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A Global Empirical Research on the Relationship Between Urbanization, Renewable Energy and Foreign Direct Investments in the Centenary of the Republic of Türkiye

Türkiye Cumhuriyeti'nin Yüzüncü Yılında Kentleşme, Yenilenebilir Enerji ve Doğrudan Yabancı Yatırımlar Arasındaki İlişki Üzerine Küresel Ampirik Bir Araştırma

Mustafa Latif Emek[1]

ÖZ

1990-2020 döneminde seçilen farklı gelir gruplarına ait 39 ülkede doğrudan yabancı yatırımlar, kentleşme ve yenilenebilir enerji tüketimi arasındaki ilişkinin incelendiği bu çalışmada serilerin durağanlık analizi CIPS testi ile yapılmıştır. GMM yöntemine dayalı panel VAR modeli kurulduktan sonra değişkenler arasındaki etkileşimi ortaya çıkarmak için Dumitrescu-Hurlin nedensellik testi, varyans ayrıştırma yöntemi ve etki-tepki analizi yapılmıştır. Bulgular, doğrudan yabancı yatırımdan yenilenebilir enerji tüketimine ve yenilenebilir enerji tüketiminden kentleşmeye doğru tek yönlü bir nedenselliğin varlığını kanıtlamaktadır. Ayrıca, yenilenebilir enerjinin kentleşme üzerinde olumsuz, doğrudan yabancı yatırımların ise yenilenebilir enerji üzerinde olumlu etkisi olduğu tespit edildi. Ancak bu etkilerin oldukça düşük olduğu görülmektedir. Cumhuriyetin yüzüncü yılında ülkemizde de yapılacak olan benzer nitelikli bilimsel çalışmalar ülkemizin karar alıcı mercileri için politikalarını belirleme noktasında referans olacaktır.

Anahtar Kelimeler: Yenilenebilir Enerji Tüketimi, Doğrudan Yabancı Yatırımlar, Şehirleşme

ABSTRACT

The relationship between foreign direct investments, urbanization and renewable energy consumption is investigated in 39 countries belonging to different income groups selected in the 1990-2020 period. In the study, the CIPS test is used to determine the series' stationarity. After establishing the panel VAR model based on the GMM method, Dumitrescu-Hurlin causality test, variance decomposition method and impulse-response analysis were performed to reveal the interaction between the variables. The findings prove the existence of unidirectional causality running from foreign direct investment to renewable energy consumption and from renewable energy consumption to urbanization. In addition, it is determined that renewable energy has a negative effect on urbanization and foreign direct investments have a positive effect on renewable energy. However, these effects are observed to be quite low. Similar scientific studies to be conducted in our country on the centenary of the Republic will be a reference for our country's decision-making authorities in determining their policies.

Keywords: Renewable Energy Consumption, Foreign Direct Investments, Urbanization

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INTRODUCTION:

We see that the concept of "urbanization" began to enter the literature as a result of the labor force shortage in cities after the industrial revolution and the migration of people living in rural areas to cities with the expectation of higher income. Migration to cities that started with work motivation has revealed the need to meet hundreds of needs, from infrastructure works to the construction of educational institutions, from social services to meeting the need for energy resources. Today, the concept of urbanization has become the most important issue that governments are interested in. As mentioned above, urbanization has brought with its thousands of problems that need to be solved. One of these problems is the search for different resources to eliminate energy consumption. Population density in cities actually means more energy consumption. Urban life, especially transportation, heating and lighting, causes energy consumption that is incomparably greater than rural areas. More energy consumption means both more carbon emissions and a greater cost. At this point, the use of renewable energy, especially in cities, appears as an alternative solution to the disadvantages expressed above. The energy obtained largely from fossil fuels presents renewable energy as an alternative due to the scarcity of resources and high costs. Countries' focus on renewable energy has made it necessary for them to work with multinational companies that will be stakeholders in this field. At this point, the concept of foreign direct investments appears. A better understanding of the current situation will be possible by determining the relationship between urbanization, renewable energy consumption and foreign direct investments.

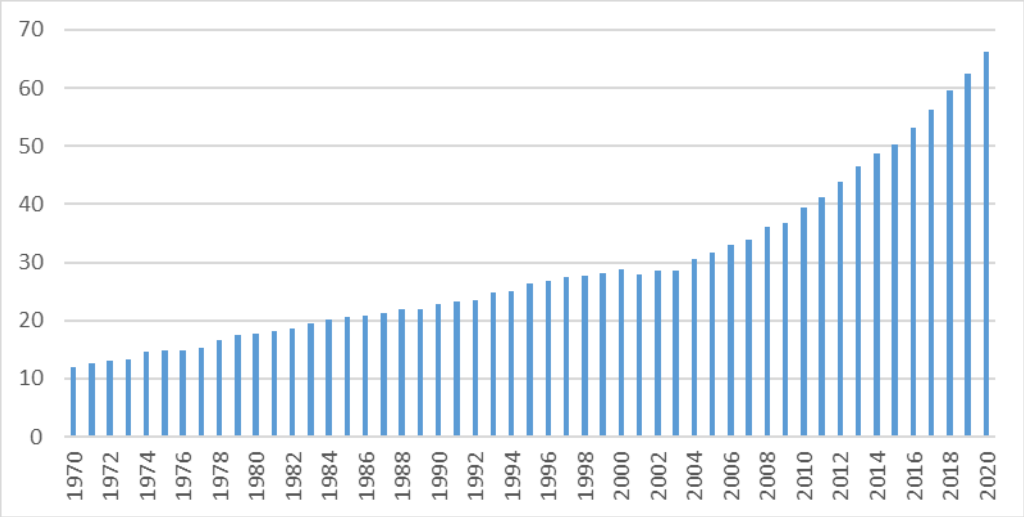
Foreign direct investments, which we can define as a company moving beyond the borders of the country where it is established and establishing a production facility in countries outside its headquarters or purchasing existing production facilities, are made all over the world for almost every sector. Considering the profitability of the energy sector, foreign direct investments also appear at this point.

With the Industrial Revolution, countries that better understand the importance of energy in terms of sustainable development have shown their interest and demand for energy resources for many years. Along with industrialization, rapid population growth and the irresponsible use of resources, the thought that fossil energy resources will run out raises concerns.

In addition to this negative trend the economic crises also emerged, experienced as a result of the policies implemented by the countries or economic associations that control the production of oil which has an important place in terms of use in fossil energy resources.

Renewable energy which has types such as solar, sea wave, wind, hydraulic and geothermal energy (Başaran et al. 2020), is a type of energy that can be obtained from neutral natural resources and is naturally renewed on a human time scale. The lack of control of fossil energy resources, which emerged as a result of years of political instability, wars, economic crises and especially frictions with OPEC member countries, has led many countries to alternative energy resources. In accordance with the geographical locations and underground resources of the countries, renewable energy sources such as water energy, solar energy, wind energy, biomass energy, geothermal energy, hydrogen energy, wave and tidal energy have emerged as alternatives. Especially the Arab-Israeli War, the first and second gulf wars increased the efforts to access alternative energy sources to fossil fuels. Chart 1 shows the course of this trend over the years.

Chart 1. The Course of Renewable Energy Consumption in the World (in Exajoules)



Source: BP (British Petroleum) Statistical Review of World Energy 2021

The striking point in Graph 1 is that while renewable energy consumption continued to be stable from 1970 to 2004, the increase accelerated after 2004. If the usage rates of renewable energy types are mentioned, the share of hydroelectric energy in total renewable energy in the last 20 years is 75%; the share of solar energy in total renewable energy is 4%; the ratio of wind energy in total renewable energy is 12%; The share of the total of geothermal, biomass and other renewable energy types in renewable energy is 9%.

Despite this increase in the amount of renewable energy consumption in the last 20 years, its share in total energy consumption is quite low. Although this share, which was determined as 6% in 1980, is increased to 12% with today's technologies in 2020, it is considered to be below the expected level.

Despite this, studies on the factors affecting renewable energy consumption have gained popularity recently, as results have been obtained that renewable energy consumption increases economic growth (Kasperowicz et al., 2020; Kahia et al., 2016). Within these studies, many factors such as the impact of human capital and industrialization (Zhou and Li, 2022), the impact of trade openness and technological advances (Alam and Murad, 2020) and the impact of governance indicators (Bellakhal et al., 2019) were examined. In this context, the role of FDI is viewed as a crucial part of both globalization and financial development. There is conflicting empirical data regarding how FDI affects energy use. Mielnik and Goldemberg's (2002) study is one that backs up our theory that FDI may be associated with energy savings.

It is seen that there are very few studies in the literature on the relationship between foreign direct investments and urbanization factors and renewable energy consumption. In this study, the relationship between renewable energy and foreign direct investments and urbanization is investigated in terms of 39 countries between 1990 and 2020. In this research, which consists of six parts, after referring to the literature on the subject, information about the data set and the methodology applied is given. The study was completed with conclusions and policy recommendations in line with the empirical findings.

Tan and Uprasen (2022) came to the conclusion that FDI has nonlinear effects on renewable energy use. And when the level of environmental regulation rigor is above the cutoff point, the orientations of FDI's effects on renewable energy shift from negative to positive. Finally, control factors that affect renewable energy use include GDP per capita, trade openness, financial development, and

urbanization. These findings however is contradictory with previous Works of Hagert and Marton (2017) who are examined the relationship between renewable energy consumption and foreign direct investments for 56 middle-income countries in the period 1990-2010 using the fixed effects method. The results show that foreign direct investments have negative affect on renewable energy consumption.

Qamruzzaman and Jianguo (2020) examined the relationship between renewable energy and foreign direct investments in 114 low-income, low-middle-income and high-income countries between 1990 and 2017 using Panel ARDL long-term coefficient estimation and Panel Granger causality tests. Results show that foreign direct investments have positive effects on renewable energy consumption. In addition, unidirectional causality running from renewable energy consumption to foreign direct investment in low-income and high-income countries and bidirectional causality between the two variables in low-middle-income countries is proven.

Khan et al. (2021) The effect of foreign direct investments on renewable energy consumption in Brazil, Russia and India between 2000 and 2014 is investigated. In the study, while coefficient estimation is made with Driscoll-Kray and GMM, the existence and direction of causality is examined with the Dumitrescu-Hurlin test. The results show that foreign direct investments reduce energy consumption according to both estimation methods. According to the results of the causality analysis, the existence of bidirectional causality between the two variables is determined.

Arı (2021) studied relationship between renewable energy and foreign direct investment for Turkiye. In her study a relationship were not determined between renewable energy and direct foreing investment. In addition to that foreign direct investment has not any positive or negative impact on renewable energy consumption

Elheddad, M. (2022) investigated how Bangladesh's FDI affected both renewable and non-renewable energy sources. They discovered that the Bangladeshi economy produces increased CO2 emissions as a result of FDI inflows. Second, FDI discourages the use of renewable energy, and in terms of volume, FDI has a greater negative impact on renewable energy than it does on CO2 emissions. This worsens the situation.

Shahbaz et al. (2022) The determinants of 2000-2019 renewable energy consumption for 39 countries are investigated using long-term coefficient estimation methods by establishing three different models (CS-ARDL, CS-DL and CCE). According to the empirical results, while foreign direct investments decrease renewable energy consumption in the second and third models, they increase it in the first model.

Bao and Xu (2019) examine the relationship between urbanization and renewable energy consumption with the Panel Granger causality test for 30 provinces of China between 1997-2015. The results show unidirectional causality from renewable energy consumption to urbanization in 2 states, and unidirectional causality from urbanization to renewable energy consumption in 3 states.

Khuong et al. (2019) investigates the relationship between renewable energy and urbanization for 6 Asian countries in the period of 1995-2013 by correlation analysis. According to the analysis, the urbanization factor positively affects the renewable energy consumption.

Wang et al. (2021) examines the impact of urbanization on renewable energy consumption for 34 sub-Saharan countries between 2005 and 2015. According to the analysis performed with the Threshold method, there is a positive relationship between the two variables.

Han et al. (2021) The effect of urbanization on renewable energy consumption is investigated with Quintile Regression analysis for China in the period 1990-2018. According to the results obtained, there is a positive relationship between these two variables.

Islam et al. (2022) investigates the long-term effect of urbanization on energy consumption in Bangladesh with the ARDL boundary test, with time series analysis for the period 1990-2019. However, the results show that there is no statistically significant relationship between the two variables.

Zhou and Li (2022) investigate the relationship between renewable energy and urbanization for 69 countries between 1990 and 2015. In the study, the long-term coefficient estimates of the variables are examined by the PMG method. The findings indicate that there is no statistically significant relationship between the two variables.

In Turkiye, significant progress has been made in renewable energy, especially in the last 20 years. Turkiye's hydroenergy, geothermal, solar, wind and energy potential are 216 billion KWh, 31500 MWt, 500 Mtoe/year, 400 billion KWh, respectively. In other words, it is located in one of the lucky regions of the world in terms of renewable energy resources (MFA, 2022). Despite the resource advantage, Türkiye is not at the desired level in terms of renewable energy technologies and is in need of foreign investments at this point. On the other hand, Turkey has an important place both in the region and in the world in terms of development in the construction sector. From the point of relationship between urbanization, renewable energy and foreign direct investment, Turkiye is one of the best locations to be applied new researches. However, in this article, we econometrically tested the relationship between renewable energy, urbanization and foreign direct investments with data from 39 countries including Türkiye from the scope. The results obtained will be an important basis for similar studies to be conducted in the future for our country. Conducting similar studies during the period called "Century of Türkiye" especially after this year in which we celebrate the 100th anniversary of the republic, will fill an important deficiency.

1. Materials and Method

In this study, which examines the relationship between foreign direct investments and urbanization factors and renewable energy consumption using the data between 1990 and 2020, 3 groups of countries are discussed. According to the World Bank classification 13 high-income countries (Austria, Belgium, Chile, Denmark, Finland, Japan, United Kingdom, South Korea, Germany, France, Australia, Italy, Uruguay), 13 high-middle-income countries (Argentina, Brazil, China) , Colombia, Ecuador, Malaysia, Mexico, South Africa, Thailand, Türkiye, Gabon, Peru, Costa Rica) and 13 low-middle income countries (Algeria, Bangladesh, Cameroon, Pakistan, Egypt, India, Indonesia, Philippines, Tunisia, Honduras) , Benin, Ghana, Nigeria) a total of 39 countries were included in the study. In addition to the fact that the countries included in the study are in different income groups their geographical distribution was also taken into account in order to prevent regional deviations.

Descriptive statistics for the series of 39 countries that are the subject of the analysis for the period 1990-2020 and the sources from which these statistics are obtained are given in Table 1.

Table 1. Definition of Variables

Variables	Symbol	Measurement	Source
Renewable Energy	REN	Renewable energy consumption thousand tons	OECD
Foreign Direct Investments	FDI	Net infolws in foreign direct investment (% of GDP)	WDI
Urbanization	URB	Urban population growth (% per annum)	WDI

Descriptive statistics of the variables included in the analysis are given in Table 2

Table 2. Descriptive Statistics and Correlation Matrix

Panel A			
	lnREN	FDI	URB
Average	8.7361	2.3124	2.2966
Median	8.7311	1.5612	2.1649
Maximum	12.5945	46.3643	5.6211
Minimum	3.0962	-7.6614	-1.6019
Std. Deviation	1.6459	3.4828	1.4748
Distortion	-0.1944	5.3187	0.2025
Kurtosis	3.7810	52.2049	1.9938
Observation	1326	1326	1326

The empirical methodology applied in the study consists of 5 parts. In the first part, the stationarity levels of renewable energy consumption, foreign direct investments and urbanization variables are determined by using the CIPS unit root test. Then, the Panel VAR model is established and the relationship between the variables has been discussed. In the following sections causality test, variance decomposition method and impulse-response analysis are used respectively.

1.1. Unit Root Test

It is accepted that there is a unit root effect in the variables if the effects of positive or negative events that occurred in the past years affect the following years intensely. Unit root tests are important because analyzes performed with variables containing unit root yield biased results. With the help of unit root tests, the raw structure of the series which is freed from the effects of shocks is obtained and predictions can be made about the series. For this reason, the existence of unit root in the variables subject to the analysis is investigated with the CIPS test.

Pesaran (2007) uses the Dickey-Fuller regression (Bui et al., 2021: 6), that considers the cross-sectional dependence and has been increased cross sectionally, to determine the stationarity levels of the variables (Bui et al., 2021: 6).

$$\bar{Y}_{it} = \alpha_i + b_i Y_{it-1} + c_i \bar{Y}_{t-1} + d_i \Delta \bar{Y}_{t-1} + \varepsilon_{it} \quad (1)$$

In number (1) in equation; $\bar{Y}_t = \frac{1}{N}\sum_{i=1}^{N} Y_{it}$, $\Delta\bar{Y}_t = \frac{1}{N}\sum_{i=1}^{N} \Delta Y_{it}$ and ε_{it} represents the error term. So, the CIPS statistic is calculated as in equation (2):

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \quad (2)$$

''$CADF_i$'' in equation (2) is a cross-sectionally enhanced DF statistic in equation (1).

The null hypothesis accepts the existence of a unit root. It is tested against the alternative hypothesis stating the absence of a unit root. If the test statistic is greater than the critical values the null hypothesis is rejected. Otherwise, the null hypothesis cannot be rejected.

1.2. VAR Analysis

Vector Autoregressive Regression models are used to examine the interaction of factors in macroeconomic models with each other due to their internality and externality. This allows us to estimate all the variables in the model by considering them together.

In the Panel VAR analysis developed by Holtz-Eakin, Newey and Rosen (1988), which meets the orthogonality conditions the GMM method is used to ensure that the variables on the right side of the model and the error term are uncorrelated. In addition, its solution to the variable variance problem provides effective estimations compared to other methods.

The estimation is made from equation (3) (Holtz-Eakin et al., 1988: 1374):

$$Y_{it} = \alpha_t + \sum_{l=1}^{m+1} c_{lt} Y_{it-l} + \sum_{l=1}^{m+1} d_{lt} X_{it-l} + v_{it} \quad , \quad t = (m+2), \dots, T \qquad (3)$$

In equation (3)

$\alpha_t = \alpha_{0t} - r_t \alpha_{0t-1}$

$c_{lt} = r_t + \alpha_{lt}$

$c_{lt} = \alpha_{lt} - r_t \alpha_{l-1,t-1} \ , \ (l = 2, \dots, m)$

$c_{m+1,t} = -r_t \alpha_{m,t-1}$

$d_{lt} = \delta_{lt}$

$d_{lt} = \delta_{lt} - r_t \delta_{l-1,t-1} \ , \qquad (t = 2, \dots, m)$

$d_{m+1,t} = -r_t \delta_{m,t-1}$

$v_{it} = u_{it} - r_t u_{i,t-1}$ is expresses.

In equation (3)

$Y_t = [Y_{1t}, \dots\dots, Y_{Nt}]' \ \ ve \ \ X_t = [X_{1t}, \dots\dots, X_{Nt}]'$ and the vector of the variables on the right side of the equation;

$W_t = [e, Y_{t-1}, \dots, Y_{t-m-1}, X_{t-1}, \dots, X_{t-m-1}\ ]$

1.3. Dumitrescu-Hurlin Causality Analysis

Dumitrescu-Hurlin (2012) causality test, which has several advantages such as allowing unobservable heterogeneity of panel data and being applicable in case of cross-sectional dependence is applied through equation (4) (Akram et al., 2021: 5).

$$\mathcal{Y}_{it} = \varphi_i + \sum_{k=1}^{K} \delta_i^{(k)} \mathcal{Y}_{it-k} + \sum_{k=1}^{K} \beta_i^{(k)} X_{it-k} + \varepsilon_{it} \qquad with \ i = 1, \dots, N \ and \ t = 1, \dots, T \qquad (4)$$

In equation (4) $\mathcal{Y}_{it}$ is the dependent variable; X_{it} is the independent variable.

At the decision stage, the null hypothesis that there is no causality and the alternative hypothesis that there is causality in at least one unit are compared. If the null hypothesis is rejected there is causality.

2. Empirical Findings and Discussion

Today, simultaneous correlations can occur between units in series due to various reasons such as globalization. In this case, which is called cross-section dependence, the first generation unit-root tests cannot perform strong tests, so biased results may occur in the analyses made. For this reason, first of all, the cross-sectional dependence in the series is investigated and the results are shown in Table 3.

Table 3. Cross-Section Dependence

	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM
lnREN	13205.64***	322.7711***	322.1802***
FDI	3151.461***	61.60158***	61.01067***
URB	10717.44***	258.1371***	257.5462***

Note: ''***'' %1 denotes the level of significance. Values in parentheses indicate statistical significance.

For all variables included in the analysis, cross-sectional dependence is determined at 1% significance level according to all three tests. For this reason, the results of the CIPS test, one of the second generation unit root tests used in the study are shown in Table 4.

Table 4. CIPS - Unit Root Test Results

	Fixed Term	Fixed Term and Trending
Panel A: Level Values		
lnREN	0.096	1.509
	(0.538)	(0.934)
FDI	-0.935	1.016
	(0.175)	(0.845)
URB	-1.253	2.230
	(0.105)	(0.987)
Panel B: Difference Level Values		
ΔlnREN	-13.437***	-11.583***
	(0.000)	(0.000)
ΔFDI	-8.593***	-5.162***
	(0.000)	(0.000)
ΔURB	-14.694***	-12.923***
	(0.000)	(0.000)

Note: ''***'' %1 denotes the level of significance. Values in parentheses indicate statistical significance.

According to the results in Table 5, three variables subject to analysis are determined as first-order stationary at the 1% significance level, according to both constant term and constant term and trend models. The results of the optimal lag length required to apply the panel VAR analysis are given in Table 5.

Table 5. Optimal Latency Results

Latency Length	J statistics	J Probability Value	MBIC	MAIC	MQIC
1	30.1774	0.3062422	-159.6558	-23.8226	-75.13927
2	13.63547	0.7525267	-112.92	-22.3653	-56.57565
3	11.46928	0.2449075	-51.80844	-6.530718	-23.63627

The determination of the optimal lag length for the model is based on the GMM-based Hansen J-statistic and the least information criterion. Since all the tools used are valid according to the Hansen J-statistic, a selection was made between 1,2 and 3 lags taking into account the information criteria. Since the smallest values in the modified Bayesian information criterion, the modified Akaike information criterion and the modified Hannan-Quinn information criterion were found in 1 delay, 1 delay was deemed appropriate for the next stages of the study.

The results of the causal relationship between the variables that are the subject of the research are shown in Table 6. According to these results, the existence of unidirectional causality from foreign direct investments to renewable energy consumption and from renewable energy consumption to urbanization is proven. However, statistically there isn't any remarkable causality relationship between foreign direct investments and urbanization.

Table 6. Causality Test Result

Zero Hypothesis	Zbar-sta.	Z-bar Possibility	Result
FDI Granger is not the reason lnREN	14.2733*	0.0740	FDI → lnREN
lnREN Granger is not the reason FDI	4.7032	0.8960	
URB Granger is not the reason lnREN	6.2377	0.9460	lnREN → URB
lnREN Granger is not the reason URB	39.4961***	0.0060	
FDI Granger is not the reason URB	14.8088	0.3060	FDI x URB
URB Granger is not the reason FDI	13.6253	0.3460	

Not: ***, and * at %1 and %10 Indicates statistical significance. ''x'' indicates no causality, ''→'' indicates one-way causality

The variance decomposition results of the changes in renewable energy consumption are shown in Table 7. While 99% of the change in the standard deviation of renewable energy consumption is due to itself in the short term, approximately ‰2 is due to foreign direct investments. The effect of urbanization can be 1% at the end of 10 periods.

Table 7. Variance Decomposition Results of Changes in Renewable Energy Consumption

Forecast Period	lnREN	FDI	URB
0	0	0	0
1	1	0	0
2	0.9962	0.0017	0.0019
3	0.9936	0.0020	0.0042
4	0.9906	0.0025	0.0067
5	0.9881	0.0028	0.0089
6	0.9862	0.0031	0.0106
7	0.9847	0.0032	0.0119
8	0.9837	0.0034	0.0128
9	0.9830	0.0034	0.0134
10	0.9826	0.0035	0.0138

The results of the changes in foreign direct investments are given in Table 8. According to the results obtained, 67% of the change in the standard deviation of foreign direct investments in the short term is self-induced, while approximately 28% is due to renewable energy consumption. The effect of urbanization, on the other hand, did not show great changes during 10 periods, affecting around 5%.

Table 8. Variance Decomposition Results of Changes in Foreign Direct Investments

Forecast Period	lnREN	FDI	URB
0	0	0	0
1	0.2239	0.7760	0
2	0.2778	0.6817	0.0404
3	0.2736	0.6840	0.0422
4	0.2785	0.6757	0.0457
5	0.2789	0.6746	0.0464
6	0.2798	0.6732	0.0469
7	0.2801	0.6727	0.0470
8	0.2804	0.6724	0.0470
9	0.2805	0.6723	0.0471
10	0.2806	0.6722	0.0471

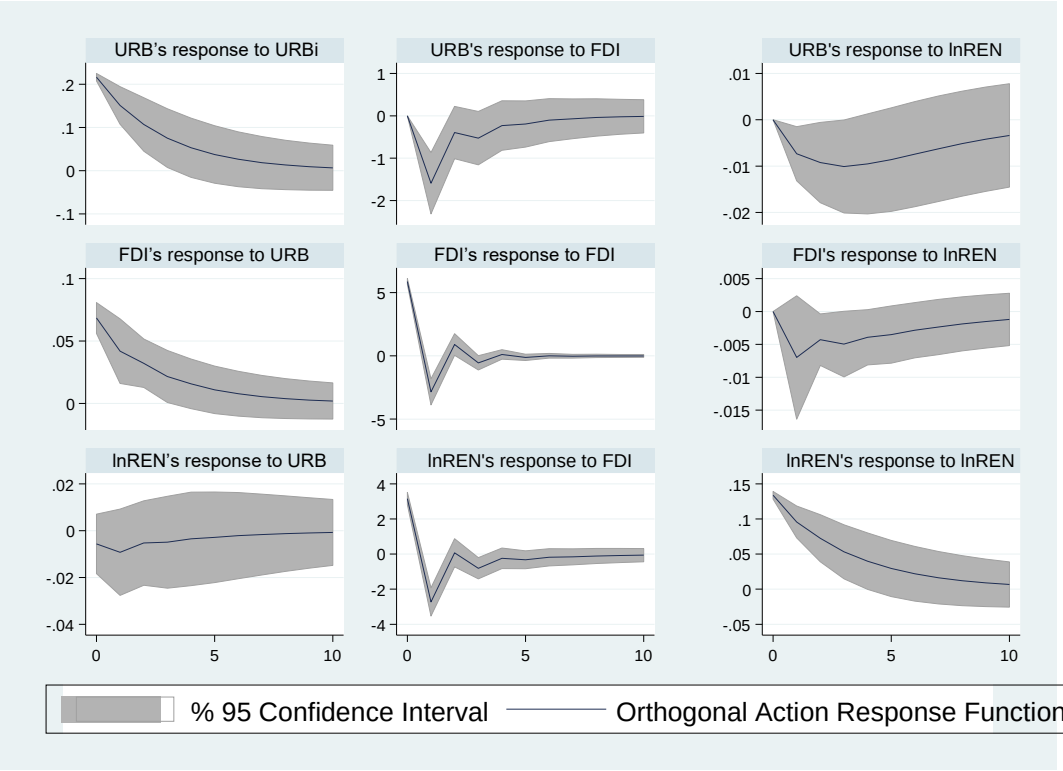
Table 9 shows the variance decomposition results of urbanization. According to these results, 91% of the changes in the standard deviation of urbanization in the short term originate from itself, and approximately 8% from foreign direct investments. The role of economic growth is very small in the short run. The renewable energy consumption's role is quite low. The part of the changes in the standard deviation of urbanization explained by renewable energy consumption is around ‰2 for 10 periods.

Table 9. Variance Decomposition Results of Changes in Urbanization

Forecast Period	lnREN	FDI	URB
0	0	0	0
1	0.0006	0.0911	0.9082
2	0.0015	0.0847	0.9137
3	0.0016	0.0844	0.9138
4	0.0017	0.0839	0.9142
5	0.0018	0.0838	0.9143
6	0.0019	0.0837	0.9143
7	0.0019	0.0837	0.9143
8	0.0019	0.0836	0.9143
9	0.0019	0.0836	0.9143
10	0.0019	0.0836	0.9143

The results of the Impact-Response analysis, which includes the effect when a one-unit shock is given to the error term of the variables discussed in the study, are shown in Chart 1.

Chart 1. Impact-Response Analysis Results



For all variables included in the analysis, cross-sectional dependence is determined at 1% significance level according to all three tests. For this reason, the results of the CIPS test, one of the second generation unit-root tests used in the study, are shown in Table 4.

According to the results obtained, when a unit shock is given to urbanization, it creates a positive but gradually decreasing effect on itself. This effect decreases and loses its effect for 10 periods. As a result of a shock to foreign direct investments, this effect, which continues to increase after the effect has bottomed in the first period, disappears. It is determined that a one-unit shock to renewable energy consumption has a negative effect on urbanization and this effect disappears after 10 periods.

When the response of foreign direct investments to urbanization and renewable energy consumption is examined; It is understood that the effect of urbanization on foreign direct investments is positive, while renewable energy is negative. The effect of these 2 variables disappears at the end of 10 periods.

Finally, the reaction of renewable energy consumption to urbanization and foreign direct investment is seen. The impact of the shock to urbanization on renewable energy consumption is negative, while the impact of the shock to FDI on renewable energy consumption is observed to be positive. While the effect of foreign direct investments disappears in the second period, the effect of urbanization disappears after the 10th period.

CONCLUSION

In this research the relationship between renewable energy consumption, foreign direct investments and urbanization was conducted for 39 countries in the period 1985-2018. At first the stationarity levels of the variables were determined where underdeveloped, developing and developed country groups were discussed. According to the CIPS test results used, it was determined that all variables

were stationary in their first differences, I(1), since the series had cross-sectional dependence. In the following process, Dumitrescu-Hurlin causality test, variance decomposition method and action-response analysis were applied. According to the causality test results, the existence of one-way causality from foreign direct investments to renewable energy consumption and from renewable energy consumption to urbanization has been proven for all three income group countries.

According to the Impact-Response analysis, it is seen that a shock in renewable energy consumption negatively affects urbanization, while a shock in foreign direct investments affects renewable energy consumption positively. In other words, a positive effect on renewable energy sources primarily affects urbanization negatively. Especially when we consider the three income group countries the more intensive use of renewable energy resources in developed countries an increase in the renewable energy resources of these countries will negatively affect these countries more harshly. Namely, developed countries' per capita energy consumption is higher due to both the technology usage rate of their people and the abundance of industrial facilities, and therefore they need more energy. Efforts to reduce fossil energies and increase renewable energy in these countries will yield negative results in the short term as they will not be able to meet the energy needs of this group. The least impact is seen in underdeveloped countries. Because these countries have lower per capita energy consumption and a change in renewable energy policies will affect these countries less. The middle group of countries including Turkiye is a group of countries that are least affected by negative or positive situations arising from renewable energy.

On the other hand, an increase in foreign direct investments gives similar results for all three country groups. An increase in foreign direct investments also increases renewable energy consumption and has a positive effect.

According to the variance decomposition results, 3‰ of the change in renewable energy consumption is due to direct foreign investments, and 2‰ of the change in urbanization is due to renewable energy consumption.

In line with these results, it seems appropriate to focus on renewable energy policies that will positively affect the urbanization factor, which will enable companies to access wider common services and infrastructure due to their scale of activity compared to low-density and long-distance dispersed settlements. Many cities, such as Munich and Copenhagen, have a goal to adopt renewable energy models and source all of their electricity use from renewable sources. Incentive programs can be created in these provinces through national and international organizations to ensure that the adopted target is transformed into a systematic model and disseminated. It is possible to build new urban structures in geographical regions suitable for renewable energy production and to increase the supply of renewable energy power plants to these regions.

A suitable environment should be provided for investment by multinational companies that will provide the necessary technology and equipment for renewable energy production. Long-term direct foreign investment gains and minimization of political risks with various advantages such as establishing a good infrastructure system, giving importance to R&D activities, applying special tax deductions to companies that produce and consume renewable energy, organizing training programs to train qualified workforce to work in these companies. It is possible with direct foreign investments, renewable energy consumption and dependence on these resources will increase for all three country groups. Thus, it will be possible to reduce fossil energy dependence, which is gradually becoming depleted. Especially considering that Turkey has less fossil energy resources than neighboring countries, it is extremely important to develop policies to increase renewable energy resources in the new period called "Turkiye Century". When designing urbanization policies, decision

makers should take into account the relationship between direct capital investments, consumption of renewable energy resources and urbanization and determine policies in the light of scientific data.

In this article the relationship between renewable energy, urbanization and foreign direct investments has been tested with data obtained from 39 countries, including Turkiye. The results will form an important basis for similar studies to be conducted in Türkiye in the future. While developing urbanization policies, especially by carrying out similar studies in the period called "Turkiye's Centennial" the relationship between direct capital investments, consumption of renewable energy resources and urbanization should be taken into account and policies should be determined in the light of scientific data.

Etik Standart ile Uyumluluk

Çıkar Çatışması: Yazar, herhangi bir çıkar çatışmasının olmadığını beyan eder.

Etik Kurul İzni: Bu çalışma için etik kurul iznine gerek yoktur.

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