ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF ARTS AND SOCIAL SCIENCES

DOES A POSITIVE RELATIONSHIP BETWEEN RENEWABLE ENERGY INVESTMENT AND REAL GDP OF COUNTRIES REALLY EXIST?

M.A. THESIS

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Department of Economics

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ SOSYAL BİLİMLER ENSTİTÜSÜ

YENİLENEBİLİR ENERJİ KAYNAKLARI VE GSYİH ARASINDA GERÇEKTEN POZİTİF BİR İLİŞKİ VAR MIDIR?

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May 2019

Ahmet Baran Zeren, a M.A. student of ITU Graduate School of Arts and Social Sciences student ID 412161002, successfully defended the thesis/dissertation entitled "DOES A POSITIVE RELATIONSHIP BETWEEN RENEWABLE ENERGY INVESTMENT AND REAL GDP OF COUNTRIES REALLY EXIST?", which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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Date of Defense : 12 June 2019

To my family

FOREWORD

Throughout my undergraduate period, economics keeps fascinate me. With it's methodology, economics is a science that makes sense of our complex environment and help us to understand everyday life. It was my aim to be part of the economics science. This thesis is the final work of my Master study at the Istanbul Technical University of Social Sciences.

It was really a pleasure to have this experience, I attained many intriguing knowledge from the papers and documents on this subject however, it was also an uneasy period with full of complications and unexpected problems.

I really appreciate to my advisor Assist. Prof. Dr. Shourjo CHAKRAVORTY for his valuable suggestions and supports during my M.A thesis study. I am also grateful to Prof. Dr. Sencer ECER to facilitate the study and inspire in every sense. I would like to thank to my family; my mother Meral, my father Hıfzı and my beloved one Gözde for their support during this process.

May 2019

Ahmet Baran ZEREN

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DOES A POSITIVE RELATIONSHIP BETWEEN RENEWABLE ENERGY INVESTMENT AND REAL GDP OF COUNTRIES REALLY EXIST?

SUMMARY

The growth hypothesis suggests that an increase in energy consumption causes an increase in real GDP. In this study, the association between real GDP and renewable energy investment are examined. The local nature of renewable energy resources is one of special importance for sustainable energy due to the fact that their countries reduce dependence on external energy sources and they are continuous and clean energy sources. For this reason, the contribution of renewable energy in global final energy production was 8.5% in 2013 while the incentives for the dissemination of renewable energies in many countries of the world increased from 19.1% in 2014 to 23.7% in 2015. This situation shows that approximately one fifth of the energy consumed in the world (1/5) is met from renewable sources. The reason why the issue is so important is the two major problems facing the world, especially economic reasons. One of them is the problem of sustainable development which is a socio-economic problem and the other is the problem of global warming and climate change. Developed and strong economic structures have begun to find solutions to the energy problem by making necessary structural changes in their economies and by establishing international organizations on the other hand, and have taken measures by making some plans. Thus, energy is at the heart of the economic development to ensure sustainable development. It is not possible for countries that cannot solve the energy problem to reach their economic targets and to establish their social balances. Although countries meet their energy needs with two different vehicles, renewable and non-renewable energy sources; the unstable distribution of non-renewable energy resources around the world, the high cost of supply for countries without such resources, and the limited availability of fossil fuel reserves make renewable energy both necessary and compulsory. In this study, a long-standing issue of energy-economic growth relation is investigated. Firstly, the theoretical background of this relation is introduced and discussed in the literature review section. Then, after gathering data, panel data model is used to detect this relation. In the panel data analysis, due to the multicollinearity, renewable energy and non-renewable energy are separately handled. Results reveal that there is no statistically significant relationship between energy and GDP.

YENİLENEBİLİR ENERJİ KAYNAKLARI VE GSYİH ARASINDA GERÇEKTEN POZİTİF BİR İLİŞKİ VAR MIDIR?

ÖZET

Teknik olarak, enerji; iş yapma yeteneği olarak ifade edilir. İş yapabilme yeteneği, maddelerin taşınmasına veya değişmesine neden olarak hayati faaliyetlerin sürdürülmesine ve kolaylaştırılmasına katkıda bulunur. Nitekim 18. yüzyılın ikinci yarısında İngiltere'de başlayan ve daha sonra kısa sürede ABD ve Avrupa'ya yayılan Endüstri Devrimi, en önemli enerji kaynağı olan kömürle gerçekleştirilebildi. O dönem refah seviyelerinin artması ve ülkelerin gelişmesiyle vazgeçilmez bir unsur haline gelen enerji, zaman içinde sadece ekonomik bir tartışma olmaktan çıkmış ve diplomasi, hukuk ve jeopolitik gibi kavramları içine alarak çok geniş bir görüş kazanmıştır. Bu noktada, enerji üretimi ve tüketimi, kalkınmadaki en temel göstergelerden biri olarak kabul edilir. Enerji ihtiyaçlarını karşılamak için kullanılan kaynaklar esas olarak; yenilenebilir enerji kaynakları ve yenilenemez enerji kaynakları olarak iki gruba ayrılır. Yenilenebilir enerji kaynakları; güneş, rüzgâr, jeotermal hidroelektrik, biokütle enerjisi ve dalga enerjisi olarak sınıflandırılırlar. Yenilenemeyen enerji kaynakları ise; Ham Yağ, Doğal Gaz ve Kömür olarak gruplandırılırlar. Fosil yakıtlarda kömür ilk aşamada bir ısıtma kaynağı olarak ortaya çıkmış, ancak buhar motoru ile bir yenilik kaynağı haline gelmiştir. Sıvı olarak taşınması ve depolanması daha kolay olduğu ve birim ağırlık başına kömürden çok daha fazla ısı ürettiği için, 20. yüzyılın başından beri petrol, kömürden daha ön planda yer almıştır. İlerleyen süre zarfında nükleer, bazı ülkelerin gündemine önemli bir enerji kaynağı olarak girmeyi başarmıştır. Özellikle II. Dünya Savaşı'ndan sonra, Avrupa ülkeleri petrol bağımlılığının yol açtığı sorunları hafifletmek ve kömür kullanımının yol açtığı çevresel zararı azaltmak için nükleer enerjiye yöneldi. Bu bağlamda, 1957'de Roma Antlaşması imzalandı ve Atom Enerjisi Topluluğu kuruldu. Yenilenebilir enerji kaynaklarının ise doğal yapısı, ülkelerinin dış enerji kaynaklarına bağımlılığı azalttığı ve sürekli ve temiz enerji kaynakları olduğu için sürdürülebilir enerji için özel bir öneme sahiptir. Büyüme hipotezleri, enerji tüketimindeki bir artışın reel GSYİH'de bir artışa neden olduğunu ileri sürmektedir. Dolayısıyla bu çalışmada, reel GSYİH ile yenilenebilir enerji yatırımları arasındaki ilişki incelenmiştir. Yenilenebilir enerjinin küresel nihai enerji üretimine katkısı 2013 yılında% 8,5 iken, dünyanın birçok ülkesinde yenilenebilir enerjilerin yayılmasına yönelik teşvikler 2014 yılında% 19,1'den

2015'te% 23,7'ye yükselmiştir. Dünyada tüketilen enerjinin yaklaşık beşte biri (1/5) yenilenebilir kaynaklardan karşılanmaktadır. Yenilenebilir enerji tüketiminin payı genel olarak günümüzde yenilenemez enerjiye göre düşük kalsa da, yenilenebilir enerji kaynakları ile ekonomik büyüme arasındaki ilişki akademik çevrede sıcak bir tartışma olmuştur. Sorunun bu kadar önemli olmasının nedeni, dünyanın ekonomik nedenli, karşı karşıya kaldığı iki büyük sorundan kaynaklanmaktadır. Bunlardan ilki, sosyoekonomik kalkınma sorunuyken, diğeri ise küresel ısınma ve iklim değişikliği sorunlarıdır. Gelişmiş ve güçlü ekonomik yapılar, ekonomilerinde gerekli yapısal değişiklikleri yaparak ve diğer yandan uluslararası örgütler kurarak enerji sorununa çözüm bulmaya başlamış ve çeşitli planlar yaparak bu konuda önlemler almışlardır. Bu sebeplerden ötürü, enerji; sürdürülebilir kalkınmayı sağlamak için ekonomik kalkınmanın merkezinde yer alacaktır. Enerji sorununu çözemeyen ülkelerin ekonomik hedeflerine ulaşmaları ve sosyal dengelerini kurmaları mümkün değildir. Ülkelerin enerji ihtiyaçlarını yenilenebilir ve yenilenemeyen enerji kaynakları ile karşılamasına rağmen; dünyada yenilenemez enerji kaynaklarının dengesiz dağılımı, bu tür kaynaklara sahip olmayan ülkeler için yüksek tedarik maliyeti ve fosil yakıt rezervlerinin sınırlı olması, yenilenebilir enerjiyi hem gerekli hem de zorunlu kılmaktadır. Bu çalışmada, uzun vadede yenilenebilir enerji ve kişi başına düşen GSYH bir arada bulunup bulunmadığı incelenmektedir. Bunu yapmak için çalışmada temel olarak 4 adet araştırma sorusu ele alınarak, cevaplanmaya çalışılmıştır: "Reel GSYİH ile yenilenebilir enerji yatırımı arasında istatistiksel olarak anlamlı bir ilişki mevcut mudur?", "Mevcut ise, ilişki negatif midir pozitif midir?", "Yenilenebilir enerji yatırımlarının reel GSYİH üzerindeki etkisi ne kadar önemlidir?" ve son olarak "''Panel veri yöntemi, yenilenebilir enerji yatırımları ile reel GSYİH arasındaki ilişkiyi hesaba katmak için doğru bir yöntem midir?" Bu çalışmada uzun zamandır devam eden bir enerji-ekonomik büyüme ilişkisi konusu incelenmiştir. İlk olarak, bu ilişkinin teorik arka planı literatür inceleme bölümünde tanıtılmış ve tartışılmıştır. Daha sonra veri toplandıktan sonra bu ilişkiyi saptamak için panel veri modeli kullanılmıştır. Araştırma sorularını cevaplamak için öncelikle eşbütünleşme testine başvurulmuştur. Eşbütünleşme testi yapmak için de, kontrol değişkeninin yanı sıra işgücü, yenilenemeyen enerji, yatırım gibi yenilenebilir enerji ve kişi başına düşen GSYİH durağanlığı kontrol etmek için test edilmiştir. Bu nedenle, birim kök testi eşbütünleşme testinden önce uygulanmıştır. Panel birim kök testlerinde, öncelikle paneli oluşturan kesitlerin arasında bir ilişki olup olmadığı araştırılmış, bu noktada, panel veri birimi kök testleri, birinci ve ikinci nesil panel veri testlerine göre ayrılmıştır. Birinci nesil panel veri testlerinde kesitsel birimler arasında bir ilişki yoktur, ikinci nesil panel birim kök testleri ise kesitsel birimlerin birbiriyle ilişkili olduğu varsayılmaktadır. Bu nedenle, kesitsel bağımlılık testi yapılmış ve bu testin sonuçlarına göre birim kök testi uygulanmıştır. Eşbütünleşme testinden sonra, kısa ve uzun vadeli parametreler ortalama grup tahmincisi yöntemi ile tahmin edilmiştir. Bu çalışmadaki panel verileri de tipik olarak birkaç yatay bölümün zaman serisi gözlemlerini içeren verileri ifade eder. Bu nedenle, panel verilerindeki gözlemler en az iki boyut içerir; i ile gösterilen bölümün büyüklüğü ve t ile gösterilen zaman dizisi büyüklüğüdür. Hem ülkelerin hem de zaman serilerinin kesitleri mevcut olduğundan, panel veri analizi kullanımı uygun görülmüştür. Daha sonra veri toplandıktan sonra bu ilişkiyi saptamak için panel veri modeli kullanılmıştır. Panel veri analizinde, çok kutupluluk nedeniyle, yenilenebilir enerji ve yenilenemez enerji ayrı olarak ele alınmaktadır. Çalışmalar tekrar işaret etmiştir ki; enerji sürdürülebilir kalkınmayı sağlamak için ekonomik kalkınmanın merkezindedir. Bu çalışmada uzun zamandır süregelen bir enerji-ekonomik büyüme ilişkisi konusu irdelenmiştir. İlk olarak, bu ilişkinin teorik arka planı tanıtılmış ve tartışılmıştır. Daha sonra veri toplandıktan sonra bu ilişkiyi saptamak için panel veri modeli kullanılmıştır. Panel veri analizinde, çok kutupluluk nedeniyle, yenilenebilir enerji ve yenilenemez enerji ayrı olarak ele alınmaktadır. Sonuçlar, enerji ve GSYİH arasında istatistiksel olarak anlamlı bir ilişki olmadığını ortaya koymaktadır. Bu sonuç, daha sonraki çalışmalarda, üretim verileri yerine enerji tüketim verilerini içererek iyileştirilebilir. Ayrıca, ülke sayısı arttırılabilir ve zamana bağlı olarak zaman ufku uzatılabilir. Sonuç olarak, enerji kaynakları, yenilenemez ve yenilenebilir enerji arasında hiçbir ilişki olmadığı ve 1990-2016 dönemi için yatırımın ve işgücünün etkisini kontrol ettikten sonra bile GSYİH üzerinde etkisinin tespit edilmediği görülmektedir.

1. INTRODUCTION

Global warming and climate change have been increasing since the late 1900s, and the interest of the whole world, especially in developed countries, has been directed to the renewable energy. Parallel to this situation, in 1997, with the Kyoto Protocol, the importance of environmental cleanliness and sustainability was recognized by both developing countries and developed countries. According to this protocol, greenhouse gas emissions were targeted to be reduced by 5.2% between the years of 2008-2012. In addition, the protocol considered greenhouse gases, particularly carbon dioxide emissions, as the main causes of global warming, indicating that carbon dioxide emissions are the most polluting gas known and accounted for 58.8% of greenhouse gases worldwide. However, the protocol pointed to renewable energy sources as one of the most important solutions to climate change and increasing energy demand (IEA, 2011).

The environmental damage caused by fossil fuels and the fact that these fuels will be exhausted soon lead countries to find alternative energy sources. At this point, investments in renewable energy sources are increasing worldwide.

The negative effects of the energy bottlenecks in the 1970s on economic growth and the development of econometric methods have enabled empirical investigation of the issue. Four hypotheses were tested in empirical studies. In the literature, four different hypotheses are tested, those are hypothesis of growth, hypothesis of consumption, neutral hypothesis and feedback hypothesis. The growth hypothesis suggests that an increase in energy consumption causes an increase in real GDP.

Thus, in order to provide a well-founded empirical application to the renewable energy investment-real GDP relation, a panel data method is, in this study, utilized.

Panel data is defined as bringing together the horizontal cross-section observations of the units such as individuals, countries, firms and households in a certain period. Panel data consists of N number of units and T number corresponding to each unit (Gujarati, 2009).

The representation of the panel data methodology as the classical regression model is as follows:

$$y_{it}=a_0+ a_1x_{it}+e_{it}$$

where y_{it} dependent variable, x_{it} is the matrix of independent variables, and finally e_{it} is the random shock.

In this study, the association between real GDP and renewable energy investment are examined. To do that the following research questions are addressed:

- Is there a statistically significant relationship between real GDP and renewable energy investment?
- If so, is the relation negative or positive?
- How important is the impact of renewable energy investment on real GDP?
- Does the panel data method work well to account for the relationship between renewable energy investment and real GDP?

The remainder is as follows. In the second part, literature review is conducted. In the third and fourth part data and methodology is introduced. In the fifth part, panel data method is presented and in the sixth part empirical analysis is conducted. In the final chapter concludes.

2. LITERATURE REVIEW

Technically, energy is expressed as the ability to do business (Dolan et al., 2014: 8). The ability to do business contributes to the continuation and facilitation of vital activities by causing substances to move or change (Spurgeon and Flood, 2010: 4). As a matter of fact, the Industrial Revolution, which started in England in the second half of the 18th century and then spread to the USA and Europe in a short period of time, could be realized through coal which is the most important energy source of that period. The energy, which has become an indispensable element with the increase of the welfare levels and the development of countries, has ceased to be just an economic argument over time and has gained a very wide view by taking concepts such as diplomacy, law and geopolitics. At this point, energy production and consumption are considered as one of the most basic indicators of development (Sevim, 2012: 7).

The resources used to meet the energy needs are mainly; renewable energy sources and renewable energy sources are divided into two groups (Özşahin et al., 2016).

Renewable Energy sources:

- Solar
- Wind
- Geothermal Hydroelectricity
- Biomass
- Wave Energy

Non-renewable Energy sources:

- Crude Oil
- Natural Gas
- Coal

The IEA's Renewable Energy Working Group defines renewable energy as energy derived from continuously renewable natural processes. The concept of renewable energy is used for a wide range of energy sources such as wind, solar, geothermal, biomass, hydro and hydrogen. The local nature of renewable energy resources is of special importance for sustainable energy due to the fact that their countries reduce dependence on external energy sources and they are continuous and clean energy sources. For this reason, the contribution of renewable energy in global final energy production was 8.5% in 2013 while the incentives for the dissemination of renewable energies in many countries of the world increased from 19.1% in 2014 tp 23.7% in 2015. This situation shows that approximately one fifth of the energy consumed in the world (1/5) is met from renewable sources (Bayrac and Cildir, 2017).

Energy resources that cannot be fulfilled in a short time after being exhausted by their occurrences are defined as "Non-renewable energy sources". Coal in fossil fuels has been demanded as a heating source in the first stage, but has become a source of innovation with the steam engine. Since it was easier to transport and store as a liquid and generate much more heat per unit weight compared to coal, it has brought oil to the fore since the beginning of the 20th century (Montgomery, 2014: 28). During this time, the nuclear has also managed to enter the agenda of some countries as an important energy source. Especially After World War II, European states have turned to the nuclear to alleviate the problems caused by oil dependence and to reduce the environmental damage caused by the use of coal. In this context, the Treaty of Rome was signed in 1957 and the Atomic Energy Community (EURATOM) was established and Europe could not establish energy security with coal. On the other hand, the widespread use of natural gas in the world dates back to the 1960s (TMMOB, 2006: 32).

In the literature, it is accepted that natural resources used in energy production have a significant impact on the economic output. There are two main approaches: Supply and demand side.

Supply side approach: The effect of natural resources used in energy production on economic growth is investigated by traditional production function. The causality relationship between energy consumption and economic growth is analyzed using different country-country groups and different methods. The results obtained are generally intended to test the causal relationship. According to the findings, the other natural resources on the economic growth of renewable energy sources show that labor and capital are as much an effective production factor. This supports the proposal to give priority to renewable energy sources to combat global warming (Çınar and Yılmazer; 2015).

Demand side approach: In this approach components of renewable energy consumption are investigated. In these studies variables which are directed by renewable energy sources and their effects are discussed. The main factors determining the demand of renewable energy sources are;

• Political Factor: Public policies, tariffs, subsidies, quotas, R&D expenditures,

• Socio-Economic Factors: Income level, net energy imports, CO_2 emissions, fossil fuel prices, fossil fuel amounts in energy consumption,

• Country-Specific Factors: Renewable energy potential, deregulation activities in the electricity market, population growth, rapid urbanization, environmental policies and so on.

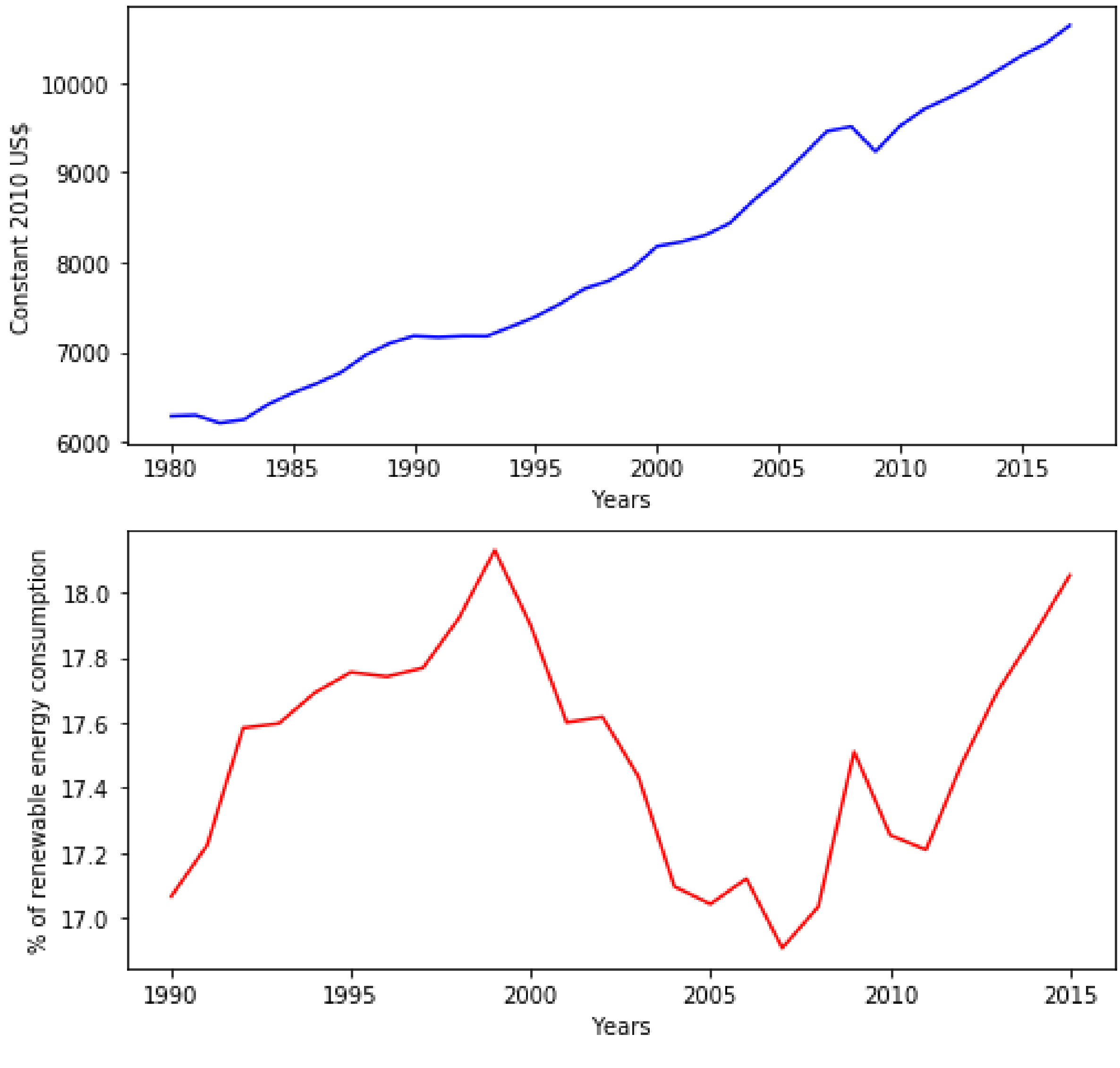
Fossil fuels have been widely used over the last two centuries, due to the fact that production technologies are highly developed and cheap. This environment has caused intense interest in renewable resources all over the world, and although oil prices fell in the mid-80s, the use of petroleum based energy was considered risky. The diversification of energy has become an indispensable element of energy policies due to the necessity of increasing oil and natural gas prices and energy security. These causes renewable energy sources to be included in the energy spectrum.

Another development that supports the development of renewable energy resources is the emergence of environmental consciousness in the 90s. This awareness has led to the understanding that traditional energy production and consumption have direct negative impacts on the environment and natural resources at local, regional and global levels, and that the renewable energy sources that do not give creative pollution to the atmosphere have been supported as clean energies.

The reason why the issue is so important is the two major problems facing the world, especially economic reasons. One of them is the problem of sustainable development which is a socio-economic problem and the other is the problem of global warming and climate change. Developed and robust economic structures have begun to find solutions to the energy problem by making necessary structural changes in their economies and by establishing international organizations on the other hand, and have taken measures by making some plans (Gilman, 1992).

The nexus between economic growth and renewable energy consumption is depicted below. Surprisingly, the percentage of renewable energy consumption with respect to total energy consumption has not changed so much 2000-2017. However, World GDP per capita has been constantly increasing over the same period. By eyeballing, it can be concluded that there is no clear-cut relationship between GDP per capita and renewable energy consumption.

Figure 2.1: GDP vs. Renewable Energy



Source: World Bank

Though the share of renewable energy consumption remains low, the association between renewable energy sources and economic growth has been a heated debate in academic circle. Pioneering studies investigating the relationship between energy consumption and economic growth are Kraft and Kraft (1978) and Akarca and Long (1980), respectively. These two studies were conducted in the same period and apply the same method, while former found a one-way relationship between income and energy consumption, the latter found no relationship between income and energy consumption. The different results of the results have brought the discussions and many studies have been done on this subject.

Fei et al. (2011) examined the relationship between the annual energy consumption and economic growth of 30 provinces in China with panel econometric methods based on panel unit root, panel cointegration and dynamic least squares (OLS). In the study, the whole economy is analyzed and 30 provinces are divided into two sub-regions, east and west. According to the results of the study, energy consumption in long term has significant effects on economic growth. In addition, a one percent increase in real GDP per capita increases energy consumption by about 0.48-0.50% and CO2 emissions by 0.41-0.43%. It is consistent with previous study results, which indicate a long-term relationship in both eastern and western China.

Wang et al. (2011) analyzed the relationship between carbon dioxide emissions, energy consumption and economic growth in 28 provinces of China using Panel co-integration, Panel VECM techniques using data from 1995-2007 period. There is a two-way relationship between energy consumption and economic growth.

Chen et al. (2011) analyzed the relationship between rural energy consumption and economic growth in the Chinese economy with econometric methods of Granger Causality and Impact Response Functions. In the study, data of 1980-2007 period, energy consumption in agriculture, forestry, animal husbandry and fishery industry are discussed. As a sign of rural economic growth, gross output values of farming, forestry, livestock and fisheries were taken. According to the study, rural economic growth directly affects rural energy consumption. In other words, the change in rural economic growth is not true, although Granger is the causal factor for rural energy consumption.

Qi et al. (2011) analyzed the relationship between energy use, environmental quality and economic development in Shandong province of China using the variables of total energy use, GDP and waste amount. According to the results of the study, economic growth in Shandong is largely dependent on natural resources. In addition, the relationship between per capita income and environmental quality was consistent with the reverse U-shaped Environmental Kuznets Curve theory.

Bowden and Payne examined the association between US economic growth and renewable and non-renewable energy consumption and found out that there is no causality between renewable energy consumption and real GDP in the commercial and industrial sectors. But it is not the case for residential renewable energy consumption.

Farhani (2015) examined the relation between causality between renewable energy consumption, economic growth and CO_2 between the periods of 1975-2008 in 12 MENA countries by panel cointegration technique. The Granger causality test explained that there is only one-way relationship between these variables in the short term from renewable energy consumption to CO_2. In the long term, one-way causality relationship from economic growth and $CO_2$to renewable energy consumption has been determined. Panel data analysis showed that CO_2emissions only affect renewable energy consumption.

Chontanawat (2008)'s article examining the relationship between energy and economic growth by using the data of over a hundred countries. It can be seen that the methods used to examine the relationship in question are listed as follows:

Firstly, the traditional methods were developed by Granger (1969) and Sims (1972). Most of these studies conducted in America and the time period spanned is 1950-1980.

In the second type of method, data ranges from 1950 to early 2000s were selected and developed and developing countries were the subject of these studies. Cointegration and error correction models (Granger, 1988) were used in many different studies.

Another method used in the literature cover the period of 1940s and 2000s and the selected countries are America, Latin America and many Asian countries. In these studies, the relationship between renewable energy sources and economic growth are investigated via Granger causality and Akaike (1970) uses Hsia’s Final Prediction Error technique.

Apart from these, Zachariadis (2007), which examines the economic growth and energy relationship in G7 countries by using bivariate models, mentions ARDL (Autoregressive

Distributed Lag-Delayed Sequential Connected Model-) and Toda-Yamamoto methods. In the case of small samples, the unit root and cointegration tests have been reported to be low, so that the use of methods that do not require stability and pre-testing of the cointegration have increased.

The studies can be categorized based on the results obtained, it is seen that it is possible to examine under 4 different headings. In terms of energy economy, it is possible to evaluate these four different cases in the literature (Sen, 2010).

1st Case: The one-way causality relationship obtained from energy consumption to economic growth is the result that the country is addicted to energy for development and that the energy saving policies to be followed affect the economic growth negatively. (Akinlo (2009), Narayan and Singh (2006), Stern (2000), Altinay and Karagol (2005), Sari and Soytas (2007)).

2nd Case: One-way causality from economic growth to energy consumption implies that the country is less dependent on the energy factor to grow and that energy-saving policies can be applied to the economy in a way that has little or no adverse effects on the economy. (Masih and Masih (1997), Chen and Lai (2002), Sari and Soytas (2006)).

3rd Case: Bi-directional causality relationship. It can be interpreted that both the country is dependent on energy to grow, and the growing economy will cause energy consumption increase. (Glasure (2002), Oh and Lee (2004), Yang (2000), Francis et al. (2007), Ghali and al-Sakka (2004), Paul and Battacharya (2004), Ang (2007)).

4th Case: If there is no causality relationship between economic growth and energy consumption, this is called neutrality hypothesis and it is concluded that the savings policies to be implemented do not affect economic growth. (Chiou-Wei et al. (2008), Sari and Soytas (2003), Karanfil and Jobert (2007), Altinay and Karagol (2004))

In this study, the log-linear specification takes the following form:

$$lnGDP_{it}=a_0+a_1lnGFCF_{it}+a_2lnLF_{it}+a_3lnRES_{it}+a_4lnNONRES_{it}+e_{it}$$

where $lnGDP_{it}$ is the logarithm of real GDP of country i at time t. $lnRES_{it}$ is the logarithm of renewable energy sources, $lnNONRES_{it}$ is the logarithm of non-renewable energy sources of country i at time t. And two control variables are used as $lnGFCF_{it}$ and $lnLF_{it}$ are the logarithm of gross fixed capital formation and labor force, respectively.

3. DATA

Jim and Kim (2018) propose a causality from the energy to GDP and suggest that even though there is no long term relationship between GDP and energy, there is a short-term association. Besides the model given below is suggested by Svenfelt et al., (2011), Shahbaz et al., (2015), and Jim and Kim (2018). In these studies, researchers use renewable and non-renewable energy together with the control variables provided below.

The control variables are employed so that we are able to better grasp the relationship between GDP and renewable and non-renewable energy. Because there are some other factors indirectly affect the relation. As Shahbaz et al., (2015) found that renewable energy consumption, capital and labour boost economic growth as well as feedback effect between economic growth and renewable energy consumption, gross fixed capital and labor force are the factor used to reveal the full-fledged relationship between GDP and energy.

Moreover, again these studies suggest log-linear function form due to the fact that log-linear form is better in capturing the relationship between GDP and energy resources.

In this study, the log-linear specification takes the following form:

$$lnGDP_{it}=a_0+a_1lnGFCF_{it}+a_2lnLF_{it}+a_3lnRES_{it}+a_4lnNONRES_{it}+e_{it}$$

where lnGDPit is the logarithm of real GDP of country i at time t. lnRESit is the logarithm of renewable energy sources, lnNONRESit is the logarithm of non-renewable energy sources of country i at time t. And two control variables are used as lnGFCFit and lnLFit are the logarithm of gross fixed capital formation and labor force, respectively. The data spans the period of 1990-2016.

Countries included in this study are as follows:

- Argentina
- Australia
- Brazil
- Canada
- China
- Denmark
- France
- Germany
- India
- Indonesia
- Japan
- Kenya
- Mexico
- Norway
- Pakistan
- Switzerland
- Russian Federation
- Turkey
- United Kingdom
- United States

4. METHODOLOGY

In this study, it is examined whether renewable energy and GDP per capita are cointegrated in the long run. In order to perform cointegration test, the renewable energy and GDP per capita series along with control variable, that is labor force, non-renewable energy, investment, are test to check the stationarity. Therefore, the unit root test should be done before the cointegration test. In panel unit root tests, it should first be investigated whether there is a relationship between the cross-sections forming the panel. At this point, panel data unit root tests are divided into first and second generation panel data tests. In the first generation of panel data tests, there is no relationship between the cross-sectional units, while the second-generation panel unit root tests assume that the cross-sectional units are related to each other. Hence, cross-sectional dependency test will be performed and unit root test will be performed according to the results of this test. After cointegration test, short and long term parameters will be estimated by means of mean group estimator (MGE) method.

Panel data typically refers to data containing time series observations of several horizontal sections. Therefore, observations in panel data contain at least two dimensions; the size of the section indicated by i and the time sequence size indicated by t. However, panel data may have a more complex clustering or hierarchical structure.

When the cross-sections of both countries and time series are available, panel data analysis can be used.

Panel data analysis, countries, firms, industries, households, etc. It combines cross-sectional observations within a certain period of time. The advantages of panel data analysis are as follows (Baltagi, 2005):

• Allows you to use more data than section or only time series data. Thus, the degree of freedom in the estimation increases and more effective prediction results are obtained.
• Panel data analysis not only takes into account the effect of observable effects on the dependent variable, but also examines the effect of unobserved or undetected effects on the dependent variable.
• In panel data analysis, the multiple connection problem between the variables is less common and therefore more reliable model results are obtained.

• Since the differences cannot be controlled in time series and section analysis, the results bear the risk of deviation. Individual differences can be checked in panel data analysis.

5. PANEL DATA METHOD

5.1. Fixed Effect Model

Fixed-effect panel data analysis is a way of uniting the variation between units, or the differences caused by differences between units and between time. This model assumes that the current change leads to a change in some or all of the coefficients of the regression model. Therefore, models that assume that the coefficients change over time in units are called Fixed Effect Models. The general formulation of the model assumes that differences between units can be captured by differences in the fixed term (Stock and Watson, 2003).

In the constant effects model, the fixed term is a linear regression model that varies between units. The fixed effects regression model has a different fixed term, one for each existing unit. These fixed terms can be represented by the display variables. These indicator variables include the effects of all excluded variables that vary from one unit to another but are fixed over time (Gujarati, 2009).

In addition, it is assumed that the mean of the error term is zero and constant variance. However, various assumptions are made about the model's constant term, slope coefficients, and error terms when estimating the model. Depending on the assumptions made, it is possible to estimate five different models. In these models (Judge et al., 1985):

- Both constant and slope coefficients do not change by unit and time
- The error term may represent differences between time and units.
- While the slope coefficients are constant, the fixed term varies by units, but may remain constant over time.
- While the slope coefficients are constant, the fixed term may vary by unit and time.
- Both constant and slope coefficients may vary depending on units.
- All coefficients vary depending on both time and unit.

5.2 Random Effect Model

In the fixed effect model, the degree of freedom decreases due to too many parameters in the model. However, this problem can be avoided if it is assumed that the individual effect is random. In this case, the error term has zero mean and constant variance and is distributed independently. It is appropriate to use the random effects model if the units are withdrawn from a large population (Baltagi, 2008).

Assumptions of the Random Effects Model (Baltagi, 1995):

- Panel data model is defined correctly.
- A random sample is taken from the horizontal section.
- X_{it} is external due to unit and / or time effects and is not associated with error terms.
- There is no complete multi-linear connection problem in the panel data model.
- The unit error variable and the residual error variable are fixed to constant variance.
- Error terms do not include autocorrelation.

5.3. Diagnostic Test

Before running Panel Data Analysis, stationarity and multicollinearity analysis were conducted within the scope of diagnostic tests.

Figure 5.1: Labor Force (% Total Population)

Figure 5.2: Investment (% GDP)

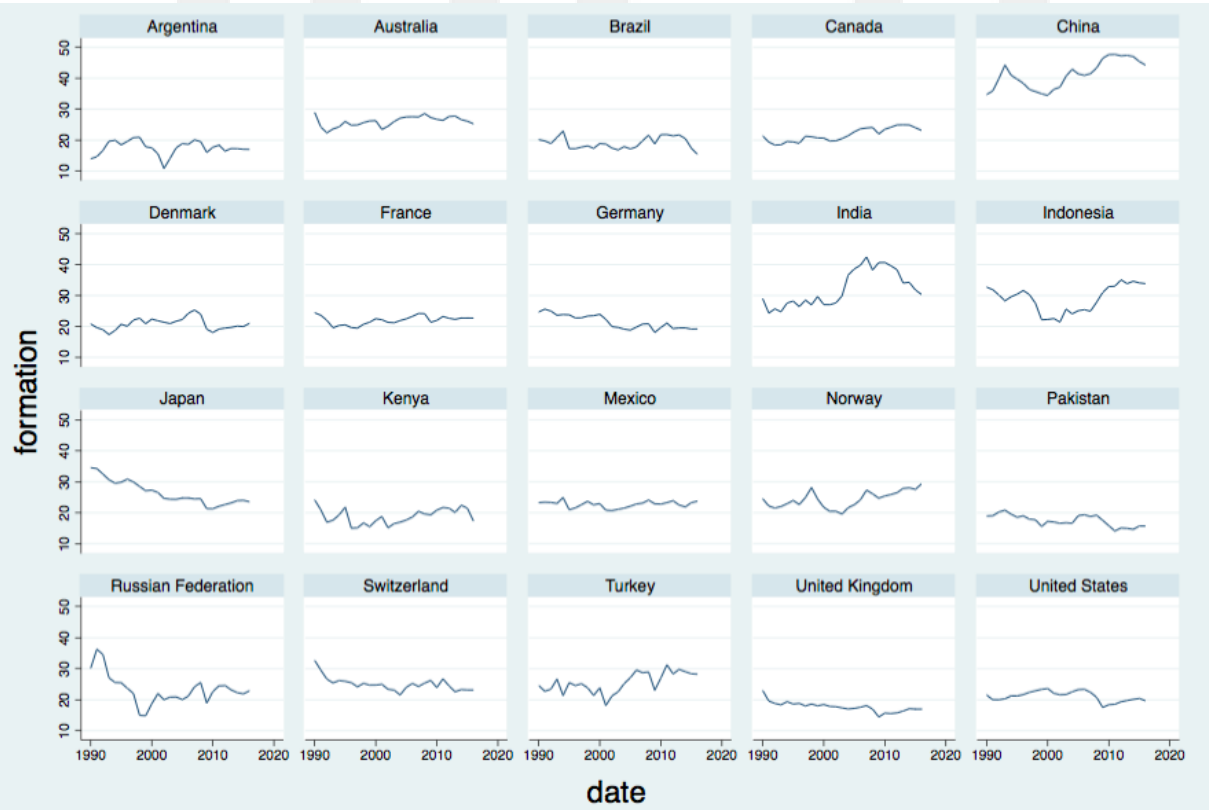


Figure 5.3: GDP per capita

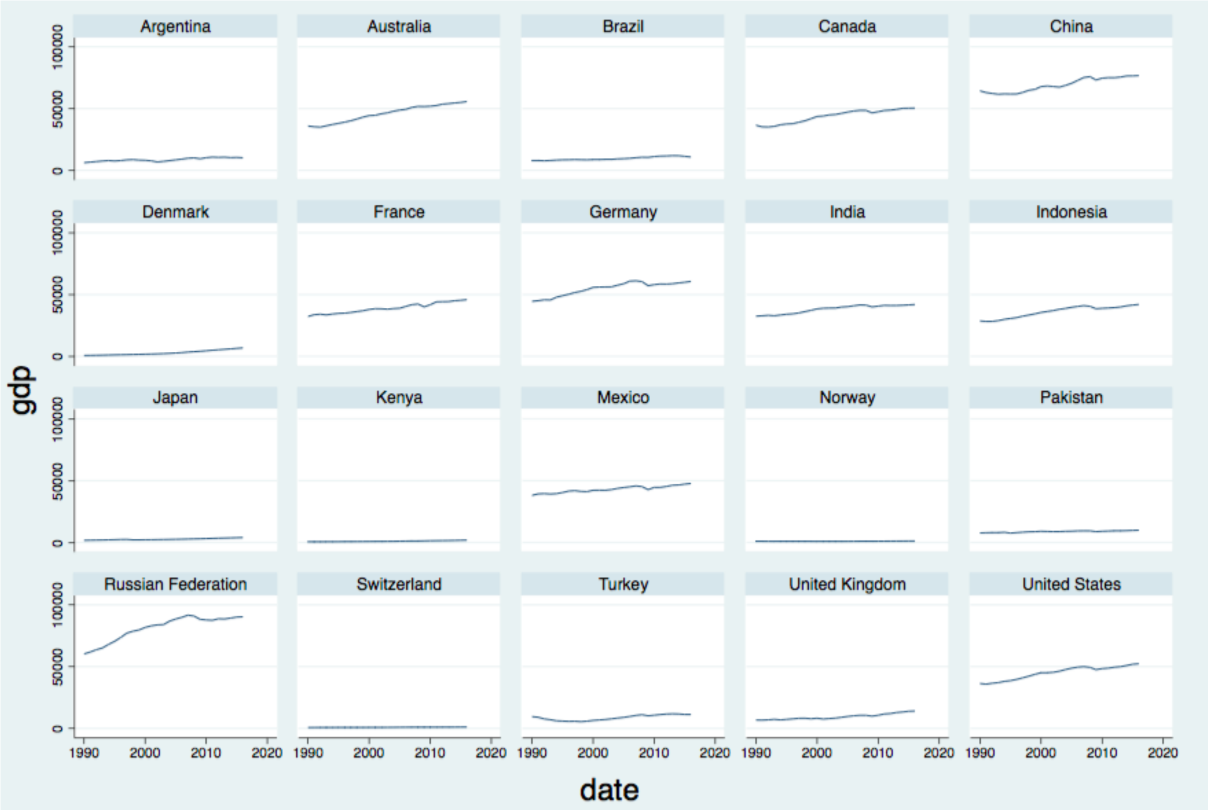


Figure 1.4: Renewable Energy

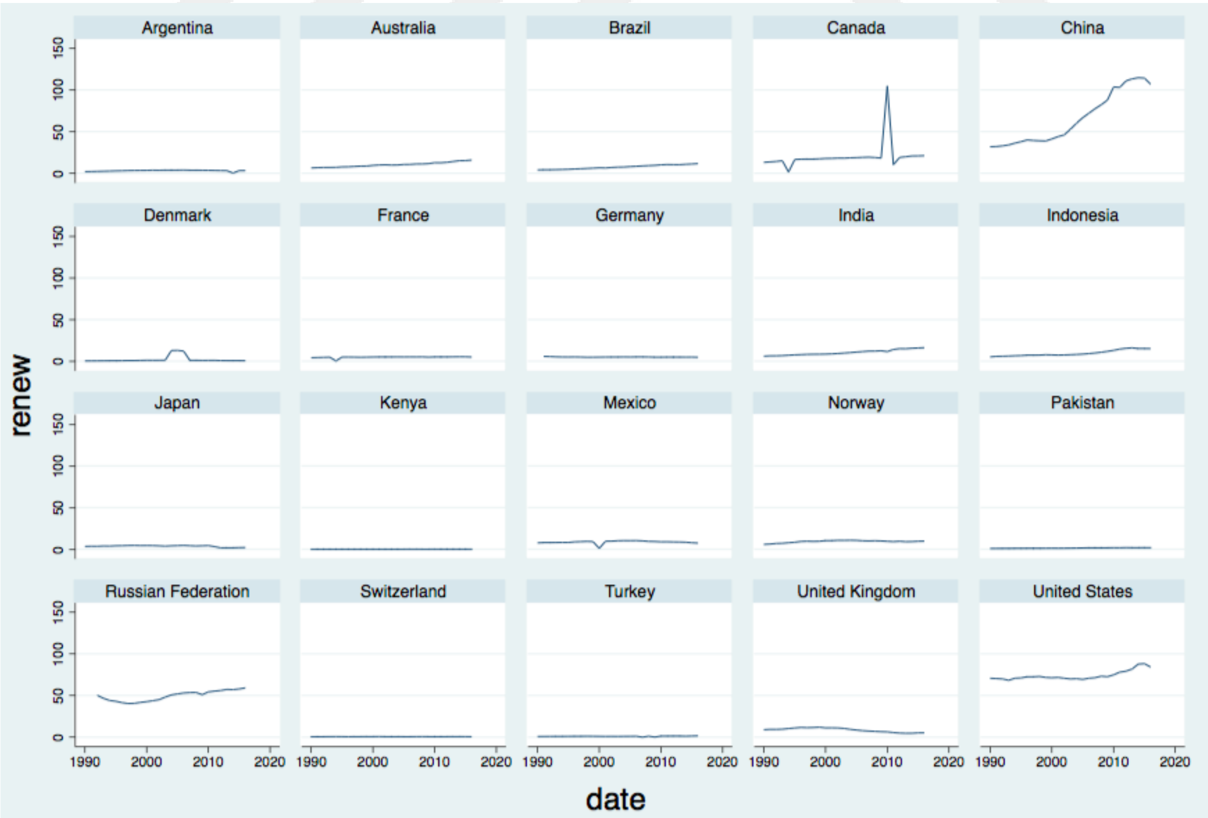
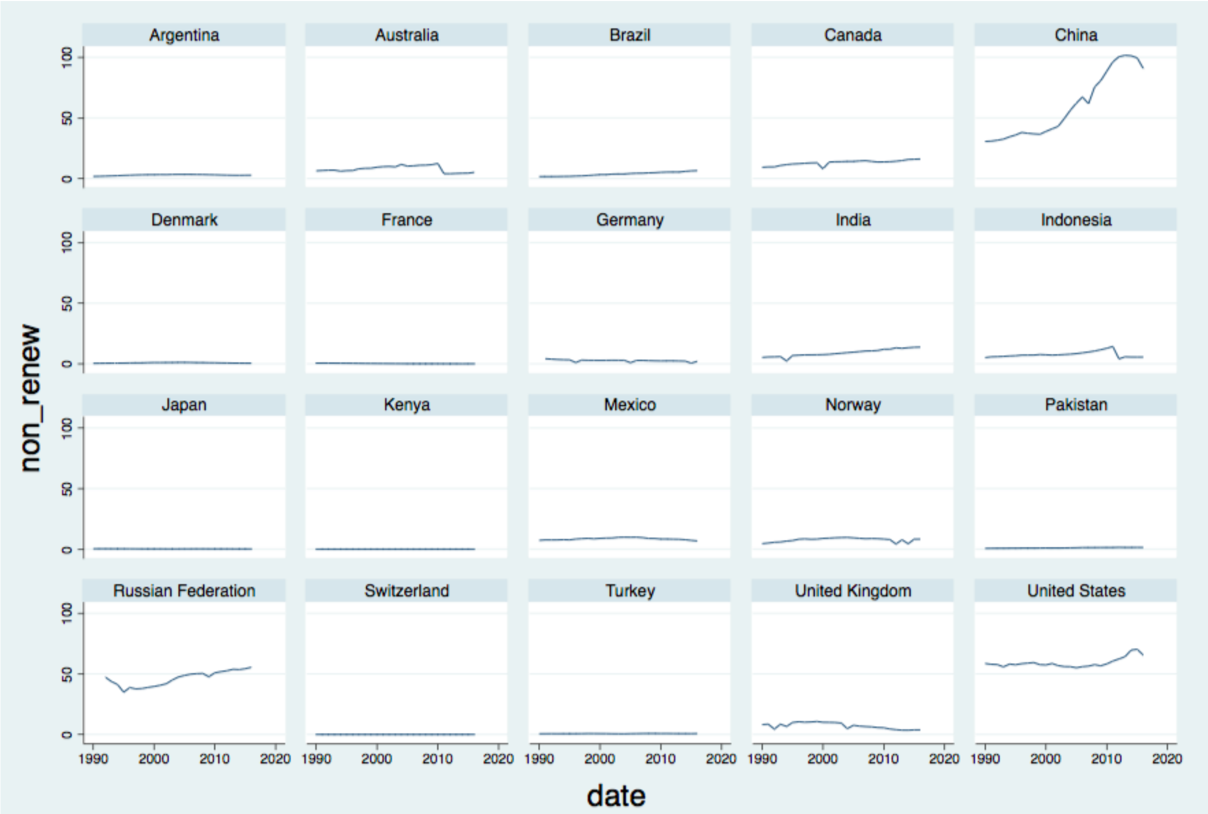


Figure 5.5: Non Renewable Energy



6. EMPRICAL ANALYSIS

6.1. Descriptive Statistics

The values used to compare one or more distributions and also summarize the frequency distributions by movement from sample data are called descriptive statistics. They are used to describe the data set and are generally used to summarize the data set taking all elements into account. It is close to the center point that can represent all the elements in the data set.

The main purpose of these statistical methods can be expressed as streamlining chaos. The main areas of use of such statistics are the classification of the data and the creation of summary tables and obtaining the measures of tendency and distribution.

Table-1 shows the descriptive statistics, that is mean standard deviation, minimum, and maximum. As can be seen, some observations are missing in renewable and non-renewable energy, Based on the result in Table-1, the mean of inflation is investment proxied by capital formation is 23.6 and standard deviation is 6.24. Whereas the mean and standard deviation of GDP per capita is much higher which are 27488 and 24719, respectively. This summary statistics shows that there is high volatility and maybe data includes some outliers.

Table 6.1: Descriptive Statistics

	Observation	**Mean**	**Standard Dev.**	**Minimum**	**Maximum**
Investment	540	23.6	6.24	10.85	47.6
Labor Force	540	53.8	10.9	33.01	47.6
GDP	540	27488	24719	530	91617
Renewable Energy	537	14.6	22.60	0.0115	114.79
Non Renewable Energy	537	11.7	19.5	0	101.62

6.2. Stationarity Analysis

It is common to observe that a variable increase or decreases over time. This increase or decrease recorded over time is an example of a non-stationary state. In the case of stationarity, standard errors may be bias and this leads to the statistical determination of the existence of an important non-existent relationship.

One of the most fundamental issues to be known in time series analysis is that the presence of unit roots can cause serious problems in the analysis. These problems:

• Spurious regression: In this case, high R^2 values can be obtained even if the data are uncorrelated.
• Improper behavior: For example, the t-ratio does not follow a t-distribution.

If the mean, variance and covariance of a time series remain constant over time, the series is said to be stationary. The difference between two successive values in a fixed time series results from the time interval, not the time itself. Therefore, the average of the series does not change over time. The most valid method used to determine whether a variable is static or the degree of stability is a unit root test. The unit root concept and unit root tests in macro-economic and financial time series are of great importance in terms of applied and theoretical researches (Hadri, 2000).

- *Mean:* $E(Y_t) = \mu$
- *Variance:* $var(Y_t) = E(Y_t - \mu)^2 = \sigma^2$
- *Covariance:* $\gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)]$

Since panel data models also include time dimension, first stationarity analysis should be performed. Some tests can be performed to determine if the series is stationary. The unit root test is one of the methods of testing the stationarity of the series by looking at whether the time series contains unit roots. Unit root tests are generally known to have low power at small sample widths, and the addition of a cross-sectional dimension to the time dimension to increase the strength of unit root tests is seen as a solution (Hurlin and Mignon, 2006: 2). As the number of observations increases, panel unit root tests are considered to be statistically stronger than time series unit root tests. (Im, Pesaran and Shin, 1997).

There are many tests that determine the existence of the unit root and this number is increasing every day. Panel data unit root test is applied because I have a panel data structure. One of the unit root tests commonly used in panel data with cross sectional dependence is developed by Im-Pesaran-Shin.

The null hypothesis of the test is that all the panels contain one unit of root and that the alternative hypothesis is that at least one panel is stationary. If the number of panels is finite, reverse Chi-square method is recommended (Choi, 2001).

Table 6.2: Stationarity Test

	Statistics	**p-value**	**Inverse Chi-square (After differencing)**	**p-value (After differencing)**
Formation	-2.2341	0.0007	215.2798	0.0000
Labor Force	-1.1615	0.9921		
GDP per capita	0.4519	1.0000		
Renewable Energy	-1.6306	0.8466		
Non Renewable Energy	-1.6516	0.4230		

6.3. Multicollinearity Analysis

The fact that the independent variables are highly correlated makes it difficult to measure the direct effects of the independent variables on the dependent variable. A variable that is associated with another variable, in part, measures the effect of the other variable. If the independent variables in a regression model are highly correlated, this is called multicollinearity.

In the case of multicollinearity, the overall effect of the independent variable on the dependent variable cannot be accurately determined. However, the total effect of the independent variables is clearly not possible due to the high correlation between the independent variables.

The apparent multicollinearity is problematic because it can lead to increased variance of regression coefficients and this can lead to the following results:

• Even if there is a significant relationship between the predictor and the dependent variable, the coefficients are not significant.

• For highly correlated estimators, the coefficients vary considerably from the sample to the sample.

• The removal of strongly correlated terms from the model has serious implications for the estimated coefficients of other highly correlated terms. Even the sign of the coefficients of strongly correlated variables can be incorrectly estimated.

As a general rule, the fact that the correlation between the independent variables is 80% or higher indicates the presence of the multicollinearity. In the presence of multicollinearity, variables that show high correlation cannot be put into the model at the same time.

Table-6.2 indicates that there is high correlation between nonrenewable energy and renewable energy which is 97 way higher than the general rule of thumb. Therefore, both renewable energy and non-renewable energy cannot be included in the analysis. They are separately handled.

Table 6.3: Correlation Table

	Labor	**Formation**	**Non Renewable Energy**	**Renewable Energy**
Labor	1.0000			
Formation	0.1565	1.0000		
Non Renewable	0.3108	0.4041	1.0000	
Renewable	0.3211	0.3781	0.9771	1.0000

Before moving to the Panel Data application, autocorrelation and heteroscedasticity of the model are tested. In order to test heteroscedasticity and autocorrelation, Modified Wald Test and conducted and Wooldridge test are conducted.

Modified Wald Test results given below shows that there exists heteroscedasticity:

Table 6.4: Heteroscedasticity Test

chi2 (19)	831.14
Prob>chi2	0.0000

Table-6.4 reveals the fixed effect model result. Accordingly, except for the investment variable, the estimated coefficient of the variables are not statistically significant. The estimated coefficient of investment is positive meaning that 1-unit increase in investment leads to an increase in GDP by 0.0009 and the estimated coefficient is significant at 5% level. In other words, though the magnitude of the estimated coefficient is not large, it is true to say that investment boost GDP and energy investment, to some extent, may be a part of this investment.

Similary, Wooldridge test indicates the presence of the autocorrelation:

Table 6.5: Autocorrelation Test

F(1, 19)	22.902
Prob>F	0.0001

To solve the problems of heteroskedasticity and autocorrelation it has been used a panel data estimator in Stata, which is “xtgls” and works as fitting panel data models by using GLS. This function gives the heteroskedasticity consistent errors and also solve the serial auto correlation problem. The sythax of xtgls is defined as follows:

xtgls depvar [indepvars] [if] [in] [weight] [, options]

In this case it has been used two different options at my model. First; panels(heteroskedastic), which means use heteroskedastic but uncorrelated error structure. This specifies a heteroskedastic error structure with no cross-sectional correlation. Secondly; corr(ar1) which means use AR1 autocorrelation structure. This specifies that, within panels, there is AR(1) autocorrelation and that the coefficient of the AR(1) process is common to all the panels.

“xtgls” fits panel-data linear models by using feasible generalized least squares. This command allows estimation in the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. In many cross-sectional datasets, the variance for each of the panels differs. In this data on countries, it is clear that units have variation of scale. Thus The heteroskedastic model is specified by including the panels(heteroskedastic) option. The limitation of a common autocorrelation parameter is rational when the individual correlations are almost equivalent and the time series are short. Since the restriction of a common autocorrelation parameter is here realistic, this allows us to use more information in estimating the autocorrelation parameter to produce a more reasonable estimate of the regression coefficients. In such matter the heteroskedasticity and serial correlation issues have been handled.

6.4. Panel Data Application

In this part of the study, the effect of energy on the GDP is examined by using Panel Data Method. To do that I first run panel data model and as multicollinearity is detected between renewable and non-renewable energy, they are separately included into the regression.

Table-6.6 indicates Panel Data Fixed Effect model including non-renewable energy. Based on the result, similar to the regression result with the renewable energy, only the estimated coefficient of investment variable is statistically significant at 10% level. The magnitude of the estimated coefficient and the level of statistical significance are even lower compared to the result given in the Table-4, the direction of the relationship between investment and GDP is kept. However, no relationship between energy and GDP is detected in this model as well.

Table-6.6 reveals the panel data application result. Accordingly, except for the labor force variable, the estimated coefficients of the variables are not statistically significant. Moreover, the sign of the estimated coefficient of renewable energy is positive indicating that an increase in renewable energy investment positively effect on GDP. The estimated coefficient of labor force is positive meaning that 1-unit increase in investment leads to an increase in GDP by 0.00151 and the estimated coefficient is significant at 5% level.

Table 6.6: Panel Data Fixed Effect Result

Variables	(1) d_log_gdp
d_labor	0.00151**
	(0.000733)
formation	-0.000270
	(0.000213)
d_renew	3.96e-05
	(0.000114)
Constant	0.0221***
	(0.00565)

Observations	517
Number of countries	20

Note: Dependent variable is differenced of logarithm of GDP per capita. Independent variables are differenced labor force, investment, differenced of renewable energy. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table-6.7 gives us the result of the panel data model with non-renewable energy. Accordingly, there is no statistically significant estimated coefficient but to interpret except for the labor force showing a positive association with the GDP per capita. Though no relation is detected, the sign of the estimated coefficient of non-renewable energy is positive implying that an increase in non-energy usage boost GDP per capita.

Table 6.7: Panel Data Method Result with Non-Renewable Energy

Variables	(1) d_log_gdp
d_labor	0.00176**
	(0.000733)
formation	-0.000139
	(0.000210)
d_non_renew	6.20e-05
	(0.000463)
Constant	0.0178***
	(0.00557)
Observations	491
Number of countries	19

Note: Dependent variable is differenced of logarithm of GDP per capita. Independent variables are differenced labor force, investment, differenced of non-renewable energy. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7. CONCLUSION

Energy is at the heart of the economic development to ensure sustainable development. It is not possible for countries that cannot solve the energy problem to reach their economic targets and to establish their social balances. Although countries meet their energy needs with two different vehicles, renewable and non-renewable energy sources; The unstable distribution of non-renewable energy resources around the world, the high cost of supply for countries without such resources, and the limited availability of fossil fuel reserves make renewable energy both necessary and compulsory.

In this study, a long-standing issue of energy-economic growth relation is investigated. Firstly, the theoretical background of this relation is introduced and discussed in the literature review section. Then, after gathering data, panel data model is used to detect this relation. In the panel data analysis, due to the multicollinearity, renewable energy and non-renewable energy are separately handled.

Results reveal that there is no statistically significant relationship between energy and GDP. This result can be improved in the further studies by including energy consumption data instead of production data. Moreover, the number of countries can be increased and based on the time availability, time horizon can be extended.

The bottom line is that no relationship between energy resources, that is non-renewable and renewable energy, and GDP is detected for the period of 1990-2016 even after controlling for the effect of investment and labor force.

REFERENCES

Altinay, G. and Karagol, E., 2004. Structural break, unit root, and the causality between energy consumption and GDP in Turkey. *Energy Economics*, *26*(6), pp.985-994.

Akarca, A.T. and Long, T.V., 1980. On the relationship between energy and GNP: a reexamination. *The Journal of Energy and Development*, pp.326-331.

Akinlo, A.E., 2009. Electricity consumption and economic growth in Nigeria: evidence from cointegration and co-feature analysis. *Journal of Policy Modeling*, *31*(5), pp.681-693.

Bayraç, H.N. and Çildir, M., 2017. AB Yenilenebilir Enerji Politikalarının Ekonomik Büyüme Üzerindeki Etkisi. *Uluslararası Yönetim İktisat Ve İşletme Dergisi*, *13*(5), Pp.201-212.

Bowden, N. and Payne, J.E., 2010. Sectoral analysis of the causal relationship between renewable and non-renewable energy consumption and real output in the US. *Energy Sources, Part B: Economics, Planning, and Policy*, *5*(4), pp.400-408.

Chen, Qiu ve diğerleri 2011. An Empirical Study on the Relations between Rural Energy Consumption and Economic Growth. Asian Social Science, 7 (10), 86-94.

Cheng, B.S. ve Lai, T.W., 1997: An investigation of cointegration and causality. Energy Economics. Sayı 19. pp. 435-444.

Chontanawat, J., Hunt, L.C. and Pierse, R., 2008. Does energy consumption cause economic growth?: Evidence from a systematic study of over 100 countries. *Journal of policy modeling*, *30*(2), pp.209-220.

Choi, I., 2001. Unit root tests for panel data. *Journal of international money and Finance*, *20*(2), pp.249-272.

Çınar, S. and Yılmazer, M., 2015. Yenilenebilir Enerji Kaynaklarının Belirleyicileri ve Ekonomik Büyüme İlişkisi: Gelişmekte Olan Ülkeler Örneği. *Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *30*(1).

Dolan, C.S., Ryus, C.R., Dopson, S., Montgomery, P. and Scott, L., 2014. A blınd spot ın gırls'educatıon: menarche and ıts webs of exclusıon ın ghana. *Journal of International Development*, *26*(5), pp.643-657.

Farhani, S., 2013. Renewable energy consumption, economic growth and CO2 emissions: Evidence from selected MENA countries. *University of Sousse, Tunisia*.

Fei, L., Dong, S., Xue, L., Liang, Q. and Yang, W., 2011. Energy consumption-economic growth relationship and carbon dioxide emissions in China. *Energy policy*, *39*(2), pp.568-574.

Francis, B. M., Moseley, L. ve Iyare, S.O., 2007: Energy consumption and projected growth in selected Caribbean countries. Energy Economics. Vol. 29, pp. 1224-1232.

Ghali K. H. ve El-Sakka, M.I.T., 2004: Energy Use and Output Growth in Canada: a multivariate cointegration analysis. Energy Economics. Vol 26, pp. 225-238.

Gilman, R., 1992. Sustainability, from the 1992 UIA/AIA. Call for Sustainable Community Solutions.

Glasure, Y.U., 2002: Energy and national income in Korea: further evidence on the role of omitted variables. Energy Economics. vol. 24, pp. 355-365.

Granger, C.W., 1969. Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society*, pp.424-438.

Gujarati, D.N., 2009. *Basic econometrics*. Tata McGraw-Hill Education.

Hurlin, C. and Mignon, V., 2007. Second generation panel unit root tests.

IEA (2011) “CO2 Emissions From Fuel Combustion: IEA Statistics”, https://www.iea.org/publications/freepublications/publication/WEO2011_WEB.pdf, (29.03.2018).

Karanfil, F. ve Jobert, T., 2007: Sectoral energy consumption by source and economic growth in Turkey. Energy Policy. Vol. 35, pp. 5447-5456.

Kraft, J. and Kraft, A., 1978. “On the relationship between energy and GNP.” Journal of Energy Development 3 (2): 401–403.

Masih, A.M. and Masih, R., 1997. On the temporal causal relationship between energy consumption, real income, and prices: some new evidence from Asian-energy dependent NICs based on a multivariate cointegration/vector error-correction approach. *Journal of policy modeling*, *19*(4), pp.417-440.

Narayan, P.K. and Singh, B., 2007. The electricity consumption and GDP nexus for the Fiji Islands. *Energy Economics*, *29*(6), pp.1141-1150.

Qi, Peng et al. 2011. Energy Utilization, Environmental Quality and Sustainable Economic Development: Evidence from Shandong Province in China. Energy Procedia, 5 (3), 314–321.

Wang, S.S., Zhou, D.Q., Zhou, P. and Wang, Q.W., 2011. CO2 emissions, energy consumption and economic growth in China: A panel data analysis. *Energy Policy*, *39*(9), pp.4870-4875.

Özşahin, Ş., Mucuk, M. And Gerçeker, M., 2016. Yenilenebilir Enerji ve Ekonomik Büyüme Arasındaki İlişki: BRICS-T Ülkeleri Üzerine Panel ARDL Analizi. *Siyaset, Ekonomi ve Yönetim Araştırmaları Dergisi*, *4*(4).

Pesaran, H.H. and Shin, Y., 1998. Generalized impulse response analysis in linear multivariate models. *Economics letters*, *58*(1), pp.17-29.

Sari, R. and Soytas, U., 2007. The growth of income and energy consumption in six developing countries. *Energy Policy*, *35*(2), pp.889-898.

Sevim, C., 2012. *Küresel enerji stratejileri ve jeopolitik*. Seçkin.

Sims, C.A., 1972. Money, Income, and Causality,'American Economic Review, LXII (September 1972), 540-52. In *Exogeneity and Causal Ordering in Macroeconomic Models." In New Methods in business Cycle Research: Proceedingsfrom a Conference. Edited by*

Christopher A. Sims. Minneapolis: Federal Reserve Bank of Minneapolis (Vol. 197, pp. 25-43).

Soytas, U. and Sari, R., 2006. Can China contribute more to the fight against global warming?. *Journal of Policy Modeling*, *28*(8), pp.837-846.

Spurgeon, Richard and Mike Flood (2010), Energy and Power, TÜBİTAK, Ankara.

Stern, D.I., 2000. A multivariate cointegration analysis of the role of energy in the US macroeconomy. *Energy economics*, *22*(2), pp.267-283.

Stock, J.H. and W Watson, M., 2003. Forecasting output and inflation: The role of asset prices. *Journal of Economic Literature*, *41*(3), pp.788-829.

TMMOB (2006), TMMOB Enerji Raporu 2006, Türk Mühendis ve Mimar Odaları Birliği, Ankara.

Yang, H., 2000: A note on the causal relationship between energy and GDP in Taiwan. Energy Economics. vol. 22, pp. 309-317.

Zachariadis, T., 2007. Exploring the relationship between energy use and economic growth with bivariate models: New evidence from G-7 countries. *Energy economics*, *29*(6), pp.1233-1253.

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- ✓ Coordinate and manage technical, commercial, legal and organizational project work packages
- ✓ Coordinate and execute customer specific configuration, payment scheme and infrastructure setup as well as testing activities and configuration within all SAP systems
- ✓ Preparation of and participation in customer presentations

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- 100% Merit Scholarship by ADVANTAGE AUSTRIA Istanbul
  - **Bachelor Degree in Economics**
  - **Minor in Social Economics,** Completed 30 credits toward Second Major

    Vienna University of Economics and Business Ranked 1st in German Speaking Countries by Handelsblatt / 13th in Economics by Financial Times Higher Education for University

July14-Sept14 **London School of Economics Summer School Program**

- Faculty of Economics - Summer School - Development Economics

2005-2010 **St. George's Austrian High School (Avusturya Lisesi)**

- Matura Diploma, 2010 (G.C.E. A-Level) Istanbul, Turkey

SKILLS: **Languages:** Native Turkish

- Advanced English (proficient: IELTS 7.0)
- Advanced German (proficient: Oesterreichische Reifeprüfung C1 Level)
- Elementary French (proficient: DELPH Diploma A2)

Technical: Microsoft Office (Word, Excel, Power Point, Outlook, Access), SPSS, E-Views, R-Statistics, Stata, SAP

INTERESTS: **Hobbies:** Swimming, Tennis, Chess, And Polaroid Photography

2013-2015 **Mentoring:** Economic Forum of Vienna University- Economic Development Mentorship with Finance Manager in Trade

Social activities:

2009-2010 Delegate at the Model European Parliament, Istanbul, Turkey

2008-2010 Vice President of Ethics Club St. Georg's Austrian High School