


**IDENTIFYING THE INFLUENCING FACTORS OF RENEWABLE ENERGY  
CONSUMPTION IN TURKEY WITH MARS METHODOLOGY**

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**Abstract**

*The aim of this study is to determine the factors affecting the renewable energy consumption in Turkey. In this context, firstly, similar studies in the literature have been examined. As a result of the investigation, 11 different variables have been identified that may affect the use of renewable energy. Annual data of the mentioned variables in the period of 1990-2018 are taken into consideration. On the other hand, MARS method is used in the analysis process of the study. As a result, it has been determined that renewable energy use increases when the population in the country goes up. As can be seen from here, with the increasing population, the demand for energy has also increased. As a result, renewable energy has started to be used more. In addition, it is also determined that the increase in natural gas prices leads to higher consumption of renewable energy. In the event that natural gas becomes more expensive, it is understood that people are turning to other alternatives. The loan amount in the country is another factor that has an impact on renewable energy consumption. In case the loan amount exceeds a certain rate, it is seen that these loans are concentrated on non-renewable energy sources. In addition, it has been determined that there is a negative relationship between carbon emissions in the country and renewable energy use. It can be understood that renewable energy usage can be increased mainly because of the obligatory reasons, such as higher demand for energy and natural gas prices increase. This indicates that no sufficient consciousness is formed in Turkey for renewable energy. Therefore, it is important to provide the necessary incentives such as tax advantage by the state to make renewable energy use more attractive.*

**Keywords:** *Renewable Energy, Economic Development, MARS*

**JEL Classification:** *O13, P28, P48*

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## **TÜRKİYE'DE YENİLENEBİLİR ENERJİ TÜKETİMİNİ ETKİLEYEN FAKTÖRLERİNİN MARS METODOLOJİSİ İLE BELİRLENMESİ**

### **Özet**

*Bu çalışmanın amacı Türkiye'deki yenilenebilir enerji tüketimini etkileyen faktörlerin belirlenmesidir. Bu bağlamda, ilk olarak, literatürdeki benzer çalışmalar incelenmiştir. Yapılan inceleme neticesinde, yenilenebilir enerji kullanımını etkileyebilecek olan 11 farklı değişken belirlenmiştir. Bahsi geçen değişkenlere ait 1990-2018 dönem aralığındaki yıllık veriler dikkate alınmıştır. Öte yandan, çalışmanın analiz sürecinde MARS yönteminden faydalanılmıştır. Netice itibarıyla, ülkedeki nüfusun arttığı durumda, yenilenebilir enerji kullanımının da arttığı belirlenmiştir. Buradan anlaşılacağı üzere, artan nüfus ile birlikte enerjiye yönelik talepte de artış yaşanmıştır. Bunun sonucunda da yenilenebilir enerji de daha fazla kullanılmaya başlanmıştır. Ayrıca, doğalgaz fiyatlarındaki artışın da yenilenebilir enerji kullanımını arttırdığı tespit edilmiştir. Doğalgazın daha pahalı bir hale geldiği durumda, insanların başka alternatiflere yöneldiği anlaşılmaktadır. Ülkedeki kredi miktarı da yenilenebilir enerji tüketimi üzerinde etkili olan başka bir faktördür. Kredi miktarı belirli bir oranı aştığı durumda, bu kredilerin yenilenemez enerji kaynakları üzerinde yoğunlaştığı görülmektedir. Ek olarak, ülkedeki karbon emisyonu ile yenilenebilir enerji kullanımı arasında da negatif yönlü bir ilişki olduğu belirlenmiştir. Bu çalışmadan elde edilen sonuçlardan anlaşılacağı üzere, Türkiye'deki yenilenebilir enerjinin talep artması ve doğalgaz fiyatlarının yükselmesi gibi mecburi nedenlerden dolayı arttığı tespit edilmiştir. Bu durum, yenilenebilir enerji kullanımına yönelik Türkiye'de yeterli bilincin oluşmadığını göstermektedir. Bu yüzden, yenilenebilir enerji kullanımının daha cazip hali gelebilmesi için devlet tarafından vergi avantajı gibi gerekli teşviklerin sağlanması önem arz etmektedir.*

**Anahtar Kelimeler:** *Yenilenebilir Enerji, Ekonomik Kalkınma, MARS*

**JEL Sınıflandırması:** *O13, P28; P48*

### **1. Introduction**

Energy is an indispensable part of the development and progress of our age, and it is one of the basic requirements for both industrialization and technology. The demand for energy is increasing day by day, and this demand will continue to rise in both developing and developed countries, with an increasing population (Zhang et al., 2017). Energy is an important requirement both for today's technological developments and for continuing our daily life. Although this requirement has been met mostly from fossil fuels until now, increasing environmental problems lead people and countries towards renewable energy sources due to climate changes and global warming. It is a fact that there is no possibility to continue using fossil resources in energy production, these can be exhausted. It is also a fact that non-renewable energy sources cause irreversible damage to the world. Anxiety for the future has increased for countries and people affected by these problems, and awareness of sensitivity to environment and climate protection has been created with this concern.

At this point, renewable energy plays an important role in meeting the energy needs of countries with domestic resources, reducing their dependency on foreign sources, ensuring sustainable energy use by diversifying resources, and minimizing environmental damage as a result of reducing carbon emissions (Vaona, 2016). Despite the high dependence on fossil fuels at present, luckily the use of renewable energy has been increasing over the years and this increase will go on as countries continue to invest in this sector. It is crucial to make this transition from non-renewable energies to renewable energies for a better environment and become more independent for countries. Hence, the more renewable energy consumption increases in a country, the more the country can reduce its import

level and be eco-friendly. In this context, it would be really beneficial to determine factors of renewable energy consumption. With these determinants, both countries and investors can take action and have more knowledge, so they can contribute renewable energies consumption to increase.

With the scarce source of fossil fuels and their effect on environment, energy consumption issue is turning a crisis. Thus, divaricating energy consumption by using renewable energies can be very helpful for countries (Steen and Weaver, 2017). Choosing whether to use renewable energy sources or not can be determined by fossil fuel prices. For example, crude oil price generally shows a negative effect on fossil fuel consumption, so this leads people to use renewable energy. In addition to this, along with the importance of air quality, natural gas, which has been an unrivaled source of heating for many years, has been put into the second plan together with renewable energy sources. Increases or decreases in natural gas prices positively affect renewable energy consumption (York and Bell, 2019). As oil and natural gas prices, the relationship between coal prices and renewable energy is similar. An increase in coal prices, is a force that pushes the consumer towards renewable energy sources.

In the other hand, some economic indicators can be significant for renewable energy consumption. Although it has long been said that renewable energy consumption contributes to economic growth, the opposite is also true. Economic growth plays an influential role in a country's renewable energy consumption. It makes people more aware of environmental issues, leading to an increase in renewable energy consumption. Like economic growth, GDP can be also an important determinant of this consumption. Generally, countries with high income tend to consume more renewable energy sources. In this context, the level of financial development in countries is of great importance. When financial sectors improve, GDP is affected in a positive way so that investments in renewable energy projects are encouraged (Bekhet and Othman, 2018).

In this study, the main factors that affect renewable energy consumption are examined. In this framework, firstly, 11 different factor that contribute to renewable energy consumption are determined by making a literature research. After that, an analyze is conducted with MARS method in order to understand the relationships between factors and renewable energy consumption. Therefore, this study can be helpful countries to take decisions in order to increase renewable energy consumption. It is possible to mention many different advantages of this study. Firstly, by determining factors that have an impact on renewable energy consumption, it will be possible to determine which factors countries should take into account in order to promote renewable energy consumption. Accordingly, the most important ones from the factors will be identified. This identification guides may contribute to increasing renewable energy investments in the country. On the other hand, another important contribution of this study to the literature is methodology that is used. For the first time, MARS method is used in renewable energy study. This situation increases the methodological novelty of the study.

This study contains 5 different sections. In the first part of the study, information about the importance of renewable energy, the benefits of renewable energy, the advantages of renewable energy consumption are explained. Additionally, in the second part of the study, a literature review is conducted on determinants of renewable energy consumption. In addition, the third part of the study covers the theoretical knowledge of MARS method that used in the analysis process. Moreover, in the fourth part of the study, the results of the analysis are expressed. Additionally, the final part gives information about the discussion and conclusion.

## **2. Literature Review**

Many studies have been conducted in the literature on renewable energy and its importance. The vast majority of these studies focused on how renewable energy consumption affect a country's economic indicators such as economic growth. An increase in renewable energy consumption can led a country's imports to decrease, so the country can be more independent in international area. At this

point, the factors that have an impact on renewable energy consumption are an important subject that must be studied.

### **2.1. Literature on Factors that Affect Renewable Energy Consumption**

Fossil fuels affect climate change more than any other energy source, and they cause import dependency for many countries. So, to increase renewable energy consumption is crucial for countries which want to be eco-friendlier and economically independent. At this point, fossil fuel prices are significant factors that facilitate this transition process. Either increasing or decreasing in fossil prices can have an impact on renewable energy consumption. When fossil prices decrease, a risk of ignoring renewable energy sources can occur (Schmidt et al. 2017). With increasing fossil fuel usage, go green movement is a must for humankind. In this context, coal price is determined

as important and significant factor for substituting nonrenewable energies with renewable ones (Apergis and Payne, 2014). Like change in coal prices, change in oil price is another factor that affect renewable energy consumption. In literature, as Brini et al. (2017) mentioned in their study by examining Tunisia between 1980 and 2011 by using cointegration and ARDL method, the possible increase in oil prices has a positive impact on usage of renewable energy sources in a unidirectional way. This idea was supported by Troster et al. (2018) in their study which takes place in United States, according to results even though there is no causality between renewable energy consumption, oil prices and economic activity, it is found that there is lower-tail dependence from changes in oil prices to renewable energy consumption.

Another study that made by Khan et al. (2017) also suggests that renewable energies become a level that can be competitive with fossil fuels so the relationship between both of them is important. In short term, changes in oil prices have no major effect on renewable energy consumption whereas in the long run low oil prices may create a threat for renewable energies and vice versa because of potential climate change policies. Natural gas prices also have the same effect on renewable energy consumption. In Dong et al. (2017)'s study, which examining the connection between CO<sub>2</sub> emission, GDP, natural gas consumption and renewable energy usage, it is expressed that in the long run there is a bidirectional relationship between natural gas consumption and renewable energy usage.

As much as fossil fuel prices, indicators of a country also have an impact on renewable energy consumption. Generally developed countries tend to use more renewable sources on energy than other countries because of legal requirements such as Kyoto Protocol or Paris Agreement. Economic development in a country makes people more aware of environmental protection, leading to an increase in renewable energy consumption. In terms of economic growth, as Sebri and Ben-Salha (2014) studied in BRICS countries by using ARDL method, growing economy in a country has positive effects on its renewable energy consumption. In another study that made by Ocal and Aslan (2013) examining Turkey by using Toda-Yamamoto causality tests, it is found that there is a unidirectional causality from economic growth to renewable energy consumption. In other developing country that is China, it shows that growing economy in China facilitates development of renewable energy sector (Lin and Moubarak, 2014).

Economic growth is an important factor to boost a country's GDP, and a country's GDP can affect the development of renewable energy sector so its consumption level. As Salim and Rafiq (2012) expressed in their article by examining six developing countries, renewable energy consumption is related to country's income in Turkey and Philippines. This suggestion is supported by Sadorsky (2009) and Nguyen and Kakinaka (2018), it is emphasized that countries will experience more and more renewable energy consumption with regards to increasing economic and social concerns and energy security, and GDP per capita is an important determinant of this consumption. There is a positive and significant relationship between GDP and renewable energy consumption, and sometimes this can be a feedback relationship (Apergis and Payne, 2014). Such as economic growth and GDP, a country's financial development level is also a significant factor for the consumption.

Banking sector, bond market, and capital market in a country have a positive effect on increase of consumption share (Anton and Nucu, 2020).

Energy represents a key actor for economic growth and welfare so that GDP. So, overall demand for energy is an also important factor that affect renewable energy consumption. Because energy shortages can occur in non-renewable energy sources, the share of renewable energy in total energy consumption is important (Tsai et al., 2017). The increase in total energy usage may help to an increase in renewable energy sources (Alvarez-Herranz et al., 2017). More substantively, it is considered as a factor of improvement of investment and productivity growth, so it is important share of electricity imports to consumption to restrict dependency to other countries. As Cole and Banks (2017) mentioned in their study, renewable energy sources are a strong motivation to reduce energy imports. In developing countries, whose energy is largely dependent on other countries, the importance of renewable energy sources is very important. To solve this problem in the country, demand can be met by using diversification of energy resources (Bujang et al., 2016). The biggest factor in revealing this demand is the rapidly growing population, that is accelerating especially in recent years. With this rapidly growing population, countries have turned to renewable energy sources to prevent global warming and meet the demand (Jones and Warner, 2016). As Shukla et al. (2017) studied in their study by examining South Asia countries, their rapid growth and development makes the transition to renewable energy consumption important with the increase in population.

Reducing carbon dioxide emission is a must for countries with high population. Greenhouse gas emissions resulting from the use of fossil fuels to generate energy are mostly caused by the intense emission of carbon and carbon dioxide gases to the atmosphere, causing global warming and climate change. Thus, it can be ensured that greenhouse gas emission is greatly reduced, and climate changes are slowed down. Activities carried out to meet today's human needs harm nature and the quality of life of future generations (Jin and Kim, 2018). Rapid increase in the world population, industrialization activities, technological innovations, increase in life level and rapidly increasing consumption expenditures lead to intense energy demand (Long et al., 2015).

Supporting the use of renewable energy sources (hydroelectric, geothermal, solar, tidal, wind, biomass and biofuel), which are considered to be more “cleaner” countries and people from carbon emissions from ever-increasing energy demand and thus fossil fuel use, and directed them towards increasing policies. It is observed that the use of renewable resources has increased in electricity production in recent years and will continue to increase in the future periods. Trade openness is also an important factor that affect renewable energy consumption. According to Lin et al. (2016), there is a long run relationship between trade openness and RE consumption. When a country opens more and more, its renewable energy consumption is affected positively. This idea is supported by Kyophilavong et al. (2015) in their study by examining Thailand, they concluded that between two variables there is a cointegration and they are interdependent. Besides trade openness, domestic investments also affect renewable energy consumption. In the long run, domestic investments increase total energy demand, so that a renewable energy demand can occur (Fu et al., 2013).

## **2.2. Literature on Methodology**

The literature related to MARS approach mainly focuses on science applications. For instance, Adnan et al. (2019) considered this approach for streamflow prediction in mountainous basin. In addition to this issue, Bateni et al. (2019) made a study about the clean water sources. On the other side, Ferreira et al. (2019) applied MARS approach to the daily reference evapotranspiration modeling with limited weather data. Moreover, Zheng et al. (2019) tried to analyze earthquake by using MARS methodology. Furthermore, Zhang et al. (2019) made an assessment related to the pile drivability. Also, Bui et al. (2019) aimed to predict forest fire by creating a model with MARS approach. Nevertheless, it is also determined that the literature regarding MARS method is very limited. Some studies related to the banking industry considered MARS model in their analysis (Oktar and Yüksel,

2016; Yüksel et al., 2016; Yüksel, 2016a; Yüksel et al., 2017; Yüksel and Zengin, 2016). In addition to them, some macro-economic issues are also evaluated by using this methodology as well (Yüksel, 2016b, Yüksel and Özşarı, 2017; Zengin et al., 2018; Yüksel and Adalı, 2017). On the other side, Dinçer et al. (2018a,b) also tried to examine some issues in the financial market.

### **2.3. Literature Review Results**

The results of literature review demonstrate that renewable energy consumption is very popular among the researchers. It can be seen that this concept was evaluated with various different purposes. Hence, it is obvious that generating originality in this subject is quite difficult. Therefore, it is thought that these studies should focus on a unique country or the analysis should be performed with an original methodology. For this purpose, in this study, leading indicators of renewable energy consumption in Turkey are evaluated with MARS methodology. Thus, it is aimed to have novelty with methodology and scope.

### **3. Multivariate Adaptive Regression (MARS) Methodology**

MARS method is used to analyze the effect of independent variables on the dependent variable. The most obvious difference of this method from other similar methods is that many different variables can be taken into account at the same time. In the process of using the MARS method, various models are created. After that, the ideal model is determined by the system. In this process, it is considered that the error rate of the model is the lowest and the explanation power is highest. On the other hand, the main difference of the MARS method from regression analysis is that there is no single linear line. In this approach, several different linear lines are combined with node points (Yüksel et al., 2018). Equation (1) includes the details of the MARS model.

$$Y = B_0 + \sum_{n=1}^K a_n B_n(X_t) + \varepsilon \quad (1)$$

In this equation, X represents independent variable whereas the dependent variable is demonstrated by Y. On the other hand, the constant term is stated as  $B_0$ . Additionally,  $B_n$  gives information about the basis function in which the conditions related to the variables are defined. In addition to them,  $a_n$  explains the coefficient of this basis function. In this equation, it is assumed that there are k different basis functions. Moreover, error term is shown as  $\varepsilon$ . It is possible to mention many different advantages of MARS methodology. In the normal regression analysis, an independent variable can take only one coefficient. However, this variable can have different coefficients according to the different conditions in MARS approach. Hence, it is believed that the relationship can be identified in a more appropriate form with this methodology. Another important advantage of MARS method is that the problem of having relationship between independent variables can be eliminated (Friedman, 1991).

### **4. An Analysis on the Renewable Energy Consumption in Turkey**

In this part of the analysis, firstly, data set and variables are defined. In the second section, MARS methodology is defined. On the other side, the final part is related to the analysis results.

#### **4.1. Data Set and Variables**

In this study, it is aimed to understand the main indicators of renewable energy usage in Turkey. Hence, for this purpose, a detailed literature review is conducted, and 11 different variables are selected. For these variables, annual data between 1990 and 2018 is taken into account and they are provided from World Bank. The details of these factors are summarized in Table 1.

**Table 1:** The Details of the Indicators

<b>Variables</b>	<b>Potential Impact on Renewable Energy Consumption</b>	<b>References</b>
Oil Price	(+)	Schmidt et al. (2017); Apergis and Payne (2014)
Coal Price	(+)	Brini et al. (2017); Troster et al. (2018)
Natural Gas Price	(+)	Khan et al. (2017); Dong et al. (2017)
Economic Growth	(+) or (-)	Sebri and Ben-Salha (2014); Ocal and Aslan (2013)
Investment	(+) or (-)	Sadorsky (2009); Nguyen and Kakinaka (2018)
Loans	(+) or (-)	Apergis and Payne (2014); Anton and Nucu (2020)
Population	(+)	Tsai et al. (2017); Alvarez-Herranz et al. (2017)
Trade Openness	(+) or (-)	Cole and Banks (2017); Bujang et al. (2016)
Carbon Emission	(-)	Jin and Kim (2018); Long et al. (2015)
Electricity Import	(-)	Lin et al. (2016); Kyophilavong et al. (2015)
Energy Consumption	(+)	Fu et al. (2013)

Table 1 states 11 selected indicators which may have an effect on renewable energy consumption. The potential impact of some variables on renewable energy consumption is certain. For example, any increase in oil, coal and natural gas prices has an increasing influence on renewable energy consumption. The main reason is that when these nonrenewable energy alternatives become expensive, the usage of renewable energy sources attracts the attention of the people. Similarly, it is also expected that there should be a positive correlation between population and energy consumption with renewable energy usage. Nonetheless, it is believed that there is a negative relationship between carbon emission and electricity import with renewable energy consumption. On the other side, it is not certain the effects of some variables on renewable energy consumption. For instance, economic growth, investment, loans and trade openness needs energy, but this can be obtained both renewable and nonrenewable sources. Thus, the effects of these variables on renewable energy consumption can be occurred in both ways.

#### **4.2. MARS Methodology**

MARS method is used to analyze the effect of independent variables on the dependent variable. The most obvious difference of this method from other similar methods is that many different variables can be taken into account at the same time. In the process of using the MARS method, various models

are created. After that, the ideal model is determined by the system. In this process, it is considered that the error rate of the model is the lowest and the explanation power is highest. On the other hand, the main difference of the MARS method from regression analysis is that there is no single linear line. In this approach, several different linear lines are combined with node points (Yüksel et al., 2018). Equation (1) includes the details of the MARS model.

$$Y = B_0 + \sum_{n=1}^K a_n B_n(X_t) + \varepsilon \quad (1)$$

In this equation, X represents independent variable whereas the dependent variable is demonstrated by Y. On the other hand, the constant term is stated as  $B_0$ . Additionally,  $B_n$  gives information about the basis function in which the conditions related to the variables are defined. In addition to them,  $a_n$  explains the coefficient of this basis function. In this equation, it is assumed that there are k different basis functions. Moreover, error term is shown as  $\varepsilon$ . It is possible to mention many different advantages of MARS methodology. In the normal regression analysis, an independent variable can take only one coefficient. However, this variable can have different coefficients according to the different conditions in MARS approach. Hence, it is believed that the relationship can be identified in a more appropriate form with this methodology. Another important advantage of MARS method is that the problem of having relationship between independent variables can be eliminated (Friedman, 1991).

### 4.3. Analysis Results

In the first stage of the analysis, all possible models are created by MARS system. Within this scope, it can be seen that 9 different models are presented by this system and they are detailed on Table 2.

**Table 2:** Different Models Created by MARS System

Model Number	Basis Functions	Total Variables	GCV	GCV R-Square
1	1	1	2.068	0.918
2	2	3	1.900	0.925
3	3	4	0.792	0.969
4	4	5	0.823	0.967
5	5	5	0.957	0.962
6	6	5	1.313	0.948
7	7	5	1.515	0.940
8	8	5	2.932	0.884
9	9	5	8.129	0.677

Table 2 indicates all necessary information about the whole models. According to this data, it is concluded that model 3 is the most optimal model. The main reason is that it has the lowest error value (GCV) and highest explanation power (GCV R-Square). The details of this optimal model are explained in Table 3.



**Table 3:** The Details of the Best Model

Parameters	p Value
Constant	0.0000
Basis Function 5	0.0000
Basis Function 8	0.0000
Basis Function 9	0.0000
Prob (F Value) = 0.0000	
Adj R-Squared = 0.982	

Table 3 indicates that three basis functions are significant in the model because probability values are lower than 0.05. In addition to this situation, the probability of F test is 0.000 which is lower than 0.05. This situation states that the whole model is meaningful. On the other side, adjusted R-squared value of 0.982 demonstrates that the independent variables are very successful to explain the dependent variable. Moreover, the details of the significant basis functions are stated on Table 4.

**Table 4:** The Details of the Basis Functions

Basis Functions	Details
Basis Function 1	Max (0, Carbon Emission - 203.720)
Basis Function 5	Max (0, Population - 17.992)
Basis Function 8	Max (0, 35.000 – Natural Gas Price)
Basis Function 9	Max (0, Loans - 14.135) * Basis Function 1

On the other side, the details of the model is given on the equation (2) based on the basis function (BF).

$$\text{Renewable Energy Consumption} = 8.173 + 87.301 * BF5 + 0.516 * BF8 - 0.002 * BF9 \quad (2)$$

Hence, this equation can be rewritten by considering the details of the basis functions and it can be demonstrated as in the equation (3).

$$\text{Renewable Energy Consumption} = 8.173 + 87.301 * [\text{Max}(0, \text{Population} - 17.992)] + 0.516 * [\text{Max}(0, 35.000 - \text{Natural Gas Price})] - 0.002 * [\text{Max}(0, \text{Loans} - 14.135) * \text{Max}(0, \text{Carbon Emission} - 203.720)] \quad (3)$$

By considering Table 1 and equation (3), it can be understood that four different variables are significant to explain the dependent variable. In this context, population is an important effect on higher renewable energy consumption. In addition to this variable, there is a negative relationship between natural gas prices and renewable energy consumption. Additionally, the loans have a smaller but negative influence on renewable energy consumption in Turkey. This situation is also similar for carbon emission.

## **5. Conclusion and Discussion**

The purpose of this article is to determine the factors influencing the use of renewable energy in Turkey. In this context, a large-scale literature review is carried out primarily. As a result, 11 different variables are chosen, which are thought to affect renewable energy consumption. The data for the mentioned variables in the period of 1990-2018 is included in the scope of the examination. Moreover, MARS method is used in the analysis process of the mentioned study. According to the analysis results obtained, in Turkey's renewable energy model, three are different basic functions (BF5, BF8 and BF9). Considering these mentioned basic functions, 4 different variables are found to be effective in explaining the use of renewable energy. On the other hand, it is concluded that the F test value of this model and the explanatory power of the model are statistically significant.

According to the results, it is identified that population growth has a positive influence on renewable energy consumption. It is obvious that when population increases, the need for energy goes up as well. Because of this increasing need, the demand to the renewable energy increases. For this purpose, companies make investment to the renewable energy projects. In the literature, Tsai et al. (2017) and Alvarez-Herranz et al. (2017) also reached to similar conclusions in their studies. Another important conclusion of this study is that there is a negative relationship between natural gas prices and renewable energy consumption. It is obvious that when natural gas becomes expensive, people will be very reluctant to consume it. Hence, they search new alternatives to solve this problem. In this framework, it can be seen that the demands for renewable energy consumption goes up. Khan et al. (2017) and Dong et al. (2017) also argue that natural gas prices strongly affect renewable energy consumption.

Furthermore, there is a negative correlation between loans and renewable energy consumption. This result gives information that after a point, the loans are provided to non-renewable energy projects. Similar to this result, it is also concluded that when there is high carbon emission, the renewable energy consumption decreases. These two different results are quite coherent. In the literature, Apergis and Payne (2014) and Anton and Nucu (2020) also support that there is a positive relationship between loans and nonrenewable energy consumption. On the other side, Jin and Kim (2018) and Long et al. (2015) discussed that the countries with high carbon emission tend to make lower renewable energy consumption.

These results mainly indicate that renewable energy usage in Turkey increases when there is higher demand. For instance, higher population and natural gas price increase positively affect renewable energy consumption. Therefore, it is mainly recommended that Turkey should focus on renewable energy investments not only for increasing demand but also for decreasing energy dependency. For this purpose, government incentives should be provided. Within this scope, tax advantage, location selection and technical support can be significant contributing factors to improve renewable energy usage.

The main limitation of this study is that it focuses on the factors that affect renewable energy consumption. Thus, it can be a nice subject to evaluate the effects of renewable energy for the future studies. Another significant limitation of this study is that the analysis is conducted only for Turkey. Therefore, in the following analyses, different country groups can be taken into account. Moreover, different methodologies can also be used in the future studies. For instance, regression and decision tree analyses can be used to understand the main quantitative factors. On the other side, fuzzy DEMATEL and fuzzy AHP approaches can also be considered for qualitative issues.

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