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RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

Influence of the COVID-19 Pandemic on Exports in Türkiye: Evidence from ARDL Model

Covid-19 Salgınının Türkiye'nin İhracat Performansına Etkisi: ARDL Modelinden Kanıtlar

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ABSTRACT

Türkiye is a country in which the COVID-19 pandemic has deeply affected export performance. The aim of this paper is to analyse the impact of the COVID-19 pandemic on Turkish export performance using different variables indicating the severity of the COVID-19 effects. The effect of COVID-19 on Türkiye's export performance is empirically analysed with the ARDL approach by employing time series data covering the 2013:q1-2022:q1 period. The estimation results of the six models indicate that COVID-19 does not affect Turkish export performance in the long term, whereas its lagged variables have negative and significant effects in the short term. Foreign income has positive and statistically significant effects on export volumes in both the short and long term. The exchange rate significantly and negatively affects export flows in both the short and long term. The results of this paper are robust against different types of COVID-19 proxies. COVID-19 has negative effects on exports in the short run for Türkiye's economy. The results indicate that policymakers should consider the lagged effects of variables in addition to the current version. The findings also show the recommendation that short- and long-run estimations should be conducted to determine the short- and long-run relations.

Keywords: Covid-19, Export performance, Supply chain, Lockdown policies, ARDL method

Jel Codes: C22, F14, I18

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ÖZ

Covid-19 salgınının dış ticareti derinden etkilediği ülkelerden biri Türkiye'dir. Bu çalışmanın amacı, Covid-19 salgınının Türkiye'nin ihracatı üzerindeki etkisini, farklı Covid-19 değişkenleri ile analiz etmektir. Covid-19 salgınının ihracat üzerindeki etkisi ampirik olarak ARDL yöntemi ile analiz edilmiş olup analiz dönemi 2013:q1-2022:q2 aralığını kapsamaktadır. Altı modelin de tahmin sonuçları, Covid-19 salgınının uzun vadede Türkiye'nin ihracatını etkilemediğini fakat gecikmeli değerlerin kısa vadede ihracatı negatif ve istatistiki olarak anlamlı etkilediğini göstermektedir. Dış dünya gelirinin ise kısa ve uzun dönemde ihracat üzerinde pozitif ve istatistiki olarak anlamlı etkileri bulunmaktadır. Bununla birlikte, döviz kuru hem kısa hem de uzun vadede ihracatı önemli derecede olumsuz etkilemektedir. Farklı Covid-19 değişkenleri ile yapılan analizin sonuçları birbirini destekler niteliktedir. Bununla birlikte Covid-19, ihracat üzerindeki olumsuz etkisini kısa dönemde göstermektedir. Bu nedenle politika yapıcılar, sadece cari göstergeleri değil değişkenlerin gecikmeleri etkilerini de göz önünde bulundurmalıdır. Sonuçlar aynı zamanda kısa ve uzun vadeli ilişkileri görmek için kısa ve uzun dönemli tahminlerin de yapılması gerektiğini desteklemektedir.

Anahtar Kelimeler: Covid-19, İhracat performansı, Arz zinciri, Karantina önlemleri, ARDL yöntemi

Jel Sınıflandırması: C22, F14, I18

1. Introduction

International trade has suffered its biggest setback since the second world war in 2020, when the COVID-19 outbreak escalated (OECD, 2021). Global commodity and service trade valued at $25 trillion in 2020 shrank by 10% ($2.5 trillion) in 2020. Depending on the spread of the pandemic, a contraction in international trade occurred to a large extent in the first half of 2020. Accordingly, the volume of international trade in goods contracted by nearly 7% in the first quarter but shrank by 18% in the second quarter. In the same period, service trade decreased by approximately 25%. Undergoing a recovery in 2021, global trade increased by more than 6 trillion US dollars and reached approximately 28 trillion US dollars (UNCTAD, 2022).

The reasons why Covid-19 has had a devastating impact on global trade include curfews, quarantines, social distancing practises, travel restrictions, stringent border controls, and border closures (WTO, 2021). Consequently, the movement of goods and people has come to a standstill. The interruption of education in schools also exerted great pressure on employees to stay at home. Diseases and deaths experienced for a long time, especially in countries most affected by COVID-19 directly affected the workforce. These changes have caused a decline in global production (Hayakawa & Mukunoki, 2021).

Although economic crises were essentially based on a crisis of confidence, COVID-19 directly stopped economic activity. Because of the quarantine measures, the economic crisis spread to all sectors instantly and simultaneously, bringing service trade to a standstill. Strict protective measures have been implemented, especially in the trade of agricultural, food and medical goods (Bulut, 2023). However, quarantine practises and curfews have prevented balancing mechanisms (such as work informally) that would come into play during economic crises. Consequently, large-scale state support was implemented to reduce the economic and social impact of the crisis. Despite all measures taken, SMEs were the ones most affected by the pandemic conditions (OECD, 2020).

Logistical interruptions in the supply and demand shocks caused by COVID-19 further spread and intensified the crisis due to the break in supply chains (Brenton et al., 2022). Accordingly, the low-tech textile, apparel, leather, and wood products sector and the high-tech transportation vehicles and parts sector, which are closely connected to the global supply chain, were most affected by the pandemic. The sectors that were least affected were agriculture, food, pharmacy, and medical

products (Pianta, 2021). Those most affected by the Covid-19 pandemic were the least developed and developing countries where foreign trade maintained its weight in the economy. The share of foreign trade in these countries in global trade, which plays an important role in increasing welfare, rose from 16% in 1990 to 30% in 2017 (WTO, 2021).

Türkiye is one of those countries where the weight of exports has increased in its economic structure. While the share of exports in GDP in Türkiye was below 10% in the 1980s, it reached 20% after the 2000s (TÜİK, 2014), as a result of which Türkiye became one of the countries whose economies were worst affected by Covid-19. With the emergence and spread of the COVID-19 pandemic in Türkiye, exports decreased by 18.3%, 41.5%, and 40.9%, respectively, in March, April, and June 2020. In parallel, the Turkish economy contracted by 10.3% in the second quarter of 2020 and by 6.5% throughout the year. All these developments necessitate clarifying important questions regarding the impact of COVID-19 on Türkiye's exports. This study aims to fill an important gap in the literature by addressing the impact of COVID-19 on Türkiye's exports from different perspectives for the first time. Dummy variable: number of confirmed total cases and deaths; confirmed new cases and deaths; average number of days off work in terms of exports. Along with these, the impact of COVID-19 on exports was assessed by dividing it into short and long periods.

2. Literature

There are many studies in the literature dealing with the impact of COVID-19 on exports. These results are of great importance for observing the various effects of COVID-19 on exports. In their paper in which they examined 29 Asia-Pacific countries, Das and Sen (2022) showed that Covid-19 adversely affected the export of medical products, resulting from the export restrictions applied by the exporting countries. Hayakawa and Mukunoki (2021), in their analysis of 34 countries, showed that the most adversely affected ones by COVID-19 were labour-intensive sectors. Barbero et al. (2021), on the other hand, in their study using export data from 68 countries, concluded that Covid-19 significantly disrupted exports, and the negative effect was most pronounced in countries with similar income levels. Hayakawa and Mukunoki (2020), in their paper, in which they examined 186 countries for the first quarter of 2020, showed that COVID-19 adversely affected the foreign trade of especially exporting countries. In addition, it has been determined that of the exporting countries, the developing countries were those most adversely affected by the pandemic, with textiles, footwear, and plastics as the main sectors affected.

Ugurlu and Jindrichovska (2022), who investigated the effect of Covid-19 on trade between Hungary, Czechia, Poland, and Hungary, showed that exports were only negatively affected by quarantine periods, and the duration of this effect varied from country to country. Jindrichovska and Ugurlu (2021) also examined the impact of COVID-19 on foreign trade between China and the EU. The results indicate that although foreign trade decreased sharply, China's exports of healthcare and medical equipment increased because of the flexibility adjusted to the increased demand. Zhang et al. (2022) analysed the causal relationship between mutual trade between the United States and China and COVID-19. Accordingly, although unidirectional causality runs from the number of deaths to exports in China, this does not apply to the number of cases. On the other hand, the causality relationship is valid for both variables in the United States. Arenas et al. (2022), in their study on the Philippines, showed that the quarantine measures implemented by the Philippines' trading partners negatively affected their exports. Meanwhile, no significant relationship was observed between the quarantine measures implemented by the Philippines and exports. Hetami et al. (2022) focused on

foreign trade between Japan and Indonesia, concluding that COVID-19 had a significant negative impact on the economy and foreign trade of the two countries. Arita et al. (2022), on the other hand, showed that COVID-19 globally affected the agricultural products traded the least. According to the other results of the study, the countries most affected by agricultural trade due to COVID-19 are less developed in the low-income group.

However, Wei et al. (2021) analysed the impact of Covid-19 on the foreign trade of South Korea, Japan and China, reaching the following conclusion: Controlling the pandemic positively affected Japan's exports. The export performance of China and South Korea also depends on the severity of the pandemic in their main trading partners. Socrates and Lashitew (2020), in their study on Kenya covering the period of June 1, 2019-2020, showed that exports to quarantine countries increased slightly, but imports from these countries decreased significantly. Minondo (2020) researched the impact of COVID-19 on Spain's trade in goods and services based on data. According to the results of the research, Spain's trade in goods and services decreased significantly due to COVID-19. Transportation equipment, capital goods, durable consumer goods, and tourism were the sectors whose exports were most affected, especially due to the quarantine measures.

Brussevich et al. (2022) did so on a firm basis differently from others and concluded that exporting French firms were most negatively affected by the quarantine measures implemented by their trading partners. In another company-based study, Ben-Xi and Zhang (2020) discussed Chinese exports, establishing that although the export of agricultural products generally decreased, the exports of grain, vegetable oil, and medicinal plants increased. The products whose exports were most negatively affected were vegetables and mushrooms. Veeramani and Anam (2021) examined the impact of COVID-19 on India's exports in the service sector. Their analysis based on the data showed that India's trade in services fell by more than 10% in 2020, with travel, transportation, and financial services being the most affected sectors. Chabossou et al. (2021) investigated the impact of COVID-19 on 122 businesses in Benin and concluded that there was a 53% decrease in the turnover of the companies in the first period of 2020.

In one of the limited studies on the impact of Covid-19 on Türkiye's exports, Çakmaklı et al. (2021) claimed that thanks to structural reforms, the negative reflection of Covid-19 in the banking and finance sector was not observed, while ongoing exchange rate increases throughout the pandemic contributed to Türkiye's economic recovery. By contrast, Açıkgöz and Günay (2021) stated that economic recovery depended on monetary and fiscal policy measures, structural reforms, and vaccination levels. Türkmen and Erturgut (2022) researched the impact of Covid-19 on Türkiye's exports for the first five trading partners and found that after the detection of the first case in Türkiye exports to Germany and England declined, whereas exports to Iraq declined after the first case was detected in Iraq, and added that exports to Italy and the USA fluctuated. On the other hand, Ugurlu (2020) showed that Türkiye can provide competitive advantage, especially in the carpet rugs, milling products, salt, sulphur, cement, motor land vehicles, furniture, iron and steel, iron or steel goods, and non-knitted goods and accessories sectors.

3. Model and Data

3.1. Model

The model given in equation (1) is constructed considering the conventional foreign trade theory extended by different variables indicating the severity of COVID-19 effects.

$$LREX_t = \beta_0 + \beta_1 LWGDP_t + \beta_2 LRER_t + \beta_3 Covid_t + \varepsilon_t \quad (1)$$

In equation 1, $LREX_t$, the dependent variable of this paper, is Türkiye's real exports. $LWGDP_t$ and $LRER_t$ are independent variables of the model and represent real foreign income and the real exchange rate, respectively. $Covid_t$ constitutes the main variable of this study and indicates variables related to pandemic conditions. In this context, 6 different variables are employed to measure the impact of COVID-19 conditions on Türkiye's export performance. First, the dummy variable (LC_DUM) that takes the value of 1 from 2020:q1 to 2022:q1 and takes the value of 0 for the remainder of the period is used as a proxy for Covid-19. Second, the average number of days off work (LC_W_CL) (Arenas et al. 2022; Brussevich et al. 2022; Arita et al. 2022; Minondo, 2020) because of pandemic requirements is used as a proxy for pandemic conditions. The number of confirmed total cases (LC_T_CS) and deaths (LC_T_DT) and the confirmed new cases (LC_N_CS) and deaths (LC_N_DT) (Das and Sen 2022; Zhang et al. 2022; Brussevich et al. 2022; Arita, et al. 2022; Hayakawa & Mukunoki 2021; Hayakawa & Mukunoki 2021) related to Türkiye are used sequentially for the remaining equations. In other words, 6 different models are estimated to measure the impact of COVID-19 on export flows. ε_t is the disturbance term in equation (1).

According to economic theory, an increase in foreign income is expected to contribute to expanding export volumes. This is because exporting countries of Türkiye, whose income level is elevated, tend to increase their import demand from Türkiye. An increase in the real exchange rate, which indicates appreciation in the national currency, is expected to negatively impact exports. When the national currency appreciates, it makes export goods more expensive in the international market, leading to a decrease in Turkish exports as import demand from Türkiye decreases (Köse & Aslan 2020). The COVID-19 virus spread globally in early 2020 and affected economies around the world; therefore, it is expected that the virus will also negatively impact Turkish exports (Nakamura & Managi 2020). Given this information, β_2 and β_3 are expected to carry negative signs, while β_1 is expected to carry a positive sign.

3.2. Data

In this paper, estimates are performed using quarterly time series data for the period 2013:q1-2022:q1 for Türkiye. The real export variable is calculated by dividing the nominal export series by the export unit price index based on 2015=100. Both series were obtained from the TurkStat databases in seasonally and calendar adjusted form. The consumer price index-based real exchange rate series are from the Central Bank of Türkiye's Electronic Data Distribution System database. Türkiye's foreign income is calculated by weighting the exports of countries' gross national product (GDP) series by their export share. The GDP series of exporting countries is from the World Bank's Global Economic Monitor database (GEM), adjusted seasonally and based on 2010=100. The COVID-19 variables were retrieved from the Oxford University database. All variables used in the analysis were subjected to logarithmic transformation except for the COVID-19 dummy variable.

4. Empirical Findings

4.1. ARDL Model

The ARDL model requires two basic conditions that must be satisfied. First, all variables in the model must be stationary at a level or first difference. Second, cointegration relationships must exist

among the variables. In this study, unit root and F-bound tests were applied to control for stationarity and co-integration.

The formulation of the classic ARDL model proposed by Pesaran et al. (2001) is shown in equation 2.

$$\triangle Y_t = \pi_0 + \Sigma_{i=1}^{m} \pi_{1i} \triangle Y_{t-i} + \Sigma_{i=0}^{m} \pi_{2i} \triangle X_{1t-i} + \cdots \Sigma_{i=0}^{m} \pi_{ki} \triangle X_{kt-i} + Y_1 Y_{t-1} + Y_2 X_{1t-1} + \cdots + Y_k X_{kt-1} + \mu_t \quad (2)$$

In equation 2, Y_t and X_t are dependent and independent variables. $\triangle Y_t$ and $\triangle X_t$ are the first differentiated forms of the dependent and independent variables. As shown in Equation 2, the ARDL model equation can be divided into two groups. In the first group, first-differenced lagged variables include the dependent variable. In the second group, one-period lagged explanatory variables.

4.2. Unit Root Test Results

The results of the ADF and PP unit root tests are presented in Tables 1 and 2. They demonstrate that LREX and LWGDP are stationary in first differing when the models include only the intercept, while they are level stationary in models with intercept and trend. The remaining variables are stationary in first differencing. This justifies that the first condition is met to implement the ARDL model.

Table 1. ADF Unit Root Test Results

Variable		Intercept	Intercept and Trend	Variable		Intercept	Intercept and Trend
LREX	Test s.	-1.1644	-3.7359	ΔLREX	Test s.	-5.7067	5.6894
	p-value	0.6790	0.0325		p-value	0.0000	0.0002
LWGDP	Test s.	-1.3204	-3.3624	ΔLWGDP	Test s.	-7.4353	-7.3226
	p-value	0.6095	0.0726		p-value	0.0000	0.0000
LRER	Test s.	0.4655	-2.3981	ΔLRER	Test s.	-7.1058	-7.1963
	p-value	0.9830	0.3743		p-value	0.0000	0.0000
LC_DUM	Test s.	-0.5290	-1.7692	ΔLC_DUM	Test s.	-5.9161	-5.9722
	p-value	0.8738	0.6986		p-value	0.0000	0.0001
LC_T_CS	Test s.	-0.4968	-1.5849	ΔLC_T_CS	Test s.	-2.2172	-3.9988
	p-value	0.8795	0.7773		p-value	0.2043	0.0183
LC_N_CS	Test s.	0.8190	-0.8318	ΔLC_N_CS	Test s.	-4.8988	-5.3299
	p-value	0.9930	0.9529		p-value	0.0003	0.0006
LC_T_DT	Test s.	-0.1528	-1.4023	ΔLC_T_DT	Test s.	-3.7140	-3.9675
	p-value	0.9354	0.8427		p-value	0.0081	0.0194
LC_N_DT	Test s.	0.3933	-1.0739	ΔLC_N_DT	Test s.	-2.8109	-6.0222
	p-value	0.9799	0.9197		p-value	0.0673	0.0001
LC_W_CL	Test s.	-2.2982	-2.7953	ΔLC_W_CL	Test s.	-3.9130	-3.8786
	p-value	0.1781	0.2083		p-value	0.0049	0.0238

Note: *The maximum lag length was set to 4, and the optimal lag was determined with respect to AIC.*

Table 2. PP Unit Root Test Results

Variable		Intercept	Intercept and Trend	Variable		Intercept	Intercept and Trend
LREX	Test s.	-0.7364	-3.6846	ΔLREX	Test s.	-12.3735	-16.7922
	p-value	0.8246	0.0365		p-value	0.0000	0.0000
LWGDP	Test s.	-1.0861	-3.3592	ΔLWGDP	Test s.	-8.5581	-8.4120
	p-value	0.7107	0.0731		p-value	0.0000	0.0000
LRER	Test s.	0.9466	-2.3584	ΔLRER	Test s.	-7.7040	-10.4784
	p-value	0.9950	0.3938		p-value	0.0000	0.0000
LC_DUM	Test s.	-0.5290	-1.7692	ΔLC_DUM	Test s.	-5.9161	-5.9849
	p-value	0.8738	0.6986		p-value	0.0000	0.0001
LC_T_CS	Test s.	0.4674	-0.9569	ΔLC_T_CS	Test s.	-3.2632	-3.4382
	p-value	0.9831	0.9376		p-value	0.0246	0.0625
LC_N_CS	Test s.	0.4996	-0.9921	ΔLC_N_CS	Test s.	-4.9730	-5.3270
	p-value	0.9844	0.9326		p-value	0.0003	0.0006
LC_T_DT	Test s.	0.4326	-0.9521	ΔLC_T_DT	Test s.	-3.7140	-3.9012
	p-value	0.9817	0.9383		p-value	0.0081	0.0226
LC_N_DT	Test s.	0.2126	-1.1692	ΔLC_N_DT	Test s.	-5.7024	-6.0221
	p-value	0.9697	0.9019		p-value	0.0000	0.0001
LC_W_CL	Test s.	-1.8653	-2.0217	ΔLC_W_CL	Test s.	-3.9281	-3.8786
	p-value	0.3443	0.5701		p-value	0.0047	0.0238

4.3. ARDL Regression Results

Table 3 presents the long-term ARDL model and the results of the F-bound test. The F-bound test confirms that the variables in this model have co-integration relationships for all 6 models. Because the requirements of the ARDL model are satisfied, this approach can be used to estimate the export demand equation.

In this paper, the models are estimated stepwise by changing the proxy variables for COVID-19. Estimations start with the COVID-19 dummy variable and proceed to the second and third estimation with the number of total and new cases instead of the COVID-19 dummy. The fourth and fifth estimations are performed using the total and new numbers of deaths. The last and sixth estimations use the number of days off work due to the COVID-19 restrictions.

According to the Table 3, in all models for the long term, consistent with economic theory and anticipation, external income coefficients are positively significant. The magnitude of the coefficients ranges from 1.029 to 1.421, implying that exports are elastic. Exports respond statistically significantly and negatively to real exchange rate movements in all models, which is consistent with expectations. The coefficients of the real exchange rate vary between 0.277 and 0.405, implying that export flows are inelastic to the exchange rate. The signs of variables showing the severity of Covid-19 effects are positive but statistically insignificant in all models regardless of the type of the Covid-19 proxy variable. Long-term findings generally show similar trend structures, which can be interpreted as the obtained results are robust.

Table 3. Long Term ARDL Model Results

Dependent Variable (LREX)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LWGDP	1.087**	1.036**	1.029**	1.047***	1.029**	1.421***
	[0.453]	[0.419]	[0.381]	[0.344]	[0.377]	[0.297]
LRER	-0.381**	-0.403**	-0.402***	-0.399***	-0.405***	-0.277***
	[0.157]	[0.149]	[0.135]	[0.121]	[0.133]	[0.086]
LC_DUM	0.058	-	-	-	-	-
	[0.035]	-	-	-	-	-
LC_T_CS	-	0.002	-	-	-	-
	-	[0.003]	-	-	-	-
LC_N_CS	-	-	0.003	-	-	-
	-	-	[0.004]	-	-	-
LC_T_DT	-	-	-	0.008	-	-
	-	-	-	[0.006]	-	-
LC_N_DT	-	-	-	-	0.004	-
	-	-	-	-	[0.003]	-
LC_W_CL	-	-	-	-	-	0.026
	-	-	-	-	-	[0.028]
Constant	-0.766	-0.008	0.066	-0.183	0.079	-5.662
	[6.642]	[6.158]	[5.598]	[5.041]	[5.530]	[4.247]
Observations	35	35	35	35	35	35
F Stat (ARDL Bound)	7.596***	4.720*	4.950**	4.090*	5.008**	7.595***

Note: **,**, and *** indicate 10%, 5%, and 1% significance, respectively. Standard errors in the parenthesis [].*

Table 4 provides short-run results for ARDL, which again show that external income increases export performance. The short-run coefficients of external income, which vary from 2.201 to 4.721, are dominant over long-run coefficients. Exchange rate coefficients are negative and significant in their level form but positive and significant in their three lagged forms. Up to this point, expectations are met for both foreign income and the exchange rate. Although it is noted that the coefficients of the variables showing severity of Covid-19 effects are not statistically significant at the current level, it is worth noting that their lagged values generally have significantly negative effects on exports, as expected.

Table 4. Short-Term ARDL Model Results

Dependent Variable (ΔLREX)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ΔLREX(-1)	-	0.187*	0.259**	0.301	0.418**	0.184**
	-	[0.094]	[0.094]	[0.190]	[0.151]	[0.068]
ΔLREX(-2)	-	0.116	0.193*	-	0.153	-
	-	[0.076]	[0.095]	-	[0.097]	-
ΔLWGDP	-	2.377***	2.656***	4.392***	4.721***	2.201***
	-	[0.322]	[0.555]	[0.895]	[1.491]	[0.274]
ΔLRER	-0.196**	-0.222***	-0.225**	-0.210**	-0.222**	-
	[0.072]	[0.077]	[0.085]	[0.081]	[0.091]	-
ΔLRER(-1)	0.055	0.095	0.129	0.110	0.168	-
	[0.077]	[0.095]	[0.101]	[0.111]	[0.113]	-
ΔLRER(-2)	-0.049	0.050	0.076	0.061	0.134	-
	[0.079]	[0.098]	[0.102]	[0.096]	[0.103]	-
ΔLRER(-3)	0.203**	0.238**	0.253**	0.212**	0.230***	-
	[0.077]	[0.088]	[0.090]	[0.087]	[0.093]	-
ΔLC_DUM	-0.002	-	-	-	-	-
	[0.024]	-	-	-	-	-
ΔLC_DUM(-1)	-	-	-	-	-	-
	0.268***					
	[0.025]	-	-	-	-	-
ΔLC_T_CS	-	0.006	-	-	-	-
	-	[0.004]	-	-	-	-
ΔLC_T_CS(-1)	-	-0.017***	-	-	-	-
	-	[0.005]	-	-	-	-
ΔLC_N_CS	-	-	0.010	-	-	-
	-	-	[0.007]	-	-	-
ΔLC_N_CS(-1)	-	-	-0.015*	-	-	-
	-	-	[0.009]	-	-	-
ΔLC_N_CS(-2)	-	-	-0.013	-	-	-
	-	-	[0.010]	-	-	-
ΔLC_T_DT	-	-	-	0.042**	-	-
	-	-	-	[0.020]	-	-
ΔLC_T_DT(-1)	-	-	-	-0.043**	-	-
	-	-	-	[0.016]	-	-
ΔLC_T_DT(-2)	-	-	-	-0.016	-	-
	-	-	-	[0.012]	-	-
ΔLC_N_DT	-	-	-	-	0.083	-
	-	-	-	-	[0.057]	-
ΔLC_N_DT(-1)	-	-	-	-	-0.050**	-
	-	-	-	-	[0.018]	-
ΔLC_N_DT(-2)	-	-	-	-	-0.076*	-
	-	-	-	-	[0.044]	-
ΔLC_W_CL	-	-	-	-		-0.064**
	-	-	-	-		[0.031]
ECM(-1)	-	-0.857***	-0.968***	-0.983***	-	-0.681***
	0.721***				1.105***	
	[0.067]	[0.183]	[0.201]	[0.227]	[0.229]	[0.117]
Constant	-	-0.007	0.063***	0.078***	-0.202	-3.853***
	0.552***					
	[0.006]	[0.006]	[0.017]	[0.022]	[0.042]	[0.663]
Observations	35	35	35	35	35	35
F Stat.	49.553***	32.284***	28.435***	30.686***	26.157***	68.597***
R2	0.933	0.936	0.937	0.933	0.932	0.901

Note: **,**, and *** indicate 10%, 5%, and 1% significance, respectively. Standard errors in the parenthesis [].*

The error correction terms satisfy the necessary conditions except for the fifth model. The error correction coefficients are statistically significant and take values between 0 and 1. According to the results of the error correction term; %72, 86, 97, 98, and 68 of the short-term imbalances are corrected after the first period for the first, second, third, fourth, and sixth models, respectively. Because the error correction term is outside the intervals 0 and 1, it does not work in the fifth model.

In summary, short-term imbalances are quickly eliminated. The coefficients of determination are quite high (above 90%), indicating that the explanatory power of this model is strong. In essence, the results appear to be logical in terms of the response of export flows to variables showing the severity of COVID-19 effects. Unfavourable pandemic conditions for export performance were only temporary, so COVID-19 did not affect export performance eventually. As a matter of fact, the results support the hypothesis of the WTO (2021) that the negative effect of COVID-19 on world trade in 2020 was largely eliminated in 2021. Furthermore, these reports specified that the repair process had occurred more rapidly in developing countries such as Türkiye. On the other hand, lagged pandemic variables have significant and negative effects on Turkish export performance in the short run. The findings are also similar to many studies that showed the negative impact of COVID-19 on exports (Brussevich et al. 2022; Hayakawa & Mukunoki 2021; Hayakawa & Mukunoki 2020; Minondo, 2020).

The fact that individuals who get infected and must give up their jobs decreases the level of production. Similarly, border controls, travel restrictions, quarantine measures such as curfews, social distance rules, and the negative impact of infection on the workforce can be given as other factors pushing pressure on economic activities. Accordingly, it stands to reason that this decline in production levels, and thus lower export performance, should be considered delayed because of the harsh pandemic conditions. In other words, the negative consequences of COVID-19 on economic activity could be felt after one or two periods. In summary, our short-term results indicating delayed unfavourable effects of the pandemic on export flows, considering the real dynamics of the production structure. The findings are robust according to different types of COVID-19 proxies.

Finally, the CUSUM and Q test results presented in Appendix 1 indicate that the second, third, fourth, and fifth models (4 out of 6 models) satisfied the necessary conditions. However, in the first model (CUSUM Q and in the sixth model, both CUSUM and CUSUM Q outputs ruin the assumptions. Although the CUSUM test implies models convenient for the first and sixth models, it was decided to report also these outputs to emphasise the robustness of the findings. Overall, with a few exceptions, the CUSUM tests show that our estimations are suitable for interpretation. Additionally, according to the LM test results, no autocorrelation problem was observed for any of the models.

5. Conclusion

This study examines the impact of COVID-19 on Turkish export performance using quarterly data from 2013:q1 to 2022:q1. The econometric methodology used was the ARDL bound test. Six different COVID-19 impact proxy variables are used to analyse the impact of pandemic conditions on Türkiye's export flows. For this purpose, the COVID-19 dummy, the number of total and newly confirmed cases, the number of total and newly confirmed deaths, and the average number of days of closing working places variables are used.

The ARDL approach was used to estimate the effects of COVID-19 on export flows and interpret them in the long and short term. Before estimating the model, we checked the stationarity and cointegration conditions to implement ARDL. To control for stationarity, the results of the ADF and PP unit root tests confirmed that all variables in the model were stationary at the level of first difference. The ARDL-linked F tests support the existing co-integration relationships. Because the required necessary conditions for the ARDL model were satisfied, the estimations were carried out using this approach.

The findings indicate that exports respond positively to foreign income and negatively to the exchange rate, in parallel with expectations as stated in the Model Section. There is no link between pandemic conditions and Turkish export performance eventually. It was concluded that the effects of the pandemic were short-lived at the international trade level. In the short term, negative COVID-19 effects on export volume are found negative for lagged variables indicating the severity of COVID-19 effects. These findings appear reasonable when real dynamic production patterns are considered. That is, the immediate effects of the pandemic on economic activity are unlikely to be observed over the same period. In this regard, the effects of COVID-19's consequences on economic activities therefore on exports could be discovered in the following periods, so it is logical to obtain negative and significant lagged coefficients of COVID-19. The results of the six models are broadly similar, meaning that the findings are robust with respect to different COVID-19 proxy variables.

This paper highlights several policy recommendations. To investigate the relationship between the COVID-19 virus and export, one should not ignore lagged effects. Moreover, as in this paper, different results can be obtained depending on the short- and long-term; thus, short- and long-term relationships should be estimated and analysed separately. There are still many avenues to explore. In future research, sectoral analysis could be explored using firm-level data. The nexus between imports and COVID-19 could also be another topic for empirical investigation.

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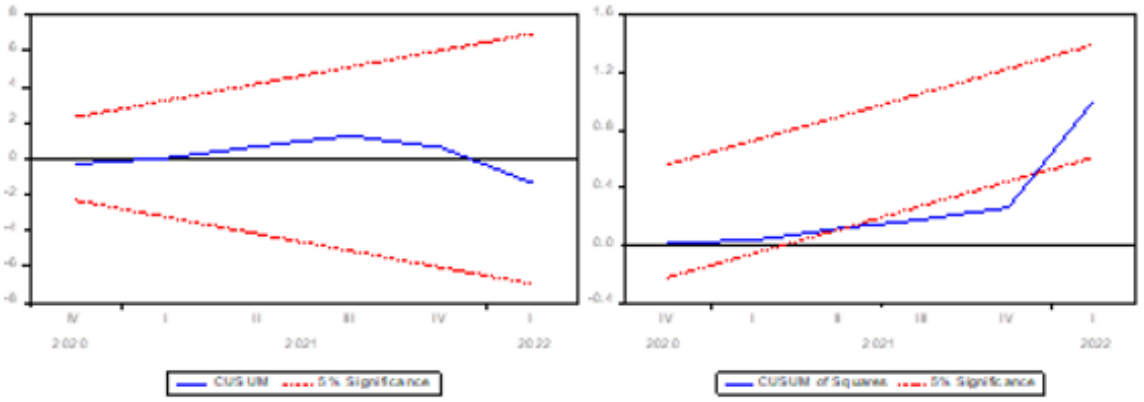
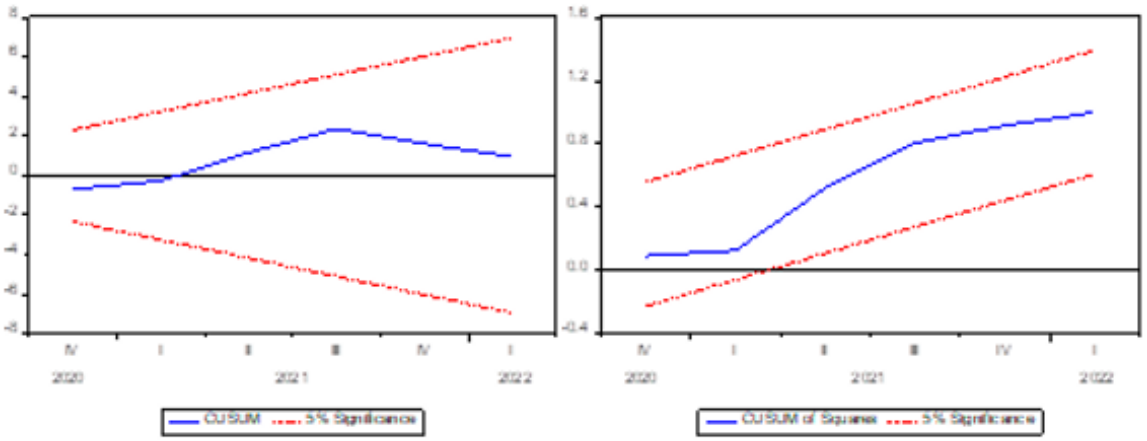
Appendix 1: CUSUM and Q Test Results

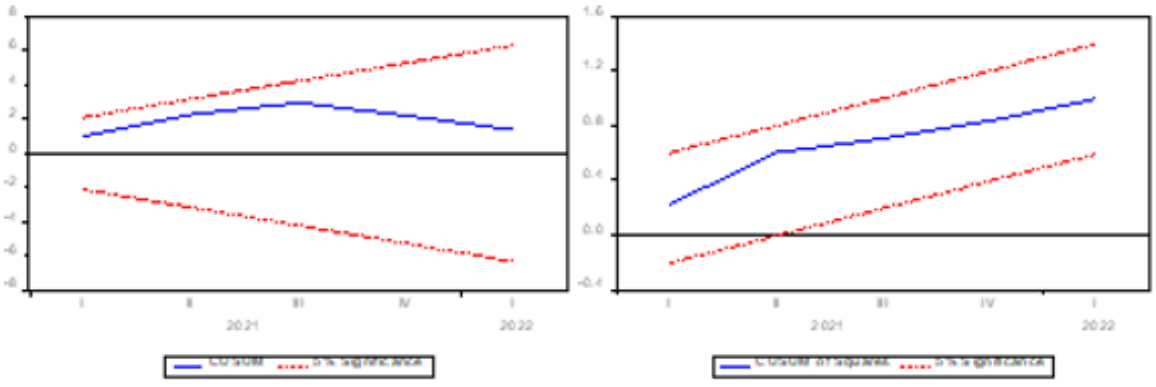
Model 1



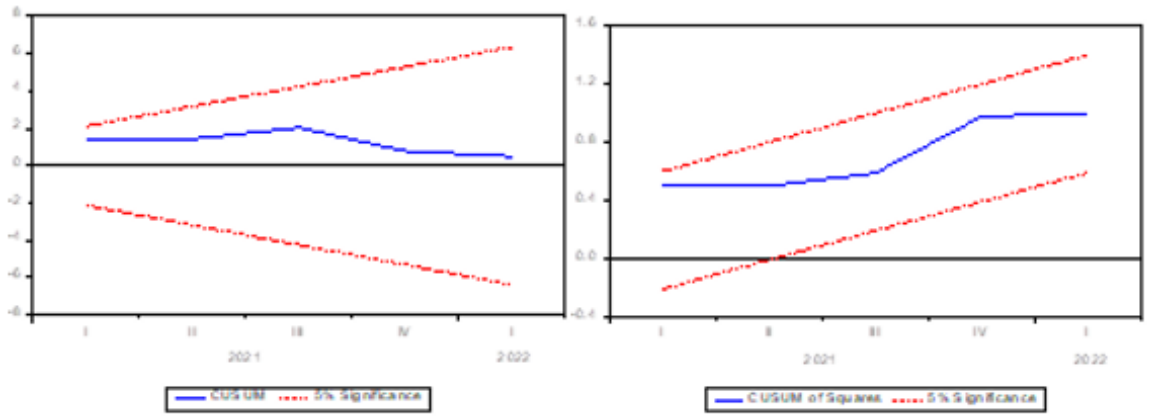
Model 2



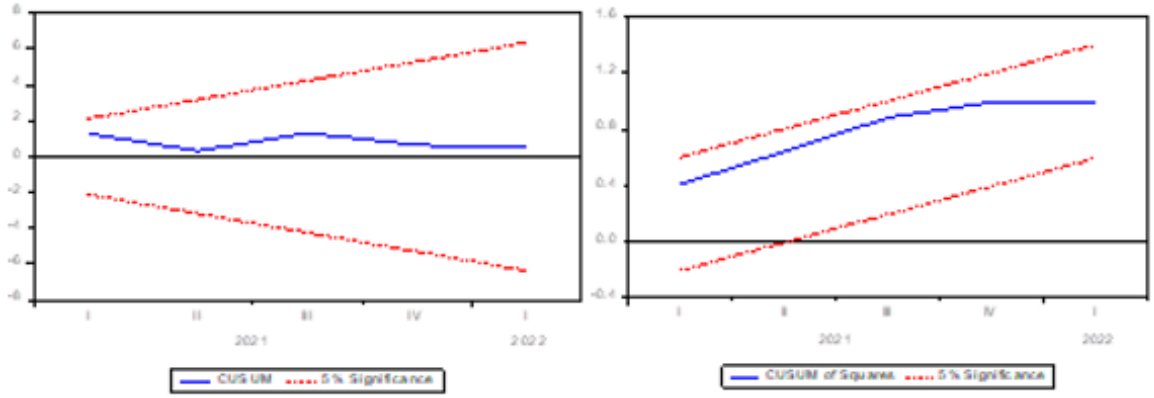
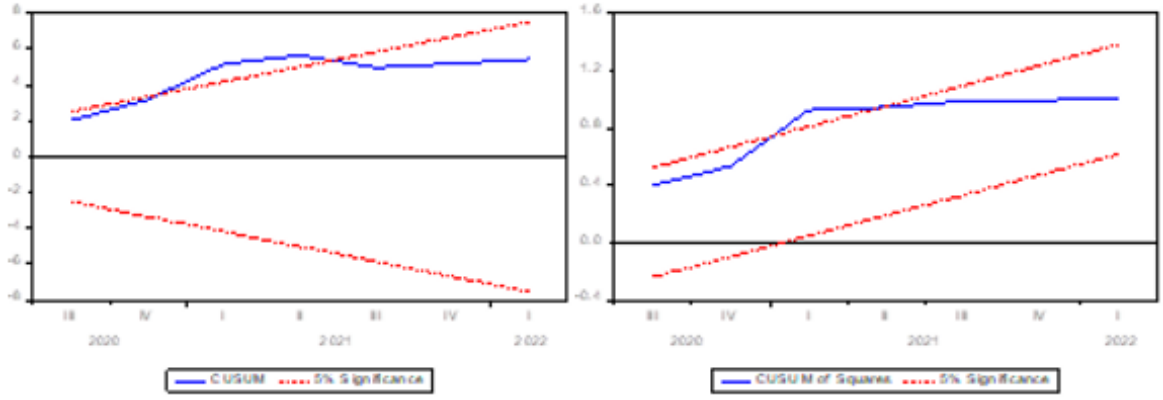
Model 3



Model 4



Model 5



Model 6