Fiscaoeconomia

E-ISSN: 2564-7504
2022, Volume 6, Issue 3, 1003-1017
https://dergipark.org.tr/tr/pub/fsecon

Research Article/Araştırma Makalesi
Submitted/Geliş: 07.02.2022
Accepted/Kabul: 24.02.2022
Doi: 10.25295/fsecon1068817

Foreign Trade and Renewable Energy Consumption: The Case of OECD and Turkey

Dış Ticaret ve Yenilenebilir Enerji Tüketimi: Türkiye ve OECD Örneği

Hakan GÜNEŞ[1], Ahmet KAMACI[2], Hatice ÖNDER[3]

Abstract

In this study, the impact of renewable energy consumption (REC) on foreign trade (FT) over the period of 2004-2017 in 27 OECD countries is analyzed via panel data analysis. In the study, the relationship between REC and FT is tested using the Driscoll-Kraay estimator within the framework of the panel regression model. The results obtained in the study indicate that the increase in REC raises exports and decrease imports. We also present the importance of the renewable energy (RE) trend in order to improve the FT balance as a policy suggestion in the study. As we move from non-RE to renewable energy, the FT balance would improve.

Jel Codes: *F18, Q47, Q56*
Keywords: *Renewable energy consumption, Export, Import, Driscoll-Kraay estimator.*

[1]Öğr. Gör. Dr., Bartın Üniversitesi, Bartın Meslek Yüksekokulu, Muhasebe ve Vergi Bölümü, hakangunes@bartin.edu.tr , ORCID:0000-0002-0537-3637
[2]Doç. Dr., Sakarya Uygulamalı Bilimler Üniversitesi, Uygulamalı Bilimler Fakültesi, Finans ve Bankacılık Bölümü, ahmetkamaci@subu.edu.tr, ORCID:0000-0002-7858-6131
[3]İktisat Bilim Uzmanı, haticeonder743@gmail.com, ORCID:0000-0003-3695-3615

Citation/Atıf: Güneş, H., Kamacı, A. & Önder, H. (2022). Foreing Trade and Renewable Energy Consumption: The Case of OECD and Turkey. *Fiscaoeconomia, 6*(3), 1003-1017. Doi: 10.25295/fsecon1068817

Güneş, H., Kamacı, A. & Önder, H. (2022). Foreing Trade and Renewable Energy Consumption: The Case of OECD and Turkey. *Fiscaoeconomia, 6*(3), 1003-1017. Doi: 10.25295/fsecon1068817

Öz

Bu çalışmada, 27 OECD ülkesinde 2004-2017 döneminde yenilenebilir enerji tüketiminin (YET) dış ticaret (DT) üzerindeki etkisi panel veri analizi ile incelenmektedir. Çalışmada, panel regresyon modeli çerçevesinde Driscoll-Kraay tahmincisini kullanarak yenilenebilir enerji tüketimi ile dış ticaret ilişkisi test edilmektedir. Çalışmada elde edilen sonuçlar, yenilenebilir enerji tüketimindeki artışın ihracatı arttırdığı, ithalatı ise azalttığını göstermektedir. Ayrıca dış ticaret dengesini iyileştirmek için yenilenebilir enerjiye yönelimin önemini de çalışmada politika önerisi olarak sunmaktayız. Yenilenemeyen enerjiden yenilenebilir enerjiye geçtikçe, dış ticaret bilançosu düzelecektir.

Jel Kodları: *F18, Q47, Q56*
Anahtar Kelimeler: *Yenilenebilir enerji tüketimi, İhracat, İthalat, Driscoll-Kraay tahmincisi*

1. Introduction

One of the biggest problems in the world as of today is the increase in the demand for energy. As a result of such an increase, energy is crucial for the world and has become the most important instrument for the development of countries. It is also the most fundamental factor for the advancement of technology. So much so that as countries keep producing and developing technologically, their demands for energy would rise, thus their level of development would increase.

Energy resources in the world are discussed under two categories such as primary and secondary energy resources. Primary energy resources are divided into two parts: non-renewable (coal, petroleum, natural gas) and RE. Secondary energy resources include electricity, LPG, and diesel fuel. Since RE resources are considered in the study, these resources are discussed. RE resources, which are valued by all countries in the world due to the decline in energy resources in the world, cover resources such as solar, wind, geothermal energy, wave, and hydraulic energy. Hydraulics, geothermal, biomass, wave, solar, wind, and hydrogen are among the RE resources. RE resources are used both globally and in Turkey. Turkey, especially in the solar energy field, is one of the leading countries in the world (Kanberoglu & Parker, 2017: 159).

Since various countries of the world are dependent on foreign energy resources and the energy resources in the world are decreasing, the countries of the world have given more importance to RE. Countries tend to concentrate on boosting the share of RE in total EC. In this regard, in order to meet their increasing demand for energy; countries have had a tendency towards RE instead of traditional energy resources such as coal, gas, and petroleum (Kutan et al., 2018: 1762, Karadağ, 2021:11). One can claim that countries have become conscious and hedged themselves by giving importance to their economy, environment, human health, and technologies. In particular, substituting RE resources for fossil fuels yields astonishing results. In 2010, 300 million tons of fossil fuel worth of energy was saved; whereas it reached approximately 600 million tons as of 2020 (Yuan et al., 2015: 178). Due to such benefits of RE, the share of renewable resources in fulfilling the global demand for energy is anticipated to increase by one-fifth to reach 12.4% as of 2023, according to the projections of

the IEA (2018) (Chen et al., 2020: 1). All technology components required for producing RE would reduce production costs. It would also promote innovation in cleaner energy technologies, as it would encourage "green trade" (Zhao et al., 2016: 1281).

International trade facilitates access to the technology required by inexhaustible energy and is a key ingredient for sustainable energy. In other words, international trade generates various trade opportunities by guiding the export of countries, from the raw material need for the production of RE to the energy produced by the use of inputs (Sebri & Ben-Salha, 2014: 15). Imports of energy products lead to trade openness (TO) in energy-dependent countries. In other words, the energy problem in those countries surpasses trade openness. Energy is required for the export and import of goods. This situation adversely affects the trade of countries that do not have an adequate level of energy supply. Due to the FT deficit, there would be a rise in domestic production and a new demand for energy would occur. With the decrease in energy density, more production would be made with less energy (Zeren & Akkuş, 2020: 323).

In previous studies in literature, the relationship between RE and economic growth has often been explicated. In this study, the relationship between RE and foreign trade is investigated. In this regard, it is thought to contribute to the literature. The ultimate aim of the study is to examine the relationship between REC and foreign trade using the panel regression method. Accordingly, the data obtained from 26 OECD countries are analyzed via second-generation panel unit root tests, and then the relationship among them is tested by determining the appropriate regression method.

Following the introduction, a literature review is included in the study. Later on, the status of RE in Turkey and OECD countries are discussed in the study, and methodology is determined along with the data. In the last part of the study, empirical results are presented.

2. Literature Review

Numerous studies have been conducted on the relationship between REC and various variables. Most of those studies have dealt with the relationship between REC and economic growth. Trade is another variable that is as popular as economic growth. In this study, the relationship between REC and FT is discussed. Accordingly, a literature review containing 23 studies explicating the relationship between REC and FT is introduced in Table 1.

Table 1: Review of Literature

Author(s)	Country(s)	Method	Variables	Result
Sadorsky (2011)	8 Middle Eastern countries (1980-2007)	PCO	EC, export, import and GDP	Export→EC
Sadorsky (2012)	7 South American countries (1980-2007)	PCO	Output, EC, labor, export and import	EC→import
Dedeoglu & Kaya (2013)	25 OECD countries (1980-2010)	PCO and PCA	EC, real GDP, export and import	Economic growth, exports and imports increase EC. 1% increase in exports, 0.21% increase in EC and 1% increase in imports increase EC by 0.16%.
Shakeel et al. (2013)	5 South Asian countries (1980-2009)	PCO and PCA	EC, export, import and GDP	Export→EC
Aissa et al. (2014)	11 African countries (1980-2008)	PCO and PCA	REC, real GDP, export and import	No causality FT with REC
Nasreen & Anwar (2014)	15 Asian countries (1980-2011)	PCO and PCA	Economic growth, TO and total EC	EC↔TO
Sebri & Ben-Salha (2014)	BRICS countries (1971-2010)	Panel ARDL	Real GDP, REC, CO2 emission and TO	TO increases REC.
Jebli & Youssef (2015)	69 countries (1980-2010)	PCO and PCA	GDP, REC and FT	REC increases FT.
Siddique & Majeed (2015)	5 South Asian countries (1980-2010)	PCO and PCA	EC, FT, financial development and economic growth	FT →EC
Akar (2016)	12 Balkan countries (1998-2011)	Panel data analysis	REC, CO2 emission, GDP per capita and commercial openness	Despite its limited power, high trade increases REC.
Jebli et al. (2016)	25 OECD countries (1980-2010)	PCO and PCA	Real GDP, REC and non-REC, real export and import	REC↔import export→REC
Vaona (2016)	Different time zones for 26 countries	Panel regression	Import, export, exchange rate, GDP, renewable sources, others energy sources	RE production reduces the increase in imports.
Amri (2017)	72 countries (1990-2012)	Panel data analysis	REC, FT and economic growth	REC↔FT

				This means that openness to FT must spend more on REC.
Brini et al. (2017)	Tunisia (1980-2011)	CO and CA	REC, exports and imports	REC↔FT
Hassine & Harrathi (2017)	Gulf Cooperation Council countries (1980-2012)	PCO and PCA	REC, exports, imports and economic growth	EC→import
Shakouri & Yazdi (2017)	South African countries (1971-2015)	ARDL	REC, GDP and TO	REC↔TO
Murshed (2018)	4 South African countries (2000-2017)	PCA	REC, commercial openness and FDI	No causality TO with REC
Chen et al. (2019)	China (1980-2014)	CO and CA	RE production and FT	FT↔RE generation
Jebli et al. (2019)	22 Central and South American countries (1995-2010)	PCO and PCA	REC, commercial openness, FDI and CO2 emissions	REC→TO
Alam & Murad (2020)	25 OECD countries (1970-2012)	ARDL	RE use, TO and GDP per capita	TO significantly affects the use of RE.
Murshed (2020)	71 countries (2000-2017)	Panel regression	REC and commercial openness	In low-income countries, as TO increases by 1%, the share of RE increases by 0.24%; it decreases 0.19% in lower-middle income countries.
Rahman & Vu (2020)	Australia and Canada (1960-2015)	ARDL	REC per capita, FT and real GDP	FT↔REC
Zeren & Akkuş (2020)	Bloomberg's best developing countries (14) (1980-2015)	PCO and PCA	REC and TO	Negative relationship (REC and TO)

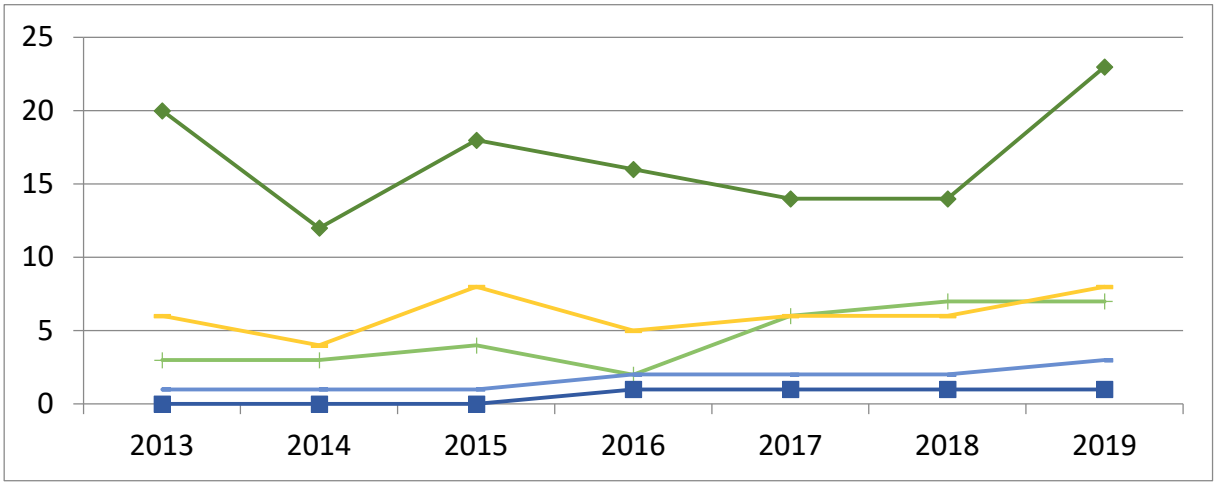
Note: PCO: Panel cointegration, PCA: Panel Causality

Although there are studies for different country groups in the literature review; Dedeoglu & Kaya (2013), Jebli et al. (2016) and Alam & Murad (2020) have discussed RE-foreign trade relationship in OECD countries, as in this study. As seen in these studies, there is either unilateral or bilateral causality between TO or FT and REC; whereas Aissa et al. (2014) could not detect any causality between trade REC in their study conducted on African countries.

3. RE in Turkey and OECD Countries

Turkey is a country with considerable potential in terms of RE sources. Nonetheless, the country could not utilize such potential properly. So that; Turkey has utilized 70.2% of its economic hydropower potential, 30.7% of its geothermal potential, 17.3% of its biomass potential, and 0.452% of its solar power potential (Ozcan, 2018: 2635). In spite of this fact, Turkey is dependent on foreign energy. RE reduces a country's energy dependence on other countries (Huang et al., 2020: 669). As the share of RE in Turkey increases, such a dependence would decline. Figure 1 illustrates the Cumulative Electricity Production based on RE Resources between the years 2013-2019 in Turkey.

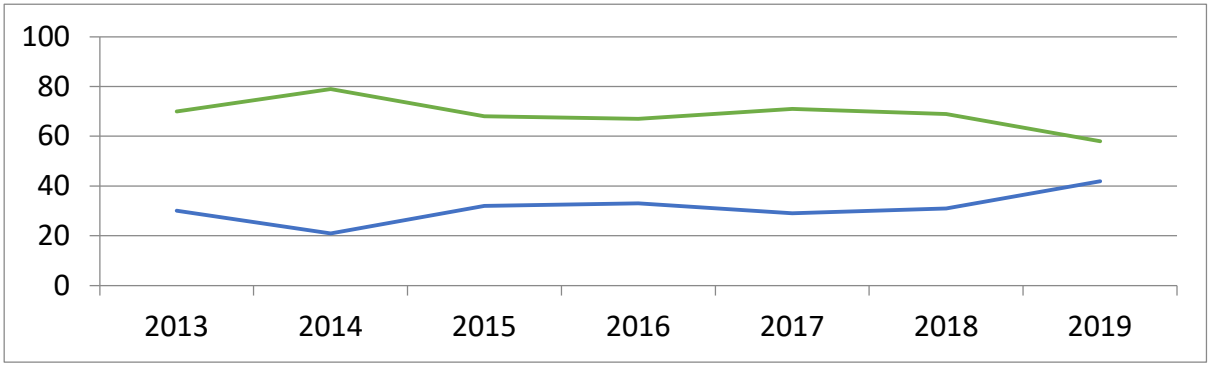
Figure 1: Turkey's RE-based Cumulative Electricity Production (2013-2019)



Source: Energy Statistics Bulletin, (https://www.enerji.gov.tr/tr-TR/EIGM-Raporlari#)

In Figure 1, dark green indicates dam HPP; yellow hydroelectric powerplants (HPP) stream; light green the wind; light blue geothermal energy and dark blue indicates waste. According to Figure 1, electricity is generated mostly from water-based hydroelectric powerplants (HPP) rather than other RE resources in Turkey. Despite the fluctuations that have been occurring since 2013, a large increase in hydraulic energy-based electricity production was observed as of 2019, and 23% of the demand for electricity is fulfilled by hydroelectric plants built on water dams, whereas 7% by hydroelectric plants built on rivers in Turkey. An increasing momentum has been observed in the share of wind energy. The share of geothermal energy is quite low. As illustrated in Figure 1, its share in the cumulative electricity production based on RE has increased slightly since 2013 and reached 3% in 2019. Distribution of Cumulative Electricity Production in Turkey between the years 2013-2019 is illustrated in Figure 2.

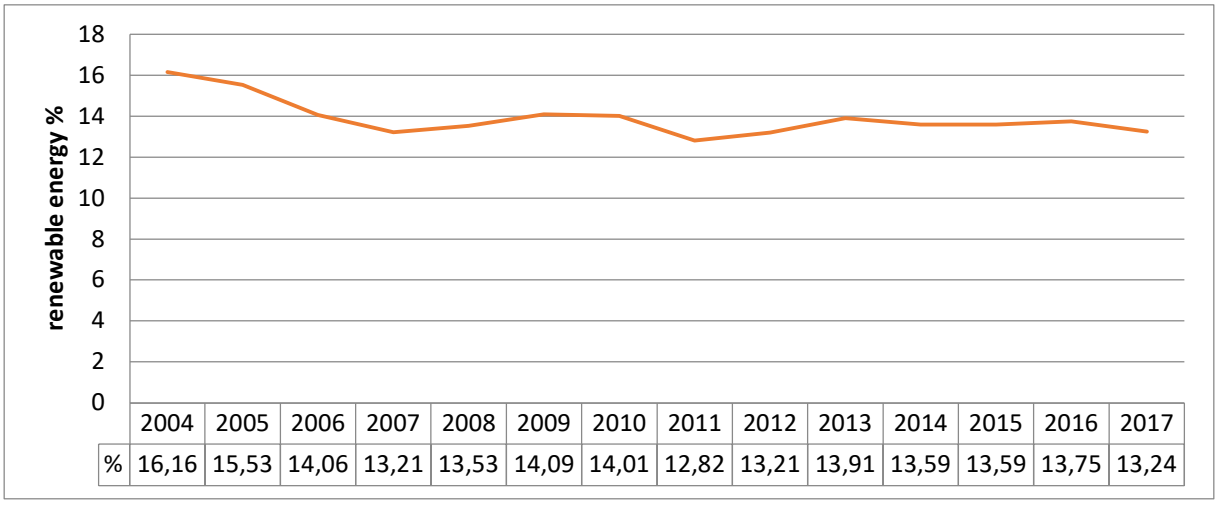
Figure 2: Distribution of Cumulative Electricity Production in Turkey (2013-2019)



Source: Energy Statistics Bulletin, (https://www.enerji.gov.tr/tr-TR/EIGM-Raporlari#)

In Figure 2, the green color indicates thermal, and the blue color indicates RE Upon overall examination, the increase in the use of RE resources in Turkey from past to present is illustrated in Figure 2. Upon considering the cumulative electricity production data obtained over the period 2013 - 2019, it is determined that an adverse relationship exists between thermals and RE. Because when the share of electricity produced using thermals decreases (increases), the share of electricity produced by RE resources increases (decreases). For instance, while 70% of the total electricity production was produced using thermals and 30% by RE resources in 2013, this ratio has declined to 58% regarding thermals and increased to 42% regarding RE resources in 2019. The share of RE in gross final EC in Turkey is illustrated in Figure 3.

Figure 3: The Share of RE in Gross Final EC (Turkey)

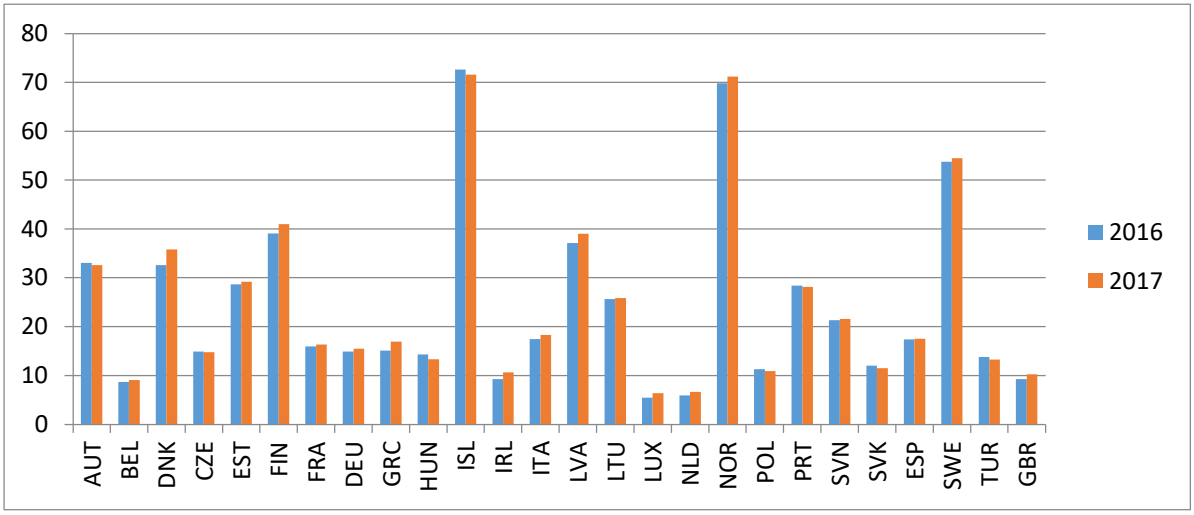


	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
%	16,16	15,53	14,06	13,21	13,53	14,09	14,01	12,82	13,21	13,91	13,59	13,59	13,75	13,24

Source: Eurostat

According to Figure 3, despite slight fluctuations, the share of RE in gross final EC in Turkey is reduced. The reason for this is due to the fact that innovation in EC is a result of the increasing population and industry in Turkey, rather than the rise in RE usage. The shares of RE in gross final EC in 26 OECD countries included in the study are illustrated in Figure 4.

Figure 4: The Share of RE in Gross Final EC (26 OECD Countries)



Source: Eurostat

As illustrated in Figure 4, the highest increase from 2016 to 2017 was seen in Denmark, Latvia, Finland, and Norway. The share of RE in gross final EC is over 70% in Norway and Iceland. In Belgium, Ireland, Luxembourg, and the Netherlands, this rate is below 10%.

4. Data, Model, Methodology, and Evaluation of Results

4.1. Data and Model

The following models (1) and (2) are used for testing the impact of REC on FT on the basis of the theoretical arguments above.

$$MGS_{it} = \alpha + ßREC_{it} + u_{it} \quad (1)$$

$$XGS_{it} = \alpha + ßREC_{it} + u_{it} \quad (2)$$

Here i denotes countries; t denotes time; REC denotes the share of REC in total EC; MGS denotes the share of total imports in GDP, and XGS denotes the share of total exports in GDP.

In this study, the relationship between REC and imports and exports is tested with the help of annual data obtained over the period 2004-2017 in 27 OECD countries[4]. RE series are obtained from the European Union's database, whereas export and import data from the World Bank's database. In the model, the dependent variables are export and import, and the independent variable is REC.

[4] Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Switzerland, Sweden, Turkey and the United Kingdom.

4.2. Descriptive statistics

Some descriptive statistics for REC, export, and import are presented in Table 3 (Observations, Mean, Standard deviation, Maximum and Minimum).

Table 3: Descriptive statistics

Summary statistics (REC, export and import)					
Vari.	Ob.	Me.	St. De.	Mi.	Ma.
REC	364	20.3915	17.32392	0.9	72.658
XGS	364	57.00211	34.15033	18.98219	221.1966
MGS	364	54.06956	28.13279	23.0196	187.1654

The REC variable, which represents the REC, was observed as 0.9 at the lowest in Luxembourg in 2004, whereas 72,658 at the highest in Iceland in 2016. This situation indicates that Luxembourg mostly uses non-RE resources in EC, whereas Iceland attaches importance to RE.

4.3. Empirical Results

If a cross-sectional dependence exists among the series and analyses are conducted without considering these results, the obtained results would be erroneous and inconsistent. Therefore, it is tested whether or not cross-sectional dependence exists in series (Menyah et al., 2014: 839). If the probability values are lower than 5%, it is concluded that a cross-sectional dependence exists among the units (Pesaran & Yamagata, 2008: 17).

Breush-Pagan (1980) CDLM test is the first test that was developed to determine cross-sectional dependence. Afterward, the Pesaran (2004) CD test and Pesaran et al. (2008) Adjusted LM tests have been developed. When the time dimension exceeds the cross-section dimension (T> N), Breush-Pagan (1980) CDLM test is performed; if T and N are close to each other or N> T, Pesaran (2004) CD test is performed; and Pesaran et al. (2008) adjusted CDLM test (CDLMadj) is performed to avoid deviations.

When N> T, Pesaran (2004) suggests a new CD test to be performed. This test is shown in Equation (3).

$$CD= \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (\hat{\rho}_{ij}) \quad (3)$$

In order to correct the deviations that may occur, Pesaran et al. (2008) developed the adjusted CDLM (CDLMadj) test as shown in Equation (4).

$$CD_{adj}= \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \left(\hat{\rho}_{ij} \frac{(T-k)\hat{\rho}_{ij}^2 - u_{Tij}}{\sqrt{v_{Tij}^2}}\right) \quad (4)$$

u_{Tij} and v_{Tij}^2 denote the newly added means, whereas $(T-k)\hat{\rho}_{ij}^2$ denotes the variance. Accordingly, the results of cross-sectional dependence of the variables are presented in Table 4.

Table 4: Cross-Sectional Dependence Test of the Variables

Va.	CD Test	t-sta.	Pr.
XGS	CDLM1 (BP LM)	36.71	0.000
MGS	CDLM1 (BP LM)	44.09	0.000
REC	CDLM1 (BP LM)	53.84	0.000

According to Table 4, the probability value of all CDLM tests is lower than 5%. Therefore, there is a cross-sectional dependence among the units that make up the panel for RE, export, and import variables. Since cross-sectional dependence exists, second-generation unit root test should be applied in series.

If there is cross-sectional dependence in series, the second-generation panel unit root tests should be used. The CADF test can be applied in cases such as N> T, and T> N (Pesaran, 2007: 269). Since there is a cross-sectional dependence in this study, the second-generation panel unit root test is used. The cross-section average of the CADF tests gives the CIPS test (Westerlund et al., 2016: 852). Nevertheless, the asymptotic distribution of the CIPS test is not standard and the values of the size are calculated on the basis of the tabulated critical values (Cerasa, 2008: 4).

Pesaran (2007) indicated the CIPS test as in Equation (5) by taking the mean of the CADF tests.

$$CIPS = \frac{\sum_{i=1}^{n} CADF_i}{N} \quad (5)$$

Table 5 indicates the CIPS unit root test results.

Table 5: CADF Unit Root Test Results

Variables	CIPS	CIPS in 1_{st}
XGS	-1.334	-2.369*
MGS	-1.603	-3.030*
REC	-1.801	-3.070*
%5 critical value is -2.17.		

The CIPS test results are presented in Table 5. Upon evaluating the CIPS test statistics of all variables, it is seen that the variables are not stationary at the level, and they become stationary after taking their first differences.

In the next step, the appropriate regression estimator would be determined. If the number of countries (N) in the study is larger than the time dimension (T), the Driscoll-Kraay estimator is more appropriate, whereas the Parks-Kmenta estimator is more appropriate and the results are consistent if the time dimension is greater than the number of countries, (Tatoglu, 2013: 277). The Driscoll-Kraay estimator generates standard error estimators that become more durable in both time and space analysis of nonparametric covariance-variance estimation

techniques (Driscoll & Kraay, 1998). In this study, the Driscoll-Kraay estimator is used since the number of countries (N) is greater than the number of years (T). Driscoll-Kraay estimator results are presented in Table 6.

Table 6: Driscoll-Kraay Estimator Results

REC	Co.	St.Er.	t	Pr.	95% Co. In.
XGS	0.4671343	0.1766042	2.65	0.020	0.0856041 0.8486646
MGS	-0.7352185	0.2170135	-3.39	0.005	-1.204048 -0.2663892
_cons	33.5168	2.645391	12.67	0.000	27.80178 39.23182
Heteroscedasticity	180.5015			0.0000	
Autocorrelation	33.50851			0.0001	

Upon examining the estimation results presented in Table 6, it is determined that the variables of REC, export, and import included in the model utilizing the data obtained from 27 OECD countries over the period 2004-2017 are significant at a 95% confidence level. According to the results of the study, while a 1-unit increase in REC increases exports by 0.46 units; it reduces imports by 0.73 units.

5. Conclusions and Discussion

In this study, the impact of renewable energy consumption (REC) on foreign trade (FT) is analyzed with panel data analysis. Our dataset covers 27 OECD countries over the period 2004-2017. The results are summarized as follows. The main contribution of the article involves the explanation of the impact of REC on FT along with parameter estimates using an up-to-date time-series and econometric methodology. We should notice that these results cover this group of developed and developing countries since the OECD is the world's largest economic institution. In this context, the rise in the consumption of RE increases the exports and decreases the imports in the countries included in the study. In other words, the increase in REC contributes positively to FT.

According to the findings of the study, a 1-unit increase in REC increases exports by 0.46 units. At the same time, a 1-unit increase in REC reduces imports by 0.73 units. In this regard, REC improves the FT balance of 27 OECD countries in the study. Therefore, countries should pay more attention to RE and solve the energy problem. As RE is used instead of non-RE resources, the world will be cleaner and greener, and the FT balance will be positively affected. As renewable energy consumption increases, countries' dependence on foreign energy will decrease relatively. However, this improvement is possible in the long term. Especially in developing countries, it may negatively affect foreign trade in the short term, as it necessitates investments in renewable energy.

References

Aissa, M. S. B., Jebli, M. B. & Youssef, S. B. (2014). Output, Renewable Energy Consumption and Trade in Africa. *Energy Policy, 66*, 11-18. doi: http://dx.doi.org/10.1016/j.enpol.2013.11.023.

Akar, B. G. (2016). The Determinants of Renewable Energy Consumption: An Empirical Analysis for The Balkans. *European Scientific Journal, 12*(11), 594-607.

Alam, M. & Murad, W. (2020). The Impacts of Economic Growth, Trade Openness and Technological Progress on Renewable Energy Use in Organization for Economic Cooperation and Development Countries. *Renewable Energy, 145*, 382-390. doi: https://doi.org/10.1016/j.renene.2019.06.054.

Amri, F. (2017). Intercourse Across Economic Growth, Trade, and Renewable Energy Consumption in Developing and Developed Countries. *Renewable and Sustainable Energy Reviews, 69,* 527-534. doi: http://dx.doi.org/10.1016/j.rser.2016.11.230.

Breusch, T. S. & Pagan, A. R. (1980). The Lagrange Multiplier Test and Its Applications to Model Specification Tests in Econometrics. *Review of Economic Studies, 47*(1), 239–53.

Brini, R., Amara, M. & Jemmali, H. (2017). Renewable Energy Consumption, International Trade, Oil Price and Economic Growth Inter-Linkages: The Case of Tunisia. *Renewable and Sustainable Energy Reviews, 76*, 620-627. doi: http://dx.doi.org/10.1016/j.rser.2017.03.067.

Cerasa, A. (2008). CIPS Test for Unit Root in Panel Data, Further Monte Carlo Results. *Economics Bulletin, 3(*16), 1-13.

Chen, Y., Wang, Z. & Zhong, Z. (2019). CO2 Emissions, Economic Growth, Renewable and Non-Renewable Energy Production, And Foreign Trade in China. *Renewable Energy, 131*, 208-216. doi: https://doi.org/10.1016/j.renene.2018.07.047.

Chen, C., Pinar, M. & Stengos, T. (2020). Renewable Energy Consumption and Economic Growth Nexus, Evidence from A Threshold Model. *Energy Policy, 139*, 1-13. doi: https://doi.org/10.1016/j.enpol.2020.111295.

Dedeoglu, D. & Kaya, H. (2013). Energy Use, Exports, Imports and GDP, New Evidence from The OECD Countries. *Energy Policy, 57*, 469-476. doi: https://doi.org/10.1016/j.enpol.2013.02.016.

Driscoll, J. C. & Kraay, A. C. (1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics, 80*(4), 549-560.

Hassine, M. B. & Harrathi, N. (2017). The Causal Links Between Economic Growth, Renewable Energy, Financial Development, and Foreign Trade in Gulf Cooperation Council Countries. *International Journal of Energy Economics and Policy, 7*(2), 76-85.

Huang, J., Li, W., Guo, L., Hu, X. & Hall, J.W. (2020). Renewable Energy and Household Economy in Rural China. *Renewable Energy*, 155, 669-676. doi: https://doi.org/10.1016/j.renene.2020.03.151.

Jebli, M. B. & Youssef, S.B. (2015). Output, Renewable, and Non-Renewable Energy Consumption and International Trade: Evidence from A Panel Of 69 Countries. *Renewable Energy*, 83, 799-808. doi: http://dx.doi.org/10.1016/j.renene.2015.04.061.

Jebli, M. B., Youssef, S. B. & Öztürk, I. (2016). Testing Environmental Kuznets Curve Hypothesis, The Role of Renewable and Non-renewable Energy Consumption and Trade in OECD Countries. *Ecological Indicators, 60*, 824-831. doi: https://doi.org/10.1016/j.ecolind.2015.08.031.

Jebli, M. B., Youssef, S. B. & Apergis, N. (2019). The Dynamic Linkage Between Renewable Energy, Tourism, CO_2 Emissions, Economic Growth, Foreign Direct Investment, and Trade. *Latin American Economic Review, 28*(2), 1-19. doi: https://doi.org/10.1186/s40503-019-0063-7.

Kanberoglu, Z. & Polat, H. I. (2017). Analysis of Renewable Energy Resources from Regional Development in Eastern Anatolia Region Example. *International Journal of Contemporary Economics and Administrative Sciences, 7*(3-4), 158-177.

Karadağ, H. (2021). Covidien-19 Pandemic Period of Living in Energy Sector Developments in The Turkish Economy. *Turkish Business Journal, 2*(3), 11-23.

Kutan, A. M., Paramati, S. R., Ummalla, M. & Zakari, A. (2018). Financing Renewable Energy Projects in Major Emerging Market Economies, Evidence in The Perspective of Sustainable Economic Development. *Emerging Markets Finance & Trade, 54*, 1762–1778. doi: https://doi.org/10.1080/1540496X.2017.1363036

Menyah, K., Nazlioglu, Ş. & Wolde-Rufael, Y. (2014). Financial Development, Trade Openness and Economic Growth in African Countries, New Insights from A Panel Causality Approach. *Economic Modelling, 37*, 386-394. doi: https://doi.org/10.1016/j.econmod.2013.11.044.

Murshed, M. (2018). Trade Liberalization and Renewable Energy Consumption in South Asia: A Panel Data Approach. *USAEE Working Paper*, No. 18-371.

Murshed, M. (2020). Are Trade Liberalization Policies Aligned with Renewable Energy Transition in Low- And Middle-Income Countries? An Instrumental Variable Approaches. *Renewable Energy, 151*, 1110-1123. doi: https://doi.org/10.1016/j.renene.2019.11.106.

Nasreen, S. & Anwar, S. (2014). Causal Relationship Between Trade Openness, Economic Growth and Energy Consumption: A Panel Data Analysis of Asian Countries. *Energy Policy, 69*, 82-91. doi: https://doi.org/10.1016/j.enpol.2014.02.009.

Ozcan, M. (2018). The Role of Renewables in Increasing Turkey's Self-Sufficiency in Electrical Energy. *Renewable and Sustainable Energy Reviews*, 82, 2629-2639. doi: http://dx.doi.org/10.1016/j.rser.2017.09.111.

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *IZA Discussion Paper*, No:1240, Institute of the Study of Labor, Bonn, Germany.

Pesaran, M. H. (2007). A Simple Panel Unit Root Test in The Presence of Cross-Section Dependence. *Journal of Applied Econometrics, 22*, 265-312. doi: https://doi.org/10.1002/jae.951.

Pesaran, M. H. & Yamagata, T. (2008). Testing Slope Homogeneity in Large Panels. *Journal of Econometrics, 142*(1), 50-93. doi: https://doi.org/10.1016/j.jeconom.2007.05.010.

Pesaran, M. H., Ullah, A. & Yamagata, T. (2008). A Bias-Adjusted LM Test of Error Cross Section Independence. *Econometrics Journal*, *11*(1), 105-127. doi: https://doi.org/10.1111/j.1368-423X.2007.00227.x.

Rahman, M. M. & Vu, X. (2020). The Nexus Between Renewable Energy, Economic Growth, Trade, Urbanization and Environmental Quality: A Comparative Study for Australia and Canada. *Renewable Energy, 155*, 617-627. doi: https://doi.org/10.1016/j.renene.2020.03.135.

Sadorsky, P. (2011). Trade and Energy Consumption in The Middle East. *Energy Economics, 33*, 739–749. https://doi.org/10.1016/j.eneco.2010.12.012.

Sadorsky, P. (2012). Energy Consumption, Output, and Trade in South America. *Energy Economics, 34*(2), 476-488. doi: https://doi.org/10.1016/j.eneco.2011.12.008.

Sebri, M. & Ben-Salha, O. (2014). On The Causal Dynamics Between Economic Growth, Renewable Energy Consumption, CO2 Emissions and Trade Openness, Fresh Evidence from BRICS Countries. *Renewable and Sustainable Energy Reviews*, *39*, 14-23. doi: https://doi.org/10.1016/j.rser.2014.07.033.

Shakeel, M., Iqbal, M. M. & Majeed, M. T. (2013). Energy Consumption, Trade and GDP: A Case Study of South Asian Countries. *MPRA Paper* No:57677, University Library of Munich, Germany.

Shakouri, B. & Yazdi, S.K. (2017). Causality between renewable energy, energy consumption, and economic growth. *Energy Sources, Part B, Economics, Planning and Policy, 12*(9), 838-845. doi: https://doi.org/10.1080/15567249.2017.1312640.

Siddique, H. M. A. & Majeed, M. T. (2015). Energy Consumption, Economic Growth, Trade and Financial Development Nexus in South Asia. *Pakistan Journal of Commerce and Social Sciences, 9*(2), 658-682.

Tatoglu Yerdelen, F. (2013). *Panel Veri Ekonometrisi*. İstanbul: Beta Yayınevi.

Vaona, A. (2016). The effect of renewable energy generation on import demand. *Renewable Energy, 86,* 354-359. doi: http://dx.doi.org/10.1016/j.renene.2015.07.062.

Westerlund, J., Hosseinkouchack, M. & Solberger, M. (2016). The Local Power of the CADF and CIPS Panel Unit Root Tests. *Econometric Reviews, 35*(5), 845–870. doi: 10.1080/07474938.2014.977077.

Yuan, J., Xu, Y. & Zhang, X. (2015). Income Growth, Energy Consumption, and Carbon Emissions, The Case of China. *Emerging Markets Finance & Trade, 50*(5), 169–181. doi: 10.2753/REE1540-496X500512.

Zeren, F. & Akkuş, H. T. (2020). The Relationship Between Renewable Energy Consumption and Trade Openness: New Evidence from Emerging Economies. *Renewable Energy, 147*, 322-329. doi: https://doi.org/10.1016/j.renene.2019.09.006.

Zhao, Y., Wang, L. & Yu, Y. (2016). Trade Liberalization and China's Exports of Renewable Energy Products: Evidence from Product Level Data. *Emerging Markets Finance & Trade, 52*, 1281–1297. doi: 10.1080/1540496X.2016.1152788.

Ethics Statement: The authors declare that ethical rules are followed in all preparation processes of this study. In case of detection of a contrary situation, Fiscaoeconomia has no responsibility and all responsibility belongs to the authors of the study.

Etik Beyanı: Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde Fiscaoeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.

Çıkar Beyanı: Yazarlar arasında çıkar çatışması yoktur.

Author Contributions: Hakan GÜNEŞ contributed in the Introduction, Conclusion, Data Set, Econometric Methodology and Findings sections of the study. Ahmet KAMACI contributed to the study in the Introduction, Data Set, Econometric Methodology and Findings sections and in the data collection and analysis stages. Hatice ÖNDER contributed to the study in the Introduction, Conclusion, Theoretical Framework and Empirical Literature sections and data collection stages. 1st author's contribution rate: 33,4%, 2nd author's contribution rate: 33,3% and 3rd author's contribution rate: 33,3%.

Yazar Katkıları: Hakan GÜNEŞ, çalışmada Giriş, Sonuç, Veri Seti, Ekonometrik Metodoloji ve Bulgular bölümlerinde aşamalarında katkı sağlamıştır. Ahmet KAMACI, çalışmada Giriş, Veri Seti, Ekonometrik Metodoloji ve Bulgular bölümlerinde ve veri toplama ile analiz aşamalarında katkı sağlamıştır. Hatice ÖNDER, çalışmada Giriş, Sonuç, Kuramsal Çerçeve ve Ampirik Literatür bölümlerinde ve veri toplama aşamalarında katkı sağlamıştır. 1. yazarın katkı oranı: %33,4, 2. yazarın katkı oranı: %33,3 ve 4. yazarın katkı oranı: %33,3'tür.

Conflict of Interest: There is no conflict of interest between the authors.