase in the COVID-19 is caused by, inter alia, the lack of "sufficient" resources to prevent the spread of the pandemic, detect and treat the cases, and avoid mass unemployment and bankruptcy caused by the promotion of isolation and social distance during the course of the pandemic.
- A positive correlation was found between the cumulative number of cases, the number of cases, and the net foreign exchange reserve. And a negative correlation was found between the infection rate and the net foreign exchange reserve. The analysis detected that, when the rate of infection increases by 1%, the net foreign exchange reserve decreases by 719.90. To put it another way, a decrease in the net foreign exchange reserve brings along a serious increase in the rate of infection.
- To question the surprisingly positive relationship between the net foreign exchange reserve and the number of cumulative cases and the number of cases, the net foreign exchange reserve was included in the analysis as an independent variable this time and a negative relationship was found between the variables.

The positive relationship between the quantity of detected cases, the cumulative quantity of cases, and the net foreign exchange reserve is surprising. The relationship between the variables will be tested in another study by the NARDL Long-run Asymmetry Test. This study is a contribution to the literature that has not yet been formed as it is one of the first empirical studies on COVID-19, and it is also important for decision-makers. New data to be announced and future studies to be conducted will be important regarding the pandemic, which has not been brought under control yet and which involves concerns for a second wave.

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