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A DOUBLE-EDGED SWORD: COVID-19 AND EMISSION:

PROOFS FROM TURKEY

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ABSTRACT

Purpose - This work inquires whether there's a correlation between Covid-19 and the emission in Turkey.

Methodology - For this purpose, the daily data on COVID-19 seen in Turkey (cumulative case and infection rate data from Public Health Experts Association (HASUDER)) and daily emission data obtained from the Central Bank of Turkey (CBT) balance sheet for the period between 11 March-22 May 2020 were tested using the ARDL Bounds Test Approach and analyzed within the frame work 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; *i.* There is a cointegration in the long run between COVID-19 and the emission, and is statistically significant. *ii.* There is a bidirectional causality between the variables in the short run. *iii.* There is a positive correlation between emission and infection rate.

Conclusion- The demand for money in this process, which started with a health crisis and turned into a global economic crisis with a global shock of uncertainty, caused sharp increases in the emission volume in the short term. However, inflation will follow this sharp increase in emissions. For the central bank, whose main purpose is to ensure price stability, COVID-19 and emission are a double-edged sword. This study contributes to the formation of literature on COVID-19 and is also noteworthy for its results.

Keywords: Emission, Covid-19, Bounds Test, ARDL.

JEL Codes: E5, I18, C01

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INTRODUCTION

Emission, which is another financing source of the Central Bank of Turkey (CBRT), which has the authority to print banknotes, indicates the number of banknotes issued by the Central Bank. The emission volume and circulating money are also indicators of cash demand and are important components of the overall money demand. According to classical economists, money is demanded only for transactions. However, according to Keynesian Money Demand Theory, money may be demanded for three purposes;

i. for transactions *(transaction demand),*

ii. for need *(precautionary demand)* and

iii. for speculation *(speculative demand).*

The demand for money for transactions and needs constitutes the demand for cash.

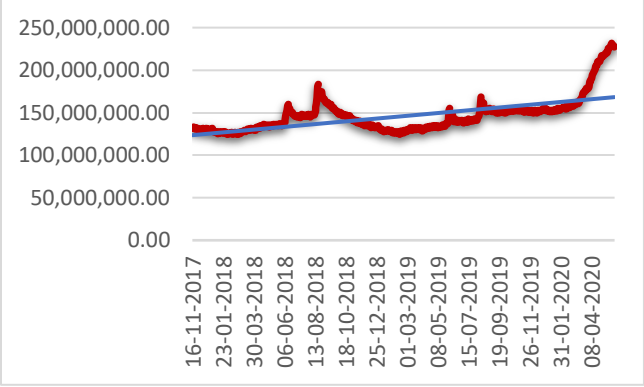
Central banks generate income by printing money and this income is called *"seigniorage"*. More specifically, seigniorage is the difference between the cost of producing money and the value written on it. In the short term, states may resort to printing a lot of money, but printing money is the most dangerous economic behavior because, according to Monetarist economists, the increase in money supply will lead to inflation. Inflation lowers the real value of money that individuals have, and the real demand for money decreases. Hence, ultimately, seigniorage income starts to decrease. Despite the fact of inflation, three main reasons require central banks to issue money;

i. Providing high employment,

ii. Financing the budget deficit, and

iii. Generating seigniorage income.

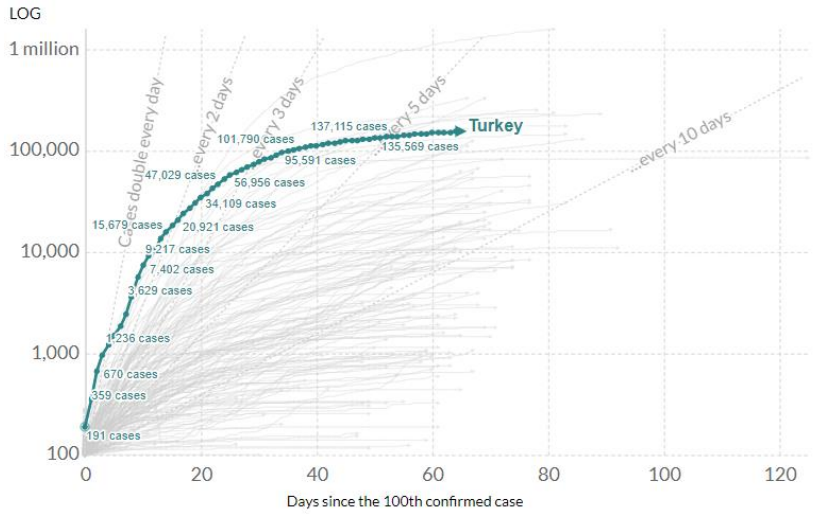
Figure 1: Emission (16.11.2017-28.05.2020)



Source: CBRT.

As can be seen from Figure 1, a rapid increase in emission is noticeable after March 11, 2020. March 11, 2020, is the date when the World Health Organization (WHO) notified the COVID-19 as a pandemic, and according to the Ministry of Health data, the first case of the Covid-19 in Turkey was seen on March 10, 2020. Figure 2 shows the course of the Covid-19 cases in Turkey after the first case.

Figure 2: Total Confirmed COVID-19 Cases, Turkey (21 Jan.-23 May 2020).



Source: European CDC.

With the spread of the outbreak following the detection of the first case of the COVID-19 after 11 March 2020, the emission increase in the central bank balance sheet is remarkable. It is a fact that the emergency measures put into practice to detect cases, to save lives, and to prevent the spread of pandemics and the applications carried out to prevent mass unemployment, loss of production and income as a result of the promotion of isolation and social distance increase the demand for cash.

Emission and pandemic are "a double-edged weapon". This critical process requires international coordination and a *"well-designed government management plan"* (Loayza and Pennings, 2020).

The empirical questioning of the relationship between the COVID-19, which created a greater global uncertainty shock than the 2008 crisis (Baker et al., 2020) and started with a health crisis, unlike the previous ones, bringing with it a global collapse and a paradigm shift (Çiğdem, 2020), and the increase in emissions constitutes the purpose of this study. First, it will be investigated whether there is any study on the effects of the COVID-19, which is a very recent case, on the economy. Then empirical tests will be carried out and the findings will be discussed.

1. LITERATURE REVIEW

It is seen in the literature that there are not many studies on emission and the demand for cash. The majority of studies have been developed for the general demand for money. Boeschoten (1992) conducted studies on demand for cash and these studies, which were mostly carried out within central banks, have been rarely published in magazines. This study addressing the relationship between the Covid-19 and emission in the Corona process in Turkey will provide an empirical contribution to literature where there is a lack of adequate studies on emissions and the impacts of the Covid-19 on the economy due to the lack of a sufficient number of observations. Table 1 shows the studies carried out so far.

Table 1: Studies on COVID-19

Author	Conclusion
Atkeson (Mar 2020)	"What is urgently needed is an economic analysis of the economic consequences of the mitigation steps currently being implemented and contemplated going forward so that economic tradeoffs between public health and the economy can be considered quantitatively."
Baker, Bloom, Terry (May 2020)	As a result of the analyzes, a decrease of 9% in US GDP is predicted as of 2020: Q4.
Baldwin and Weder di Mauro (2020)	They offer various policy suggestions in their study.
Çiğdem (May 2020)	Turkey's net foreign currency reserves in the Long-Run with COVID-19 has been found to be cointegrated. In the short-run, net foreign exchange reserve is a Granger cause of COVID-19.
Eichenbaum, Rebelo and Trabandt (2020)	Using single-sector dynamic model analysis, they examined the impact of the pandemic by taking into account optimal rational responses by special agents. They internalized externalities with the most appropriate Pigouvian policy.
Fernandes (Mar 2020)	Countries which are more dependent on tourism (such as Greece, Portugal and Spain) (more than 15% of GDP) and countries that are heavily dependent on foreign trade will be more affected by this crisis. Analysis results; on average, it shows that each additional crisis month costs 2.5-3% of global GDP.
Fornaro and Wolf (Mar 2020)	They examined COVID-19 as a negative impact for the growth rate of productivity.
Jorda et al. (2020)	They provide time series evidence for the impact of historical outbreaks on return rates, demonstrating that pandemics reduce real rate of interest.
Guerrieri et al. (Apr 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.
Ozili and Arun (Mar 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.

Note: Created by the author.

2. DATA

In order to test the relationship between COVID-19 and emission, daily cumulative case and infection rate data from HASUDER and daily emission data from CBRT were analyzed. 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
Emission	EMS	Central Bank of Turkey (CBT)
Number of cumulative cases	CUM	HASUDER
Infection Rate	INF	HASUDER

3. METHODOLOGY AND EMPIRICAL RESULTS

In this section, the relationship between COVID-19 and emission have been tested empirically.

3.1. Unit Root Tests

Examining unit roots of variables is the first and compulsory step. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) which is the most accepted stagnation in the literature and which is accepted as the most valid test in determining the stagnation in time series (Enders, 1995) unit root tests were used to determine the degree of stationary of time series. Table 3 shows the ADF and PP test results.

Looking at the ADF and PP test results, the emission (EMS) is found to be I_1, and the number of cumulative cases (CUM) and infection rate (INF) series I_0. This shows that when the first difference of the emission 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	Critical Values		
					%1	**%5**	**%10**
1	**Emission**	**ADF**	LOGEMS, *level*	-0.767840	-4.284580	-3.562882	-3.215267
			LOGEMS, *1st difference*	-3.414595	-4.498307	-3.658446	-3.268973
		PP	LOGEMS, *level*	-0.153152	-4.165756	-3.508508	-3.184230
			LOGEMS, *1st difference*	-6.106652	-4.186481	-3.518090	-3.189732
2	**Number of Cumulative Cases**	**ADF**	LOGCUM, *level*	-15.49412	-4.170583	-3.510740	-3.185512
		PP	LOGCUM, *level*	-18.07524	-4.144584	-3.498692	-3.178578
3	**Infection Rate**	**ADF**	LOGINF, *level*	-11.92232	-4.180911	-3.515523	-3.188259
		PP	LOGINF, *level*	-12.98868	-4.152511	-3.502373	-3.180699

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

3.2. ARDL (Autoregressive Distributed Lag) Model

The results of the analysis show that the series are at the different level stationary. In the ARDL test developed by Pesaran et al. (2001); the cointegration relationship of series which are at different levels can be questioned. Variables still need to be tested against the possibility of being stationary I_2 in the second difference. In the second difference, ARDL model cannot be applied in stationary variables. In the ARDL test, healthy and effective results can be obtained in small samples and can be integrated with short-run dynamics and long-run equilibrium error correction (ECM).

"H_0: No cointegration between variables", thus, rejecting H_0 hypothesis shows that such a cointegration exists. If the *F statistic > the critical upper bound*, H_0 is rejected. When *F statistic < the critical lower bound*, H_0 is accepted. And when *the upper critical bounds < F statistic < lower critical bounds*, other cointegration tests should be considered as there is no sufficient data to reject or fail to reject the H_0 hypothesis (Pesaran, Shin, Smith, 2001).

Table 4: ADF and PP Unit Root Test Results

Predicted Equality =LOGEMS=*f*(LOGINF, LOGCUM)		
F Statistic	11.39777	
Significance level	Critical Value	
	Lower Limit	*Upper Limit*
%1	5.15	6.36
%5	3.79	4.85
%10	3.17	4.14
Diagnostic tests	Statisitcs	
R^2	0.998034	
Adjusted R^2	0.996961	
icsF Statistics	930.5046 (0.000000)	
Breusch-Godfrey *	0.9760 (0.9958)	
Breusch-Pagan-Godfrey *	0.9565 (0.9052)	
ARCH LM *	0.0640 (0.0398)	

Note. The values in parentheses are the probabilities.
*Maximum lag length is taken as 6.

There is a cointegration between the variables. (F statistic value (11.39777) > the upper bound (6.36) at 1% significance level) (Table 4). There is a long-run correlation between LOGEMS, LOGINF and LOGCUM. To address heteroscedasticity, the 1st and 2nd order LM autocorrelation test, Breusch-Godfrey and Breusch-Pagan Godfrey (1979) test were used. According to the results; the model does not have heteroscedasticity.

3.3. Error Correction Model (ECM) and Long Run Coefficients

For ECM to be valid, the error correction coefficient (CointEq (-1)) must be negative and statistically significant. So, the prob value must be less than 0.05. Principal circumstances are provided (Table 5). If there is only a negative and significant error correction coefficient, a long-run relationship between the series can be considered.

Table 5: Error Correction Model and Long-Run Coefficients

ECM				
Variable	**Coefficient**	**Std. Error**	***t*- Statistic**	**Prob.**
C	51.02827	8.353624	6.108519	0.0000
D(LOGEMS(-1))	0.146438	0.194340	0.753513	0.4591
D(LOGEMS(-2))	-0.625435	0.221386	-2.825085	0.0099
D(LOGINF)	4.886664	0.783689	6.235460	0.0000
D(LOGINF(-1))	-1.511807	0.562566	-2.687343	0.0135
D(LOGINF(-2))	-1.023013	0.297104	-3.443281	0.0023
D(LOGINF(-3))	-0.041514	0.010151	-4.089663	0.0005
D(LOGCUM)	-4.950237	0.792810	-6.243911	0.0000
D(LOGCUM(-1))	1.521011	0.556441	2.733461	0.0121
D(LOGCUM(-2))	0.980818	0.294648	3.328780	0.0030
CointEq(-1)*	**-0.121514**	**0.019896**	**-6.107519**	**0.0000**
Long-Run Coefficients				
Variable	**Coefficient**	**Std. Error**	***t*- Statistic**	**Prob.**
LOGINF	90.45553	39.05153	2.316312	0.0302
LOGCUM	-90.52036	39.03043	-2.319225	0.0301

Dependent Variable: LOGEMS.

A positive relationship was found between LOGEMS and LOGINF. In the event that LOGINF is increased by 1%, there is an increase of 90.45553% in LOGEMS (Table 5). Conversely, a negative relationship was detected between LOGCUM and LOGEMS. According to the analysis result; an increase of 1% in LOGCUM causes a decrease of 90.52036% in LOGEMS. In order to examine this surprising result, when LOGCUM is taken as the dependent variable and LOGEMS as an independent variable, it was determined that a 1% increase in LOGEMS led to a decrease of LOGCUM of 0.004165% (Table 6).

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

Variables	Coefficient	Std. Error	t- Statistic	Prob.
LOGEMS	-0.004165	0.001338	-3.112158	0.0046

Interpreting the error correction coefficient (ECC); it is possible to calculate the rebalance ratio of the system by dividing the ECC by "1" (1 / 0.121514 = 8.2295). This value shows that the system will take roundly 8,2295 days to rebalance.

3.4. Granger Causality Test over VECM Model

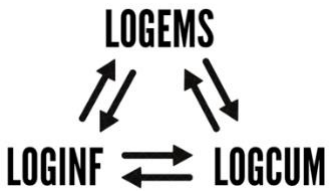
After finding the long-run correlation between the variables, Granger Causality Test over VECM Model has been applied to investigate the short-run correlation. As can be seen from Table 7, the null hypothesis H_0 is rejected since prob<0.05 in the short-run and therefore alternative hypothesis is accepted. There is a bidirectional causality between variables (Figure 3).

Table 7: Results of the Granger Causility Test Over VECM

Hypothesis	Prob.	Direction of Causality
LOGINF does not (Granger) causes LOGEMS	0.0245	LOGINF → LOGEMS
LOGCUM does not (Granger) causes LOGEMS	0.0636	LOGCUM → LOGEMS
LOGEMS does not (Granger) causes LOGINF	0.0000	LOGEMS → LOGINF
LOGCUM does not (Granger) causes LOGINF	0.000	LOGCUM → LOGINF
LOGEMS does not (Granger) causes LOGCUM	0.000	LOGEMS → LOGCUM
LOGINF does not (Granger) causes LOGCUM	0.000	LOGINF → LOGCUM

*Maximum lag length is taken as 4.

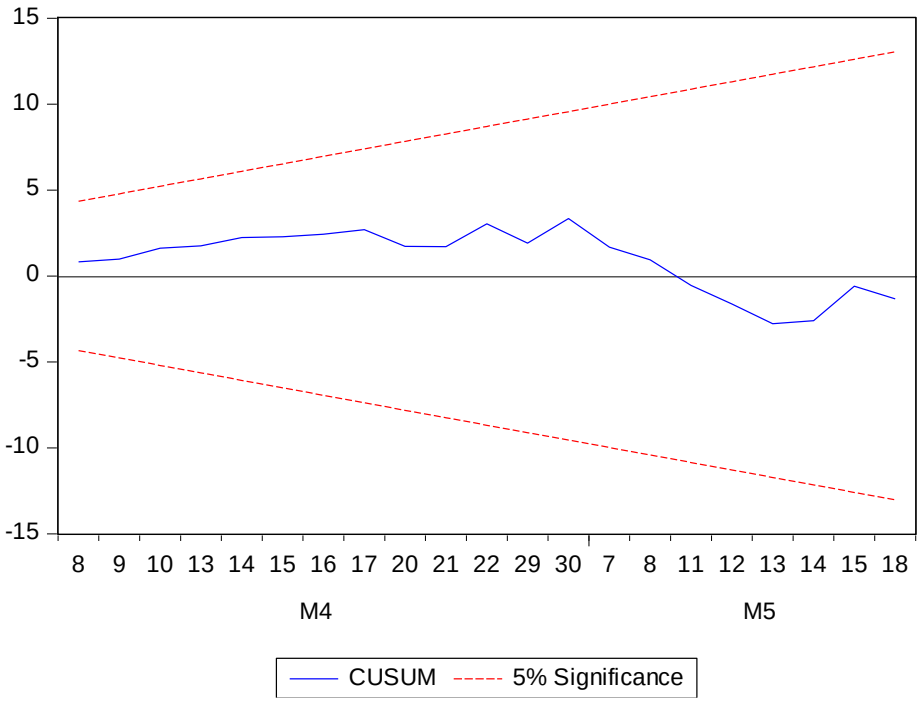
Figure 3: Results of the Granger Causility Test Over VECM



3.5. CUSUM Test

CUSUM Test was used to investigate the stability of the estimated coefficients in the ARDL model. In the CUSUM test, the relative error terms being within the confidence interval indicate that the estimated coefficients are stable. Coefficient estimates are shown with straight lines and 95% confidence limits are shown with broken lines (Figure 4). According to CUSUM Test, the coefficients are stable.

Figure 4: CUSUM Test Result



CONCLUSION

COVID-19 was detected the first case in Turkey and the increase in the emission figures in the period after 11 March 2020, when WHO declared COVID-19 as a pandemic, is remarkable. The purpose of this study is to question the relationship between COVID-19 and emission figures, which is the indicator of cash demand. For this purpose, cumulative cases and infection rate daily data from the Association of Public Health Professionals (HASUDER), and daily emission 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-term relationship was detected between the variables, a Granger Test was performed through the VECM Model to question the presence of a short-term relationship. Then, the stability of the coefficients was tested by CUSUM Test.

As a result of the analyzes carried out;

- It was found that the cumulative number of cases and the rate of infection are *cointegrated* with the emission in the long run.

- The emission is a Granger cause of COVID-19 and COVID-19 is a Granger cause of the emission. There is a bidirectional causality between variables in the short run.

i. Determining the number of cases, treatment, loss of life, trying to prevent the spread of COVID-19, preventing mass unemployment and bankruptcies, steps taken to prevent production losses have been a reason for the increase in emissions.

ii. Due to the increased cash requirement as a result of COVID-19, the creation of the required cash by printing money, the ability to produce / purchase more test kits, more diagnostic tests to more people, and thus, it is possible to diagnose infected patients. Therefore, it is not surprising that emission is the cause of the number of cumulative cases and the rate of infection.

- A positive correlation was found between the infection rate and the emission. The analysis detected that, when the infection rate increases by 1%, the emission increases 90.45553%. This result is an empirical evidence that measures taken to prevent the spread of outbreak increase the need for cash.

Due to the surprising negative correlation between the emission and the number of cumulative cases (LOGCUM), LOGCUM was taken as dependent variable and analyzed. This time, it was determined that a 1% increase in the emission brought about 0.004165% decrease in LOGCUM.

The process triggered by the COVID-19 and started with the health crisis turns into an economic crisis. The sharp drop in demand caused by the pandemic and the promotion of social distance and isolation brought mass unemployment and the closure of companies. Measures taken to prevent the pandemic from spreading rapidly, for diagnosis, treatment, and protection, to prevent loss of life, to support the vulnerable and income-losing individuals of the society, and to prevent unemployment and bankruptcy have resulted in a serious demand for money. In the short term, the fastest and easiest method to meet the money demand is issuing money. However, it is a method that will result in inflation. The primary purpose of the central bank is to maintain price stability. The emission applied in the COVID-19 process and inflation are two sharp edges of a sword. The emission increase applied in this period is the first step of other problems to be encountered in the medium and long term.

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.

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