T.C.
SAKARYA ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ

THE SYMMETRIC AND ASYMMETRIC DYNAMICS OF ENERGY DEMAND IN TURKEY

YÜKSEK LİSAN TEZİ

Iqra AKRAM

Enstitü Anabilim Dalı : İktisat

Tez Danışmanı: Dr.Öğr.Üyesi Ünsal Ozan KAHRAMAN

NİSAN – 2019

T.C.
SAKARYA ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ

THE SYMMETRIC AND ASYMMETRCI DYNAMICS OF ENERGY DEMAND IN TURKEY

YÜKSEK LİSANS TEZİ

Iqra AKRAM

Enstitü Anabilim Dalı : İKTİSAT

"Bu tez 05/04/2017 tarihinde aşağıdaki jüri tarafından Oybirliği / ~~Oyçokluğu~~ ile kabul edilmiştir."

JÜRİ ÜYESİ	KANAATİ	İMZA
Dr.Öğr.Üyesi Ünsal Ozan KAHRAMAN	Olumlu	[signature]
Prof. Dr. Yusuf BAYRAKTUTAN	Olumlu	[signature]
Doç. Dr. Ali KABASAKAL	Olumlu	[signature]

	T.C. SAKARYA ÜNİVERSİTESİ SOSYAL BİLİMLER ENSTİTÜSÜ TEZ SAVUNULABİLİRLİK VE ORJİNALLİK BEYAN FORMU	Sayfa : 1/1

Öğrencinin

Adı Soyadı	:	**Iqra AKRAM**
Öğrenci Numarası	:	**Y156002027**
Enstitü Anabilim Dalı	:	**İKTİSAT**
Enstitü Bilim Dalı	:	**İKTİSAT**
Programı	:	☑ YÜKSEK LİSANS ☐ DOKTORA
Tezin Başlığı	:	**THE SYMMETRIC AND ASYMMETRIC DYNAMICS OF ENERGY DEMAND IN TURKEY**
Benzerlik Oranı	:	**8%**

SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜNE,

☐ Sakarya Üniversitesi SOSYAL BİLİMLER Enstitüsü Enstitüsü Lisansüstü Tez Çalışması Benzerlik Raporu Uygulama Esaslarını inceledim. Enstitünüz tarafından Uygulalma Esasları çerçevesinde alınan Benzerlik Raporuna göre yukarıda bilgileri verilen tez çalışmasının benzerlik oranının herhangi bir intihal içermediğini; aksinin tespit edileceği muhtemel durumda doğabilecek her türlü hukuki sorumluluğu kabul ettiğimi beyan ederim.

15../04../20.19
Öğrenci İmza

☐ Sakarya Üniversitesi .... Enstitüsü Lisansüstü Tez Çalışması Benzerlik Raporu Uygulama Esaslarını inceledim. Enstitünüz tarafından Uygulama Esasları çerçevesinde alınan Benzerlik Raporuna göre yukarıda bilgileri verilen öğrenciye ait tez çalışması ile ilgili gerekli düzenleme tarafımca yapılmış olup, yeniden değerlendirlilmek üzere ....@sakarya.edu.tr adresine yüklenmiştir.

Bilgilerinize arz ederim.

....../....../20.....
Öğrenci İmza

Uygundur

Danışman Doktor Öğr. Üy.
Unvanı / Adı-Soyadı: Ünsal Ozan KAHRAMAN

Tarih: 15.04.2019

İmza:

☐ KABUL EDİLMİŞTİR ☐ REDDEDİLMİŞTİR **EYK Tarih ve No:**	**Enstitü Birim Sorumlusu Onayı**

ACKNOWLEDGMENT

I have no words to express my deepest and infinite sense of gratitude to Almighty Allah, who knows all the things hidden or evident in this universe, who gave me the courage to complete this work. Countless salutations are upon the Holy Prophet Muhammad (peace be upon him) who enabled me to recognize my Creator and declared it to be an obligatory duty of every Muslim to acquire knowledge.

I feel highly privileged in taking the opportunity to express my profound gratitude and sense of devotion to my supervisor Dr. Ünsal Ozan KAHRAMAN from the Social Science department at SAKARYA UNIVERSITY. The door to Prof. KAHRAMAN office was always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently allowed this paper to be my own work but steered me in the right direction whenever he thought I needed it.

I am also very thankful to Dr. Aziz KULTAR, Head of Department. I express my sincerest appreciation for his assistance in any way that I may have asked.

I would also like to acknowledge Dr. Tomasz SCHABEK from the Institute of Finance at University of Lodz-Poland as the second reader of this thesis, and I am gratefully indebted to his precious time and for his very valuable comments on this thesis.

I am truly indebted to TURKİYE BRUSLERİ for giving me the opportunity to study in Turkey.

I want to thank my sincere friends, Syed Ikram Akbar, Ahmad Bakhtiyar, Waqar Saleemi, Raisal Fahrozi, Fatima Aziz, Batzorig Ganbold and Syeda Maryarm who have been very helpful and supportive to me during this entire journey in Turkey.

In the last, nobody has been more important to me in pursuit of this thesis than the member of my family. I offer my gratitude especially to my Parents, Sibling, Family, and Teachers whose prayers and inspirations is the torch to my destination.

Iqra AKRAM

TABLE OF CONTENTS

ABBREVIATION

ARDL **:** Autoregressive Distributed Lag

CO_2 **:** Carbon Dioxide Emission

CRBT **:** Central Bank of Turkey

FDI **:** Foreign Direct Investment

GDP **:** Gross Domestic Product

IEA **:** International Energy Agency

MENR **:** Ministry of Energy and Natural Resources

MMT **:** Million Metric Tons

NARDL **:** Nonlinear Autoregressive Distributed Lag

OECD **:** Organization for Economic Co-operation and Development

TcF **:** Turbine cubic Feet

LIST OF THE TABLE

LIST OF GRAPH

Sakarya Üniversitesi
Sosyal Bilimler Enstitüsü Tez Özeti

Yüksek Lisans X	**Doktora**
Tezin Başlığı: Türkiye'de Enerji Talebinin Simetrik Ve Asimetrik Dinamiği	
Tezin Yazarı: Iqra AKRAM	**Danışman:** Dr.Öğr.Üyesi Ünsal Ozan KAHRAMAN
Kabul Tarihi: 05.04.2019	**Sayfa Sayısı:** vii (ön kısım) + 67 (metin) + 7(ek)
Anabilim Dalı: İKTİSAT	

Bu çalışmanın amacı, doğrudan yabancı yatırım, sera gazı ve ülkenin büyüme oranı gibi çeşitli makroekonomik göstergelerin bir fonksiyonu olan enerji talebinin dinamikleri üzerinde ampirik bir analiz yapmaktır. Her ne kadar birçok araştırma, bu konuyu çeşitli ekonometrik tekniklerin uygulanmasıyla irdelemiş olsa da. Bununla birlikte, zaman serilerindeki ilerleme ve eşbütünleşme analizi, doğrusal olmayanlığın etkilerini kontrol etmemizi sağlayacaktır. Bu nedenle, bu çalışma Shin, Yu ve Greenwood-Nimmo tarafından (2014: 281) yeni geliştirilen Doğrusal Olmayan Otoregresif Modelin (NARDL) uygulanmasıyla ekonomik değişkenlerde doğrusal olmayanlığın ortaya çıkmasının bu konuyla ilgili bir yenilik sağlayabileceğini sormuştur.

1980-2015 arasında bir dönem almayı ve doğrusal ve ilgili doğrusal olmayan bir Autoregressive Distributed Lag (ARDL) eşbütünleşme ve hata düzeltme metodolojileri uygulamayı önermekteyiz. Enerji talebinin açıklayıcı değişkenlerinin pozitif ve negatif kısmi toplam ayrışmaları ile doğrusal olmayanların gösterilmesidir.
Değişkenlerin durağan seviyesini kontrol etmek için ADF ve PP birim kök testi uygulanmış ve karma düzen eşbütünleşme bulunmuştur. Optimal gecikmeyi kontrol etmek için gecikme uzunluğu kriterleri uygulanmıştır. NARDL testinin ampirik sonuçları, DYY'nin kısmi olumlu toplamının enerji talebi ile pozitif ilişki içerdiğini gösterirken, negatif kısmi toplamın enerji talebi ile ters ilişkisi olduğunu göstermektedir. Hem pozitif hem de negatif kısmi toplam tutarı GSYİH ve CO_2 emisyonu, enerji talebi ile doğrudan ilişkilidir. Uzun süreli NARDL sonuçları, değişkenler arasındaki asimetrik eksiklikleri gösterirdir. Ayrıca, ARDL bağlı testi, değişkenler arasında uzun süreli eşbütünleşmenin çıktığını göstermiştir. Sonuçlar, DYY'nin hem kısa vadede hem de uzun vadede enerji talebi üzerinde olumsuz etkisi olduğunu göstermiştir. Ancak GSYİH ve CO_2 emisyonunun kısa vadede ve uzun vadede enerji talebi ile pozitif ilişkisi vardır. Sonuçlar, Hükümet'in yabancı yatırımcıları çekmek, enerji yoğun projeleri taklit etmek, enerji ithalatı bağımlılığını azaltmak, yerli kaynakların kullanımını arttırmak ve iklim değişikliği ile başa çıkmak, yenilenebilir kullanımı artırmak için ülkedeki kanunun ve düzen koşullarının iyileştirilmesi gerektiğini ileri sürdü. CO_2 emisyonlarını çevreden azaltmak için enerji kaynaklarıdir.

Anahtar Kelimeler: Enerji Talebi, Doğrusallık, Doğrusal Olmayanlık, Büyüme

Sakarya University
Institute of Social Sciences Abstract of Thesis

Master Degree X **Ph.D.**	
Title of Thesis: The Symmetric and Asymmetric Dynamics of Energy Demand in Turkey	
Author of Thesis: Iqra AKRA	**Supervisor:** Assist. Prof. Ünsal Ozan KAHRAMAN
Accepted Date: 05.04.2015	**No. of Pages:** vii(pre-text)+67(main body) + 7(app)
Department: Economics	

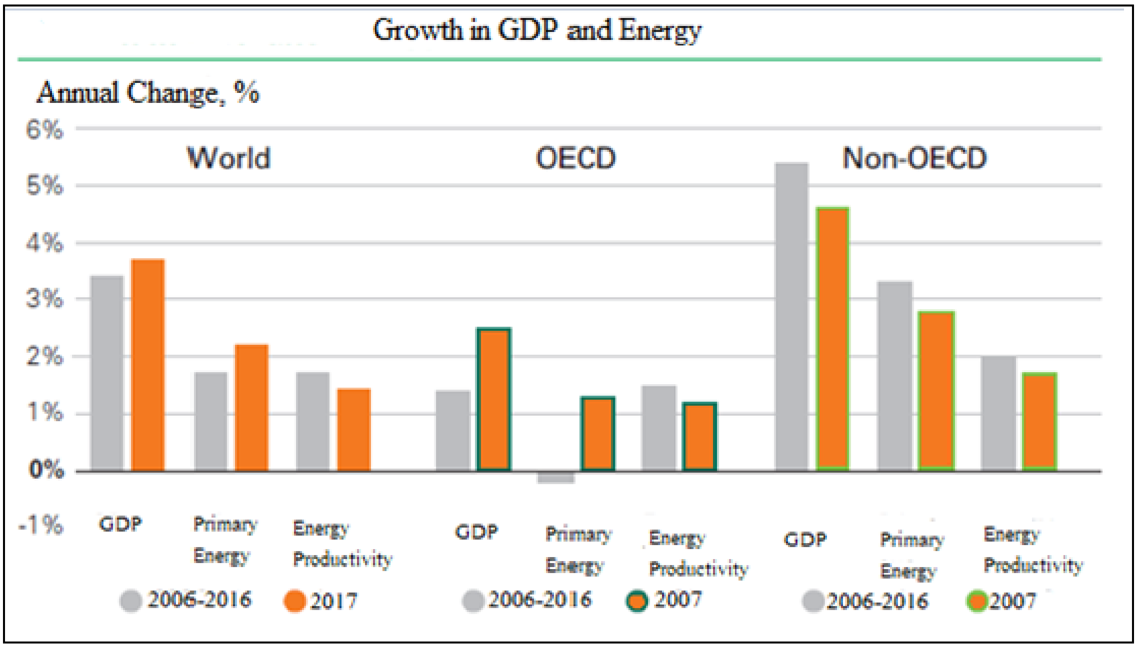
The purpose of this research is to carry out an empirical analysis of dynamics of energy demand, which is a function of several macroeconomic indicators such as direct foreign investment, greenhouse gases and the economic growth of the country. Although plenty of studies have scrutinized this issue through the application of several econometric techniques. However, progression in time series and cointegration analysis will allow us to check the effects of non-linearity. Therefore, this study asked whether the emergence of nonlinearity in the economic variables through the application of the newly developed Non-linear Autoregressive Model (NARDL) founded by Shin, Yu, and Greenwood-Nimmo, (2014:281) could provide a novelty on this subject.

We propose to take a period from 1980-2015 and applying a linear of Autoregressive Distributed Lag (ARDL) bound model and correspondingly nonlinear class of cointegration i.e. NARDL methodologies. To demonstrate the nonlinearities of the explanatory variables of Energy demand, the positive and negative partial sum of decompositions generated. To find out stationarity of data ADF, PP and Kim Perron ADF unit root test has been applied and results indicated that our model has mix order cointegration. To check the optimal Lag length criteria AIC and SIC criteria have been applied. The empirical results of NARDL test indicate that partial positive sum of FDI has a positive relationship with energy demand while negative partial sum has an inverse relationship with energy demand. Both positive and negative partial sum of GDP and emission of CO2 has direct relationship with energy demand. The long-run NARDL results indicate the absences of asymmetric between variables. Further, the ARDL bound test showed that long-run cointegration exits among the variables. The results showed that FDI adversely affects both long and short-term energy demand. However, GDP and CO2 emissions have a positive relationship with energy demand both in short-term and long-term. Results have suggested that Government should improve the law and order condition in the country to attract the foreign investors, imitates energy-intensive projects, reducing the energy imports dependency, increasing the usage of domestic resources and coping with climate change. Furthermore, Government should increase the usage of renewable energy in production and domestic consumption in order to decrease the emission of carbon dioxide in the environment.

Keywords: Energy demand, Nonlinearity, Linearity, Growth, FDI

INTRODUCTION

There is a vast majority of reasons behind the importance of research on energy demand in developing countries. In 2017, global energy demand increased by 2.2% exceeding the 10-year average of 1.7% from 1.2% last year. The growth of the above trend is driven by the OECD (Organization for Economic Co-operation and Development), particularly from the European Union. Despite tremendous strong growth in the OECD, much of the world's energy consumption comes from developing countries, which is accounts for almost 80% of growth. Shown in below Graph 1. (Nguyen-Van: 2008, IEA: 2017:13, BP Statistical Review, 2017: 3).



Graph 1. Growth and Energy of World, OECD and Non-OECD countries
Source: BP Statistical Review 2017

Energy is considered as a lifeline for the economy, and the most important tool of economic growth (Sahir and Qureshi, 2007: 2031). In traditional economic growth models, labor and capital utilization is considered to be a crucial factor of production, disregarding the fact that energy is also an important determinant in production process. (Stern and Cleveland, 2004, Oh and Lee, (2004a: 51,2004b: 971), Ghali and El-Sakka, (2004: 225). After the two largest oil crisis, the 1973 oil embargo and the excessive increase in oil prices in 1979 awakened the importance of energy among people, and people started considering energy as a major factor of production. From that moment on to today, in production function, energy is incorporated as a production factor (Ertuğrul, 2013: 252). Along with the capital and labor energy is an imperative factor of production on the resource side of economy. In the production of all goods, energy is required because the entire production process contains the transformation and development of goods. Ergo, an increase in the consumption of energy plays vital role in economic expansion. In contrast, on the demand side of economy, households consume energy as one of the products to maximize their utility level. Hence improving the standard of living of the population may lead to elevated usage of energy- intensive goods and services, such like electronic home appliances, and wireless communications. Due to this reason, higher demand for these goods and services increases energy use among humans. With rapid rise in world population, developments in the industrial sector, urbanization and trade development, there has been an increase in energy demand (MENR, 2010: 1). It is expected that the population of world will reach 9 billion by 2040. (IEA, 2017). This leads to the necessity of providing more energy to human beings.

The study comprises of three chapters. In the first chapter, Turkey's strategic location and value in the global energy context, major energy challenges will be explained. In addition, the macroeconomic factors such as FDI, GDP and greenhouse gases specifically CO2 affecting energy consumption in Turkey will be examined. The second chapter will review the previous studies mentioned. In the third part of the study, theoretical information of the applied unit root test (ADF and PP tests), cointegration tests i.e. ARDL model and NARDL model will be enlightened. Moreover, the results obtained from the applied econometric analysis will be explained and interpreted. The last section presents conclusion and policy recommendation.

Importance of the Study

Several researches have inspected the link of energy demand with various independent variables, for example energy price, foreign direct investment, employment, economic growth, income and population. We examine the dynamics of energy demand, which is the function of foreign direct investment, growth and greenhouse gases emission and examined the linear and non-linear short-term and long-term consequence of the explanatory variables to energy demand. Majority of research on this issue has been conducted in linear framework in this study. This study underlines the need to observe more closely towards the issue of cointegration between energy consumption and other potential variables with regard to asymmetrically cointegrating relationship.

Problem Statement

There is a growing recognition to check the Asymmetry and other forms of non-linearity among economic variables. Since traditional econometric models failed to incorporate the asymmetric effects. Non-linear Autoregressive Distributed Lag (NARDL) to check long-run and short-run asymmetries and capture asymmetries in dynamic adjustment at the same time which was developed by Shin, Yu and Greenwood-Nimmo, (2014:281). As non-linearity is a real phenomenon and give a result more accurately to understand the real economic world. Therefore, this study explores both long and short-term relationship of macro-economic variables of the energy demand. As Energy demand, determine by the number of economic variables such as Foreign Direct Investment, Carbon Dioxide, and GDP.

Objectives of the Study

It is a fact that everyone knows that above-mentioned economic variables are one of the core determinants of Energy Demand. So moving on further, we have the following objectives, which we are to achieve from this study.

- To explore the symmetric and asymmetric both long and short term relationship of Energy Demand.
- To gauge out which variable is most affecting the energy demand.
- To highlight the significance of non-linearity.

Research Questions

- What is the causal dynamic relationship of energy demand, FDI, CO2 and GDP in Turkey?
- Does foreign direct investment increase or decrease Energy demand in Turkey?
- Does decrease in the CO2 emission lead to elevation of Energy demand?
- What extent economic expansion will lead to increase in Energy demand in Turkey?

Methodology

Time series data from 1980-2015 has been taken from World Bank Indicator. To determine symmetric and asymmetric cointegration, Auto Regressive Distribution Lag (ARDL) and Non Linear Auto Regressive Distribution Lag (NARDL) applied.

Limitations of the Study

This study has been conducted on macro level of a single country and used the data set from 1980 to 2015. This study has tried to cover major variables that effect energy demand directly but still there may be some variables that have not been used in this study due to data limitations and econometric technique limitations. Future research on this topic can be conducted on sector wise energy demand or group of different countries (Panel analysis).

CHAPTER 1. ENERGY SITUATION IN TURKEY

In this first part of the study, explain energy market of Turkey, the basic concepts related to energy demand and foreign direct investment, economic growth and green gas emission will be explained in order to clarify the concepts that will be mentioned in many parts of the thesis.

1.1. Turkey's Strategic Value in the Global Energy

Due to the difference in income level, geographical position and availability of natural resources, growth, and energy consumption trends vary across the countries. Compared to the countries with low and middle income, high-level income countries require comparatively more utilization of energy in transportation, commercials and industrials sector. On the contrary, developing countries at an early stage of industrial development are experiencing a vast demand for energy. Analyzing the global demand for energy, the largest contribution to the growth in energy demand comes from Asia, specifically from India (IEA, 2017). Asia's developing countries generally account for two - thirds of the world's energy growth, with the rest mainly coming from the Middle East, Africa and Latin America.

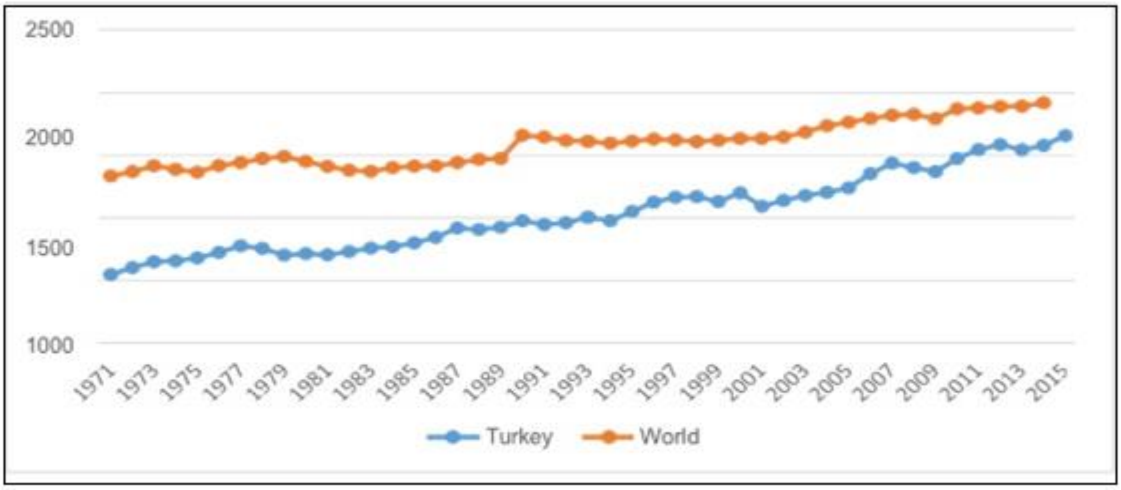
Turkey being a transcontinental country between Asia and Europe has a very significant geographical status. As one of the oldest countries in the region, it has a strong historical, culture and economic impact on neighboring countries and has multidimensional significance in the energy scene of the region. Geographically, Turkey is located among the region, which produces more than 75% of the world’s energy obtained from gas and oil reserves. Turkey is one of the high-energy consuming region. The geo-strategic role of Turkey as a transit country can open the way for it to become the energy hub of continental Europe. Turkey works as a bridge between them energy needy west and the energy abundant east. It is convinced that Turkey needs to strongly emphasis on this unique role that nature has given geostrategic location.

Secondly, during the recent decades, Turkey successfully developed the energy consumption potential (Ediger, 2003:2991). Turkey is prospective to experience the quickest medium to long term growth in energy demand amongst its member states (Energy policies of IEA, Country review, 2016:25). For this reason, in regards to the energy sector of the world Turkey is considered as one of the most important emerging country. Importance of Turkey in the global energy sector is not only influenced by the strategic location, but it is also dependent on the performance of economic growth. It is resulted by ongoing reform efforts for more than 20 years. Among all the member countries, Turkey is regarded as one of the EU and OECD's fastest-growing economies. Statistics from the last 15 years demonstrate that it is one of the few countries whose population growth, urbanization and industrialization supports the sustained economic growth. The main objective of Turkey's energy policy defined as, “similar with other countries, with a special emphasis on sustainable development, economic and social development to support and taking into account environmental issues, the price competitive, ensure an adequate and reliable energy supply". The First National Communication on the Framework Convention underlines this objective for Climate Change. Among OECD countries, Turkey has the topmost position in energy demand for almost one and half decade (Turkey’s Energy Profile and Strategy 2016). In 23 World energy congress (Istanbul, 2016) remarked that Turkey's energy demand will double over the next decade, requiring a minimum investment of 100 billion dollars.

Turkey is also a founding member of many international organization such as OECD , G-20 countries and many other trade organizations namely WTO (World Trade Organization), BSEC (Organization of the Black Sea Economic Cooperation), European Union Customs Union, ECO (Economic Cooperation Organization), and D-8 (Developing Eight) which implies that Turkey hold great position in Asia and Europe.

1.2. Turkey’s Energy Situation and Major Challenges

Turkey is home to a constantly growing population, rapid urbanization, low per capita electricity consumption, and home to one of the strongest economic growth, has been fast-growing energy markets in the world (Topçu and Ülengin, 2004: 137). Graph 1. Shows the world and Turkey’s energy consumption pattern from 1971-2015. According to the Graph, the change in world energy consumption is continuously increasing. However, Turkey’s energy demand is illustrated by the economic situation changes. The most important indicator of this is the decline in energy demand in 1999, 2001 and 2009. In other years, Turkey’s energy demand with the world's energy demand is high in the visible increase level.

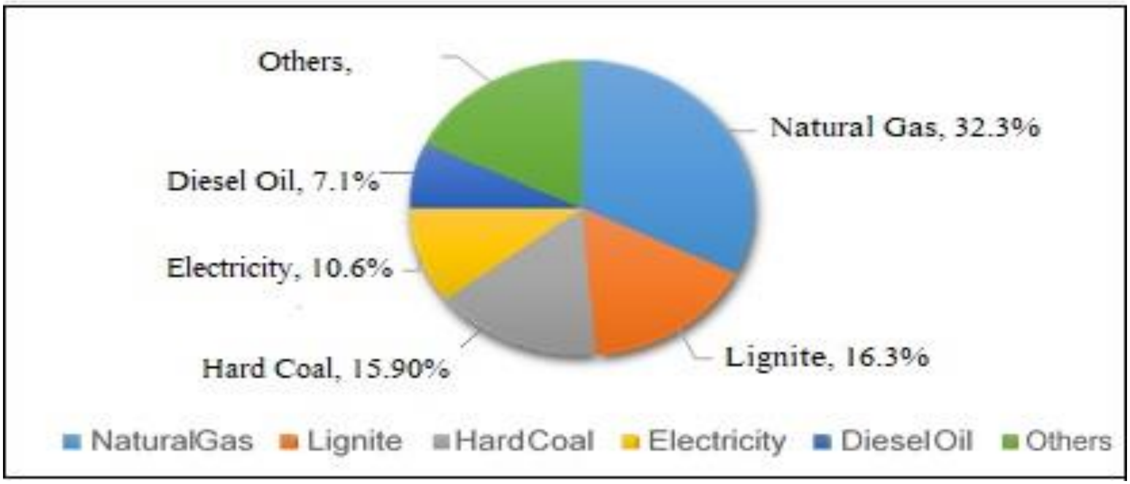


Graph 2. Consumption of Energy (kilogram of oil equal per capita)
Source: World Bank

Turkish energy systems are facing three major problems noted as (Çamdalı and Ediger, 2007:251):

1. Too much reliance on outer sources of energy
2. The energy consumption is dominated by fossil fuels, which was 87.59% of the total energy in 2015 (World Bank)
3. Relative to the other countries, Turkey faces low energy efficiency

Obviously, Turkey's future achievement will depend on the development and implementation of a sound energy policy to address these problems. Turkey ranked 35 number on the world's primary energy consumer with a total share 1.0% in 2016 (BP World Energy Statistical Review, June 2017). The current energy consumption composition of Turkey indicate in the Graph.3, shows that is 32.3% of natural gas, 16.3% of lignite, 15.9% of hard coal, 10.6% of electricity, and 7.1% of diesel oil 17.8% and others including aviation fuel, oven coke, gasoline etc. (TURK STATA, 2015).



Graph 3. Turkey's Energy consumption composition

Source: TURKSATA, 2015

Turkey's consumption of primary energy in 2016 was about 137 mtoe, of which domestic sources contributed around 26.7 mtoe of its total demand and 73.8 mtoe of energy was met from net-imports. The largest import of Turkey in 2016 was LNG (liquified natural gas), natural gas and oil, in which the country spent 198.6 billion dollars.

Considering the major three problems, Firstly Turkey greatly relies on costly energy imports, which expose the country to heavy burden. The country imports a large part of its oil from two countries - Azerbaijan and Iraq. Together, the two countries annually supply about 120 million tons of crude oil to Turkey, of which about 71 million tons coming from two pipelines in Iraq. (Botaş, Annual report 2015:12). In 2016, oil consumption in the domestic market was about 42 million tons, increasing from 38 million in 2015. The rest of this oil is sent to European energy markets. Ankara also sells back refined crude oil to Iraq. Despite the fact that Turkey is bordered by oil-rich countries, it is not well known for its own oil fields. In 2016, Turkey domestically drilled 2.6 million tons of oil per year from the southeastern Batman province (MENR).

Natural gas is one of the most consuming sectors in Turkey and its demand has been rising. However, domestic production of natural gas cannot fulfill the required demand and only contributed 1% of the total demand in last year. There are four gas pipelines operating in Turkey, two of which are coming from Russia, and are the largest natural gas supplier in Turkey, pumping 53% of total consumption in 2016. The other two gas pipelines are coming from Iran and Azerbaijan, providing 31% of total demand last year. (MENR). Ankara has signed a contract for the construction of two new pipelines - the Anatolia gas pipeline project (TANAP) and the TurkStream gas pipeline project. At the end of 2016 Turkey and Russia agreed to build of TurkStream, which would run from Russia across the Black Sea to a receiving terminal on the Turkish coast, about 100 kilometers west of Istanbul. The controversy between Russia and Ukraine, the countries of Eastern Europe, which is on the way to Europe through the Black Sea, has prompted Moscow to contract a gas supply to reach the European market through Turkey.

Recently Turkish lira currency crisis also raises the question: How will Turkey pay for its dependence on imported oil and natural gas? As turkey is one of the largest importer of fuels among the neighborhood countries. Depreciation in lira makes paying these imports even more expensive. Simultaneously, there is also rapidly decline in current account to pay for imported energy and supports all its foreign exchange requirements, especially among those Turkish companies that have heavily borrowed in the US dollar. Turkey's energy demand can also affect the global oil market and cause more concern about growth and trade tensions. According to the US Energy Information Administration, Turkey's oil demand is about 1% of global demand and it is one of the fastest-growing oil and gas consumers among the OECD member countries in 2010-2016.

A decline in the exchange rate means country economy will reevaluate. Consumers turns to use local products instead of expensive imports. However, according to the senior investment manager named Viktor Szabo employed at Aberdeen Standard Investments, Turkey can solve the problem only over a long period because a country cannot produce large quantities of energy quickly and cheaply at home.

Secondly, Turkey satisfied most of the energy requirements by excessively consuming fossil fuels. Because of using fossil fuels in the production of energy, severe environmental issues were sustained to the country. According to the MENR in July 2017, natural gas contributed 34% of electricity generation, 31%is generated from coal, 24% is obtained from hydropower, 6% is generated from wind, 2% is obtained from geothermal and 3% is generated from other sources. In 2015, total fuel oil consumption in Turkey was about 860,000 barrels per day (b/d). In which more than 90% of the total volume of liquid fuel was imported. Most of Turkey's oil imports in 2015 came from Iraq and Iran (IEA, Monthly Oil Data Service, 2015) which combined, 40% from Iraq and 20% from Iran, which provided 60% of the country's crude oil. Once Russia was the largest exporter of Turkey's crude oil, but its share has fallen because Russian crude oil is gradually exporting to the Asian region. (US Energy Information Administration based on International Energy Agency, 2017: 4).

Natural gas consumption in Turkey rose sharply during the last decade, up to 1.7 million turbine cubic feet (Tcf) in 2014. Consumption of the natural gas in 2015 was also 1.7 million Tcf, decreasing by less than 0.1 Tcf from 2014. Almost half of the total natural gas consumption is used to generate electricity in 2014. The remaining natural gas consumption evenly distributed between the two sectors; industrial sector and residential/commercial sector. (International Energy Agency, 2017: 8). By 2015, 1.7 Tcf of natural gas imported, represented 99% of Turkey’s total natural gas supply. In 2015, Russia's Gazprom was by far the largest single supplier responsible for 56% of Turkey's total natural gas supply. After Germany, Russia’s largest natural gas export market is Turkey. (International Energy Agency, 2017: 9).

Traditional low efficiency in the Turkish energy system is also one of the biggest problems. It is to be noted that the final consumption of energy of Turkey is found to be 77.639 mtoe while the consumption rate of primary energy is 99,840 mtoe, which indicates that 22.2 percent of total consumption of 99,840 mtoe of primary energy was used for energy conversion. Electricity is the largest proportion of secondary energy, i.e. 15.7 percent or 12,231 mtoe of final energy. (Ediger, 2008: 84). Apart from conversion efficiency, other subdivisions including distribution, transport, and consumption also have low efficiency. Electricity distribution system can be taken as an example of high loss of electricity i.e. 15% (Hepbasli, 2005: 311).

1.3. Energy Demand and Macroeconomic Variables

Following section will discuss the link between Energy sector and other economic variables.

1.3.1. Foreign Direct Investment in Energy Sector

Turkey’s government has been actively pursuing all measures aimed to increase FDI in the Republic of Turkey. This is the reason that Turkey has progressively privatized state owned power companies. Many foreign companies have taken part in the purchase of these companies as a direct investment or joint ventures. Privatization is an essential tool for economic reform policy. It is considered a great opportunity for investment for international investors which does not risk the green field projects. Turkey’s privatization program was successfully implemented in 2002, has led to the distribution of electricity now completely in the hands of the private sector. This privatization program provides the country's energy sector with a strong competitive structure and a new growth horizon.Until the first half of 2000s, the energy sector was vastly regulated by the state and the larger number of energy corporations were operated by the government. On contrary, oil industry allows private companies to operate. Nonetheless, the largest petrol station, 4 out of 5 productions (Tüpraş) were also owned by government. The generation of electricity, transmitting and distributing of electricity in the energy sector were regulated by the government and Turkish Electricity Authority (TEK).

Due to economic reforms and budgetary constraints that began in the early 1980s, Turkey launched the Built-Operate-Transfer (BOT) system and Transfer-of-Operating Rights (TOOR) systems to ensure the participation of private companies in order to generate investments. (Sirin, 2017:369).

In 2001, the Electricity Market Act (EMA) was ratified along with economic reforms that began after the economic crisis of 2001 and the EU accession negotiations, creating a competitive and loosened electricity market TEAS, that has been divided into three economic companies: the Turkish Electricity Transmission Company (TEIAS), Turkish Electricity Contracting and Trading Company (TETAS) and the Electricity Generation Company (EUAS). Furthermore, state power plants (excluding for large-scale plants of hydropower) and distribution entities have been stripped of the status of national asset to attract more investment in the industry. For example, the government has established the Turkish Investment Promotion Agency (ISPAT), a formal body that promotes Turkey's opportunities to invest in the global business community and support investors before, during and after immigration in 2006 (Sirin, 2017: 1369).

The Turkish Ministry of Economy and the Central Bank of Turkey (CBRT) reported in 2006, $145 billion of FDI from Europe, Asia, the Middle East and the United States has flown into Turkey. About 10% of this amount went to the energy sector, which ranked third in the investment sector during the above period. After the manufacturing and finance sector ($38.4 billion and $29.7 billion, respectively), international companies' energy investments reached $15.7 billion over the period 2006-2016. The State Oil Company of Azerbaijan (SOCAR) has made one of the largest investments in the energy sector in the last decade. SOCAR's investments in natural gas, oil refinery and wind power in Turkey when in 2008, SOCAR purchase the one of the biggest petrochemical company PETKİM (Petkim Petrokimya Holding A.Ş) for $2 billion. The company is one of the many partners of the Trans-Anatolian Natural Gas Pipeline (TANAP) project, the import gas pipeline in southern gas corridor that is starting in Baku, Azerbaijan, and ending in Italy. The TANAP project aims to transport the production of natural gas to the Shah Deniz-2 gas field of Azerbaijan and other parts of the Caspian Sea sided with Turkey and to the continent of Europe through the Trans-Adriatic Pipeline (TAP).

2016 was the most turbulent year in Turkey’s political history, when the country experienced a failed coup on 15 July. This failed coup attempt might have led to anxiety, particularly among foreign investors. The Turkish government and business people began to focus on the economy and take measures to counter the potential economic consequences of a coup attempt. Because of these efforts from last year, the economy raised about 12.3 billion dollars of FDI and energy sector, attracting $740 million of investment in 2017, therefore energy again becomes the third sector in obtaining the largest amount of foreign investment.

Turkey wants to attract more investments by diversifying energy projects such as renewable energy and nuclear to fossil fuels. These factors have had a significant impact on Turkey's energy sector, making Turkey to attract more investment from the worldwide. With the implementation of investor-friendly regulations and high demand growth, the Turkish energy sector is attracting investors' attention to each component of the value chain in the various energy sub-sectors that are more vibrant and competitive.

1.3.2. Economic Growth and Energy Sector

Energy demand is also growing parallel with economic growth in Turkey. Similarly, energy consumption (kilogram of oil equivalent/capita) has enhanced by 50%. However, the consumption of electricity (kWh per capita) has been tripled in the last two decades (World Bank Development indicator). Oil, coal and hydropower were three core sources of energy until the late 1990’s in Turkey. On the other hand, natural gas has become the key source of energy supply because of its enhanced use in heating and power generation systems. As a matter of fact, the goal of the energy strategy of Turkey is to satisfy increasing demand exclusive of any adversative effects on the economic growth of the state (Ozturk, 2005: 2424).

Rising per capita income, economic expansion, rapid phase of urbanization and positive demographic trends are the core drivers of Turkey's energy demand. This demand is predicted to rise by approximately six percent annually from 2023 onwards. Further investments have been commissioned by the private sector of Turkey in the current 80-GW installed electricity capacity. These investments estimated the increase of electricity capacity from 80-GW to 120-GW by the year 2023. To provide a reliable and sustainable energy to consumers, Turkey has offered some favorable incentives to its investors, which include purchase guarantees, license exemption, feed-in-tariffs etc. The type and capacity of energy generation facility determines the kind of incentive to be offered.

Nevertheless, the ratio of self-sufficiency of Turkey is very nominal in comparison with the increased demand. The country is greatly reliant on costly imported sources of energy, which bring noteworthy pressure on the economy, price stability and balance of payments. According to the 2015 statistics of TurkStat, 55,916 million USD made up the total energy import bill which is equal to 22.2 percent of the total bill of importation in 2013. Economic growth has generated fast urbanization and eventually elevated the consumption of energy. Similarly, severe ecological problems have been created by the air pollution.

1.3.3. Energy related Carbon Emission

Over the last few decades, the climate change and global warming turned out to be a worldwide issue. Experts suggest that the main reason of global warming is the upswing of worldwide economy, increase of consumption of energy by humans and the greenhouse effect which is generated by the emission of six different gases which includes N2O (nitrous oxide), CO2 (carbon dioxide), SF6 (sulphur hexafluoride), HFCS (hydrofluorocarbons), methane (CH4) and perfluoro carbons (PFCS); which eventually cause climatic changes in our planet. (Pao et al, 2012: 400). Turkey remains a growing country with rapid consumption of energy as well. However, this growth has led to a dramatic increase in emission of hazardous gas in 1980s (Keleş and Bilgen, 2012: 5199). In May 2004, Turkey joined United Nations Framework Convention on Climate Change (UNFCC) and in February 2009, recognized the Kyoto Protocol (Tunç, Türüt-Aşık, and Akbostancı, 2009:4689). Total emissions of CO2 from the world's five largest fuel-burning countries in 2015 are followed by China on the number one with 9040.74 mmt emission, secondly the USA with 4997.50 mmt, India (2066.01mmt) Russia (1468.99

mmt), Japan (1141.58 mmt) respectively, and Turkey with 317.22mmt emission is ranked on 18 on the world emission list (IEA, 2017:15).

According to the GHG inventory results, greenhouse gas emissions are equivalent to the CO2 for the year 2015 were 475.1 million tons (Mt). Compared to 1990 emissions, total greenhouse gas emissions as equivalent to the carbon dioxide increased by 122% in 2015. In 2015, the per capita carbon dioxide equivalent emissions were 6.07 tons, compared with 3.88 tons in 1990. The largest portion of total carbon dioxide emissions comes from the energy sector, accounting for 86.1%. Among the remaining, 0.2% was originated from agricultural activities and waste and 12.7% from product use and industrial process in 2015 (TURK STATA, 2015). According to the statistics by the "Potsdam Institute for Climate Impact Research (PIK)" in 2015, Turkey emitted 415m tones of CO2, which is lower than the United Kingdom emission, but more than France's emission at the same year.

This amount is lower than the United Kingdom's productions of the same year. However, it was greater than the emission rate of France. In addition, it was identical to 0.83% of the global GHG emissions of the same year. Turkey became part of Kyoto Protocol in the year 2009 and made its entry into the force after four years. This protocol puts into effects the developed countries to shrink their emission. Nonetheless, Turkey is the only country which makes no such commitment to reduce their emissions till the year 2020 in UNFCCC.

Turkey has suggested a climate pledge to UNFCCC in the year 2015 related to the agreement made in Paris. Turkey also has signed the Paris agreement, however, has not formally ratified it yet, which makes it the only country among the G20.

Total of 195 UNFCCC countries have signed the Paris deal and only 22 of them have not ratified it yet. Turkey's Paris pledge has been rated as "critically insufficient" by the Climate Action Tracker (CAT). This insufficient rating by the CAT demonstrates that the pledge is not consistent with the goals of the agreement i.e. limiting the warming to well below 2°C, let alone 1.5°C. This rating also means that if all the governments' target were similar to the target of Turkey, then the warming would breach 4°C. CAT has also noted that the NDC target of 2030 is equivalent to 348% emission increment from levels as compared to the year 1990. Additionally, NDC of Turkey also requested the international financial support, which according to Turkey, will play a vital role in reducing their emissions.

Turkey has effectively ratified the Paris agreement on the condition of access to the Green Climate Fund (GCF) as a financial source to achieve their targets. It should be noted here that Turkey is receiving substantial international climate finance from numerous bilateral channels and multilateral development banks. It is also at the receiving end of financial support for capacity building and technology from several other financial institutions.

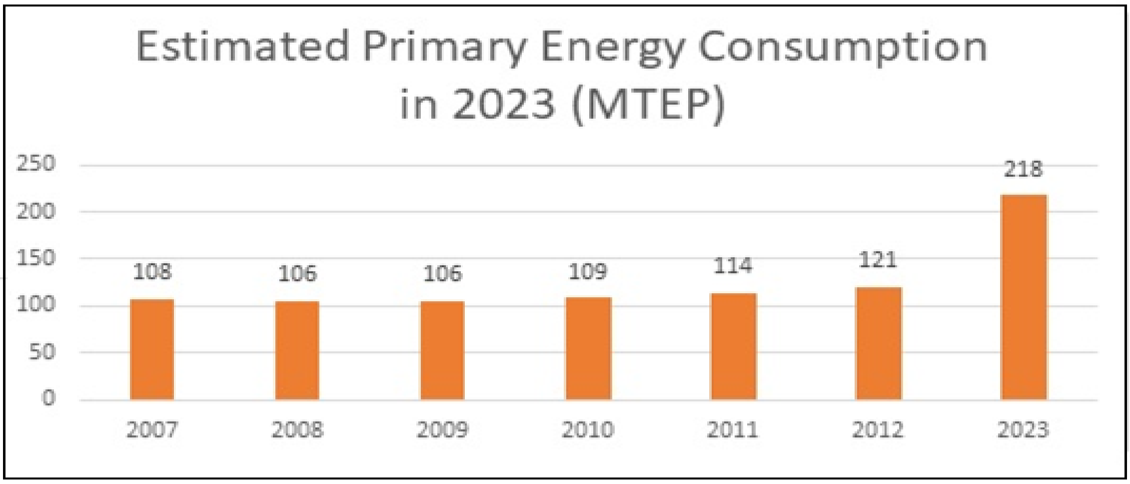
According to a recent report, Turkey received €667m/year on average bases between 2013 and 2016, which makes it the largest EU climate finance recipient. This amount is far more than any amount received by more weak and least developed countries (LDC). Similarly, an analysis published by Carbon Brief last year, Turkey has been ranked as the fifth highest recipient of multilateral climate funds during the years 2013 and 2016. It received $231m via various networks like the Global Environment Facility (GEF) and Clean Technology Fund (CTF). Turkey has been also guaranteed that its current climate support will be continued in the future as well.

Turkish delegation repeated their verdict at yearly climate conference held at Bonn on November 2017 that they will not consent the agreement of Paris until a way out on the admittance of GFC was decided. Apparently, the talks failed because of the concerns of major negotiation blocks which include G77/China while keeping in mind that GFC was supposed to support developing countries.However, Turkey continues to push for more differentiation. The pledge made by Turkey to reduce productions by 37% till the year 2025 as compared to the level of emission of the year 2005 came from its NDC submitted by them to UN in the year 2015.

1.4. Energy Policies in Turkey

National energy policies of Turkey aims to deliver necessary energy to people on time, with reliable source, cost-effective, high quality and environment friendly basis so it will work on the line of development and social progress. (Tunc, Çamdali and Parmaksizoğlu, C., 2006:52).

Focusing on the Vision 2023, Turkey is applying new energy goals within the framework of the economic growth and development strategy to 2023. Energy targets by 2023 consist of the rising the proportion of domestic energy resources, such as coal that is abundant in nature in Turkey, 30% use of renewable energy to producing electricity and reducing the energy intensity up to the 20% by improved efficient technology and constructing two-three nuclear power plants. (Energy Policies of IEA Countries, Turkey, 2016; 14).



Graph 4. Estimated primary energy consumption 2023
Source: MENR, Turkey's National Renewable Energy Action Plan 2015

As shown in the above Graph 4, according to MENR primary energy consumption tends to increase up to the 218 MTEP in 2023. As shown in the above illustration, according to the MENR primary energy consumption tends to increase up to the 218 MTEP in 2023. In order to achieve these goals, Turkey get support from the international community to prepare Energy Efficiency Action and Renewable Energy Action Plan in 2015. However, the Climate Action Plan does not prioritize the importance of assessing actual carbon reduction contributions and cost effectiveness, but rather explains many of the measures. The overlapping and inconsistencies between various strategies and action plans hamper the assessment of progress and identify gaps in progress towards the goals.

Considering the environmental dimensions of Turkey's energy policy in recent years, with respect to the United Nations Framework Convention on Climate Change (UNFCCC) 21 COP21, Paris in 2015, Turkey has set its first goal of quantitative greenhouse gas (GHG) emissions reduction in 2030. As a fast growing economy with low per capita emissions, Turkey's first Nationally Determined Contribution (NDC) tries to limit 21% of the growth of greenhouse gas emissions than projected business-as-usual (BAU) growth in 2030. However, this will not be sufficient to implement global climate goals. The Paris 2015 agreement aims to reduce the global average temperature rise to below 2°C and maintain efforts to 1.5°C. However, the initiative has so far lacked ambitions to financial assist such a path, particularly in the field of energy renewability and energy efficiency, as well as in the energy sector, where Turkey invest substantial in the coal development program. (Intended National Determined Contribution (INDC).The IEA analysis of COP21 shows that around 70% of worldwide emission reductions required to follow 2°C scenario to improve the efficiency of energy and renewable energy investments. Turkey should significantly increase its ambitions in renewable energy (hydropower, wind and solar energy) and energy efficiency.

Energy efficiency (EE) will make the greatest contribution to achieving emission reductions by 2030. Turkey, in some key sectors should have a significant potential for energy savings but the possibility has not been revealed because monitoring and evaluation have not been conducted. Energy efficiency will be an important tool to improve economic productivity and energy security. Governments need to assess profits in capping consumption (not energy intensity) to make an investment. In the past decade, the energy intensity of the Turkish economy has increased by 7.1% compared to the average reduction rate of 16.3% in IEA member countries. In Turkey, the use of energy in transport, industrial and construction has surged. Turkey still has the lowest total primary energy supply per capita (TPES), which is expected to increase rapidly in the future.

Renewable Energy (RE) a second priority. After the initial phase and after a quick take-off in the deployment of the RE, the capacity has almost doubled from 15.6 gigawatts (GW) to 28 GW between 2009 and 2014. (Energy Policies of IEA Countries, Turkey, 2016; 14). Conversely, due to the acceleration of the electricity demand and the use of natural gas to create a huge explosion, the share of RE in total energy supply remained constant. The government has developed a number of technologies specific for renewable energy in different strategies and plans for 2023. The country has great potential of hydropower, wind and solar energy. In recent years, solar photovoltaic has been increasing. At the second stage in the development of renewable energy, the government will ensure that all renewable energy technologies have clear and long-term goals (in line with long-term goals of 2030). To remediate the sources of air pollutants, the Turkish government has already has scrapped local old cars notably in large cities like Ankara, Izmir and Istanbul and encourage passenger to use public transportation to ensure air quality.

CHAPTER 2. LITERATURE REVIEW

In past 20-25 years, the relationship between consumption of energy, foreign direct investment, economic growth and environmental pollution has been thoroughly analyzed.As mentioned by Halicioglu, (2009: 1156), this nexus is divided into two broad research strands, the first is closely related to Environment Kuznets curve (EKC) that scrutinizes the dynamic linkage of energy consumption, economic growth and ecological degradation altogether. Energy consumption and output are the second filament. This relationship makes it possible to synchronize economic growth and production because Economic growth is closely associated with energy consumption, since more energy consumption is required for high economic development in the same way; an elevated level of economic growth and development is required for more use of the efficient energy.

Finally, a mutual approach has emerged to these two approaches in modern literature that Allows researchers to verify the validity of both aspects. This combined approach was pioneered by Ang, (2007: 4772) and Soytas, Sari and Ewing, (2007: 482).

This study adopts the mutual approach framework, but extending the econometric model by including the impact of foreign direct investment in the connection. Mielnik and Goldemberg, (2002: 87) when analyzing the energy demand, first time use that variable. So we divided our literature into 3 strands with the aim of fulfilling the research gap and supplementing to the existing literature and policies.

2.1. Energy Consumption-Foreign Direct Investment Nexus

Researchers have examined economic effects of foreign direct investments on home and the host countries comprehensively in the previous decades. There was a perpetual idea that the FDI could influence the intensity of energy consumption by improving the technology of importing countries. Foreign direct investment (FDI) is the net transfer of funds as well as attain capital and suitable way to exploit advanced technology (Zeng and Eastin, 2012: 2221).

The relationship between FDI and consumption of energy has been studied first time by Mielnik and Goldemberg, (2002: 87). Economic growth was included in their research as a control variable for the function of energy demand. Their empirical results have shown that the decrease in energy intensity is linked to increased foreign direct investment, which theoretically prove the outcomes by giving logic that investor interest is to maximize profit in developing countries, for this purpose they bring their own advanced production equipment in the host countries consequently, domestic production increases with low energy consumption. On the contrast, Antweiler, Copeland and Taylor, (2001: 877) came up with contradictory results that FDI has an impact on the domestic production of the host country but does not effect on energy demand. Besides these findings, Cole, (2006: 108) found the less contradictive results, by concluding in his research that the impact of FDI on energy consumption varies across countries, it depends on the one's country economy policy, structure, growth, and energy prices. Hübler and Keller, (2009:59) analyzed the FDI inflows on energy concentration in 60 emerging countries They didn't find any significant impact of FDI inflows along with other determinants of energy intensity. Later on, another researcher, Xiaoli, (2007: 117), Chima, (2007: 17), Zheng, Qi and Chen, (2011: 2688) confirmed the results of Mielnik and Goldemberg, (2002: 87) that FDI decreases the energy demand of host countries.

According to the Shahbaz et al., (2015: 576), FDI affects energy consumption through three channels that are termed as composition effect, scale effect and technique effect. When an economy is in development stage, it requires more resources in the process of production to reach the level of output. Therefore, FDI directly enhances domestic production, which in turns increases energy consumption that add to emission of CO_2. This is labeled as scale effect (Shahbaz et al., 2015: 576, Zhang, 2012:371). When there is a change in the structure of the economy, FDI affects economic growth with positive and negative effects also known as positive composition effect and negative composition effect (Cole, 2006:108). When the structure of economy changes from agriculture to industrial sector, more energy is required to increase the production that in turns increase the energy demand and that increases CO_2 emissions in the environment, is termed as positive composition effect. On the other hand, when the structure of economy changes from industrial sector to services sector, energy demand decreases due to the knowledge base technology and hence it emits less CO_2 emissions in the environment, is called the negative effect of composition (Stern, 2004, Lee and Brahmasrene, 2013:70). Whenever an economy adopts advance technology that effect emission of CO_2, is called as technique effect. The adoption of advance technology consumes less energy and emits less CO_2 emissions, but it produces more output (Arrow, 1962:131). Increasing dependence on foreign energy sources is a popular debate from last few years. Energy use is also a major determinant of economic growth and CO2 emissions (Sadorsky, 2009:2528).

Theoretically Karanfil, (2009: 1191) presented importance of financial elements in connection with energy growth and econometrically tested by Sadorsky, (2010: 2528). He discovered that financial development is a part of financial liberalization, which enables the country to access financial capital easily for investments between countries, Facilitate FDI inflows and reduce the cost of borrowing and financial risk for lenders and borrowers (Sadorsky, 2010:2528). Economic growth, together with all its procedures (stock market capitalization, traded stock worth and energy consumption turnover proportion) will therefore improve economic performance and growth, which eventually influences energy demand. However, in his study, the author could not find any significant and clear relation between energy demand and FDI.

In 2011, again Sadorsky, (2011: 999) analyzed the financial development and consumption of energy for focusing nine Central and East Europe States and adding Banking variable in the econometric framework. After some model specification, he finds out that foreign direct investment in these panel countries has an optimistic impact on the energy consumption. Çoban, and Topcu, (2013:81) confirmed this positive effect of FDI on energy consumption. They examined the influence of financial development on the consumption of energy by using system-GMM estimator in EU27 countries. Although the study focused on the stock market development and the banking system, they have aggregated FDI as part of some model features. Their findings indicate that regardless of what kind of financial development steam of the country leads to increase the energy demand.

Lee and Brahmasrene, (2013:483) used the data in G-20 countries to examine the consequence of FDI and productivity evolution on clean energy demand and energy consumption. The author revealed that the series are cointegrated and FDI enhances the adoption of clean energy. The current literature also explains the track of interconnectivity between direct foreign investment and energy utilizations. For instance, Dube, (2009: 175) and Foon Tang, (2009: 371) examined the relationship between energy consumption and economic growth by including foreign direct investment into the function of electricity demand respectively in South Africa and Malaysia. They found that FDI and energy consumption have a co - integration relationship.

The link between FDI and consumption of energy at the sectoral level of a country was scrutinized by Ting et al., (2011: 100), who worked on the configuration and technology, effects of FDI on intensity of energy demand in Chinese Province named Jiangsu. The research determined that the effect of FDI might raise energy intensity whereas the technological and structural impact of FDI did not decrease energy intensity. In the period of 1993-2003 Jiangsu Province. Shahbaz and Lean, (2012: 473) pointed out that growth in industrial sector leads to increases the energy demand in two ways: First, depending on cross-sector growth; second, Due to increase in economic growth, labor demand rise to fulfill the requirement of a country's growth, as well as it leads to improving the income of the labor that promotes the demand for consumer energy products hereby it will increase the energy demand in a country. Moreover, Li and Qi, (2016: 1305) considered the three ways in which FDI affects the consumption of industrial energy in China by examined the effect of scale, structure effect and technique effect. They scientifically proved the FDI increase the energy consumption of Industrial sector.

Xu, (2012: 524) measured Financial development based on the ratio of foreign direct investment (FDI) to GDP and the proportion of loans to GDP from financial institutions. It was found that financial development and energy consumption in China have an affirmative relationship. Another time Elliott, Sun and Chen, (2013: 484) also checked the relationship between energy consumption and FDI in case of China. They revealed the adverse relationship between FDI and energy demand, along with these findings, they also focused on income and income per square capita according to EKC assumption. Sbia, Shahbaz, and Hamdi, (2014: 191) considered the different macroeconomic variables, including FDI, CO2 emission and growth contribution on energy demand in UAE. Results revealed the FDI decline the energy consumption. Carbon emission also has a negative impact on energy demand.

Omri, and Kahouli, (2014: 913) discovered the positive effect of FDI and economical evolution on energy consumption after implementing dynamic simultaneous-equations models Taking into account the sample of 69 states (elevated - income countries, midlevel - income countries and countries with low income). Chang, (2015: 28) extended study and measured the effect of Financial development, considered five indicators of financial development: Foreign direct investment, private credit, stock market turnover, domestic credit and stock traded. He found no impact on energy consumption from foreign direct investment, using linear and nonlinear analysis of a sample of 53 countries. Similarly a panel data study of Portugal, the author, Leit, (2015: 38) suggested that both energy consumption and foreign direct investment complement each other. During the years 1990 - 2011, the author attempted to investigate the relationship between energy consumption, FDI and GDP (gross domestic product) in Portugal. The author confirmed the relationship between income/capita and consumption of energy is inverted. In addition, the author has also shown positive impacts on energy consumption from foreign direct investment and carbon dioxide emissions.

2.2. Energy Consumption-Growth Nexus

In the literature on economic energy, the effect of economic growth on required energy is widely discussed. The energy-growth nexus attracts attention to the economists and policymakers. Economic growth led to an increase in energy demand was the first time studied by Kraft and Kraft, (1978: 401) by researching the United States' consumption of energy by taking a period of time from 1947-1974. However, other researchers, like Yu & Choi (1985: 249), Akarca and Long (1980: 326), Erol and Yu (1987: 113), have challenged these findings and their results were totally opposite of Kraft's findings. Yu and Hwang, (1984: 186), Akarca and Long (1980: 326), they concluded that the casual association between GNP and energy expenditure in USA revealed by Kraft and Kraft (1978: 401) is spurious due to the selection of the sample size. Besides these studies, Yu and Choi, (1985: 249) in five different countries at diverse economic growth stages, energy use and GNP connections were studied. It also found the hypothesis of neutrality that the relationship between energy and GNP for the United States, the United Kingdom and Poland is not casual. However, uni-directional causality is detected in South Korea from GNP to consumption of energy and in the Philippines from energy expenditure to GNP.

Stern, (1993: 137) employed multiple variable vector autoregressive (VAR) analysis to examine the causal correlation of energy usage and GDP in the United States of America. Instead of using a total energy consumption scale, the author used a proxy of energy consumption with the weighted index of energy quality and moved from low worth energy like coal to high-end energy source like electricity. The researcher applied various causality tests and eventually concluded that total energy usage does not Grangerly affect GDP in the USA. Albeit the use of weighted index proxy of energy did Granger-caused the GDP. Additionally, Cheng, (1995: 73) also ran a bi-variable analysis on the data and no causal relationship has been found in either direction between energy usage and gross national product (GNP) in the United States of America. Even after multivariate analysis, insignificant relationship between energy use and GNP was detected.

Masih, A and Masih, R., (1996a: 165, 1998b: 1287) analyzed the energy consumption and economic growth by the implementation of econometric tools called Cointegration and Trivariate VECM models with the respectively years in Asian countries. Their empirical results show that economic growth in Pakistan and Indonesia is Granger-caused by energy. For India, Sri Lanka and Thailand, the energy consumption causalized the economic growth of the concerned countries. Whereas, for Malaysia, Philippines and Singapore no causality exists between them. Glasure and Lee, (1998: 17) did further analyses, in the East Asian countries. They discussed the issue of causality between South Korea and Singapore about energy and GDP. They applied not only standard causality test like previous studies did, Cointegration and error rectification models have also been practicalized to uncover the causality of GDP and energy consumption. For both countries, they found two - way causality from energy to GDP.

Cheng, (1999: 39) applied Granger causality test on consumption of energy and economic growth in India. The results showed that causality ranges from economic growth to consumption of energy in both long and short-term. Pakistan shares border with India and most likely both are sharing the same economic growth policies, therefore similar results were found in Pakistan also found the similar results. It was concluded economic growth initiate an increase in the country's total energy (Aqeel, A., and Butt, M. S., 2001: 101).

Yang, (2000: 309) studied the causal correlation between energy usage and GDP in Taiwan. He used the aggregated consumption of energy sources and sub-sources energy consumption comprises of natural gas, oil, electricity and coal. He found unidirectional causality between energy usage and GDP. This finding was contradicted with Cheng, and Lai, (1997: 435), who found that in Taiwan, causality ranges from GDP to energy expenditure. The reason why Yang, (2000: 309) findings do not support Cheng, and Lai, (1997: 435) results were attributed to the selection of the variables and time period. Asafu and Adjaye's, (2000: 615) research was based on the relationship among energy price, utilization of energy and economic growth. They have applied co-integration and error rectification techniques in four energy dependent countries in Asia, i.e. Indonesia, India, Thailand and the Philippines Result of the tri-variate model analysis indicated that unidirectional causality in Indonesia and India run from energy to revenue whereas in the Philippines and Thailand, bifacial causality ranges from energy to revenue.

The study of Fatai, k et al., (2002: vol-2) was based on the causality between employment, energy expenditure, and economic growth in New Zealand. Their study confirmed the one-directional causality from utilization of electricity to employment and consumption of oil to employment. Wei, (2002: 17) debated the long-standing association between aggregate energy utilization and other significant economic variables including energy, revenues and the share of heavy industry in GDP. They observed the co - integration of energy consumption and other economic variables. Moreover, if causality runs from revenue to energy, this indicates a lower energy - intensive economy. As a result, it is probable to formulate such energy preservation policies that have low adverse effect on income (Jumbe, 2004: 61). In his study Jumbe, (2004: 61) analyzed the relationship of electricity consumption and GDP. He categorized GDP into three segments. The overall GDP of the country, Agriculture- GDP (AGDP) or non-agriculture-GDP (NGDP). The findings showed that electricity consumption is cointegrated with GDP and NGDP, but cannot be cointegrated AGDP. The Granger test shows that electricity consumption and GDP have bidirectional causality. However, one-way causality running from electricity use NGDP. Error correction detects bi-directional causality running from GDP and NGDP to electricity utilization. The causality between GDP and energy utilization was investigated in the 10 topmost developing markets except China, (Soytas, and Sari, 2003: 33).The researchers found that Argentina has bifacial causality. Causality ranges from GDP to energy depletion in Italy and Korea, contrary to energy utilization and GDP in Japan, France, Turkey and Germany.

Lee, (2005: 415) has worked on the 18 developing countries and applied the panel unit root test, cointegration and panel error rectification model. The result shows the cointegration relationship exists between consumption of energy and GDP in all countries over the long-term. Moreover, results showed only unidirectional causality successively directed from the energy utilization to GDP, but unlike Al-Iriani, (2006: 3342) worked on a panel of six Gulf Corporation Council countries He found that the integration of energy consumption and GDP. For the first time in Namibia, De Vita, Endresen and Hunt, (2006: 3447) carry out the research on the total Energy consumption and other types of energy consumptions like diesel, petrol, and electricity. Their results have shown that energy demand in Namibia is negatively related to energy prices, but positively with GDP as expected.

In 11 oil exporting countries, Mehrara, (2007: 2939) reviewed the causal association between consumption of energy and economic development. His finding indicates that strong unidirectional causality from economic progression to energy utilization in oil - exporting countries. Similarly, Squalli, (2007: 1192) Worked for OPEC countries on electricity utilization and economic progression. He was in favored the argument that there is a long-term relationship between consuming of the electricity and real GDP per capita. He also suggested that elevation in energy consumption could have an adverse impact on actual GDP. However, on a panel of East Indian Ocean countries, Joyeux, and Ripple, (2007: 50) found that GDP and energy consumption were not integrated.

Lee, and Chang, (2008: 50) once again took the 16 Asian countries to reexamine the comprehensive relationship between consumption of energy and economic progression and practical panel cointegration and panel based error rectification model as well as a causal relationship. The results reveal that energy utilization granger because the Real GDP in the short-term, but not vice versa. Huang, Hwang and Yang, (2008: 41) found that only in midlevel income countries, economic progression increase consumption of energy. However, for higher income group countries economic growth has a negative impact on energy consumption. Similarly, Yuan et al, (2008: 3077) pointed out that different countries have undergone different stages of the growth and development so that development process could have a substantial impact on consumption of energy and economic growth. Likewise, he recommended that during the analyses of any country, data should be classified as aggregate and disaggregate level to overcome the ambiguous results.

The study of Sadorsky (2009: 456) was based on the relationship between CO2 emissions and oil prices and renewable energy consumption in the G7 countries. The empirical analysis indicated that increase in real GDP and CO2 emissions also increases the G7 countries ' per capita consumption of renewable energy. Likewise, Apergis, and Payne, (2009: 211) Cointegration panel model and error rectification model used to scrutinize the association between consumption of energy and economic growth in six countries of Central America. They found that there was a short and long-term Granger causality from consumption of energy to Economic growth. They also determined that energy demand directly and indirectly plays a role of substantial actor in economic growth.

Ozturk, and Acaravci, (2010: 1938) carried out another empirical study for the countries of Eastern Europe to examine the causal affiliation between demand for energy and economic growth. All projected countries they examined, weak evidence of the long term and causal link between growth and consumption on contrary, according to Bartleet and Gounder, (2010: 3505), economic activities in a country lead to elevation in utilization of energy.

Farhani and Rejeb, (2012: 282) examined the linkage between consumption of energy and economic growth in 95 countries. These countries are categorized into four major income groups following the World Bank's classification. The empirical results revealed that long run causality runs in low and high income countries from GDP to consumption of energy. For lower middle and upper midlevel income countries, bifacial causality was observed between GDP and EC. Particularly about the Latin countries, a study was undertaken by Campo and Sarmiento, (2013: 233). The outcomes indicate that there is insufficient proof to support the long - term and causal link between energy consumption and economic growth. Consumption of energy and economic growth in Turkey shows positive relations, indicating that Turkey's economic growth is largely reliant on the energy sector (Saatci and Dumrul, 2013: 20).

2.3. Energy Consumption-CO_2 Nexus

An increasing debate on global environmental changes, the environmental impact associated with energy consumption is facing a wide range of concern. Various factors that contribute to the CO2 emission in the environment, the most notable is the consumption of energy from fossil fuels and the level of economic activity. Many studies scrutinized the association between CO2 emissions, energy utilization in different countries is based on the different econometric techniques, and mostly these studies rely on the Environmental Kuznets Curve (EKC) hypothesis.

For the first time, the energy consumption is taken as a primer unit of energy consumption that divided into the three potential sectors; economic, transportation and residential and examined the impact of CO_2 emission Alcántara and Roca, (1995: 221). They concluded that the final demand for energy in transportation increased, which meant an increase in total CO_2 emissions in the environment. Pagáaa and Gürer (1996: 311), Gürer and Ban, (1997: 309) analyzed energy-related CO_2 emission among different countries and income groups. Both of them concluded that majorly developing countries are undergone with development processes and growth in the population make more contribution to the economic growth itself, in that sense, the development process contributed to the emission in the environment. In the same perspective, Schipper et al, (1997: 651) examined the CO_2 emission from energy usage for industrial countries. They concluded that between 1970 and starting of 1990s, emission of CO_2 from major energy-depleting sectors in 10 OECD countries declined. According to them, it combines renewed economic growth with a slowed down rate in the reduction of energy intensity, increasing demand of the personal vehicles in these countries predicted to increase in emissions or accelerate emission in some countries.

Choi, and Ang, (2001: 115) examined the energy-related carbon emission in Korea. They found that influence of energy intensity (dependent on industrial development Pattern, fuel type, fuel efficiency, and lifestyle) on the carbon concentration is superior to collective carbon factory (including variations in the fuel mixture and/ or fuel carbon aspect, which are limited). This same finding of Korea has supported the claim of Ang, (1999: 943). Lise, (2006: 1841) found the largest contribution in the increment of CO_2 emissions in Turkey is the economical extension. In addition, apart from economic expansion, Carbon intensity and energy utilization which contributes to escalation in carbon dioxide emissions in Turkey.

Ang, (2007a: 4772, 2008b: 271) n France and Malaysia, they scrutinized the connection between Carbon dioxide emissions, energy utilization and output. According to his finding, France is an energy independent country and Malaysia is an energy-dependent country. Therefore, country should implement the policy, according to it and control the pollution level in a county. Apergis, and Payne, (2009: 3282) extended his work to six Central American countries. They discovered that energy use has an affirmative and substantial impact on emissions. The findings also support the hypothesis of the EKC.

Zhang and Cheng, (2009: 2706) investigated the association between utilization of energy, economic growth and CO_2 emissions in the Peoples' Republic of China. To determine the causality effect between energy utilization, economic growth and CO2 emanations, the Granger causality technique was used. Empirical results show that one-way causality from economic growth to energy consumption and causality from consumption of energy to CO2 emissions is unidirectional.

In South Africa, Menyah, and Wolde-Rufael, (2010: 1374) examined the long term and causal association between energy consumption, economic growth and emission-pollutant with multiple variable framework analysis including aspects of production, labor, and investment. Econometric results indicated that in order to reduce pollution in the environment, South Africa has to decrease consumption of energy per unit of output and reduce the economic growth. The researcher came up the suggestion that instead of reducing economic growth, the Government should focus on renewable energy consumption as South Africa has adequate renewable energy resources. Also, Lotfalipour, Falahi, and Ashena, (2010: 5112) have discovered that controlling greenhouse gas emissions through the decrease in energy consumption will affect the economic growth of Iran. In the same year, Menyah and Wolde-Rufael, (2010: 2911) studied the nexus among nuclear energy, renewable energy, CO2 emission and economic growth in the US. They suggested that usage of nuclear energy could reduce the CO2 emission in the environment.

Niu et al., (2011: 2121) worked in eight Asian economies on the association between energy depletion and carbon dioxide emissions and found an affirmative relationship among them. They also examined that in developing countries, CO2 emissions per capita are higher than in developed countries. However, energy consumption per capita is far greater than developing countries in terms of energy proficiency and carbon release in developed countries. Similarly, Arouri et al., (2012: 342) observed the relationship between CO2 emissions, energy depletion and real GDP in the North and Middle East African countries. The bootstrap panel unit root and co-integration technique was applied for the period 1981 to 2005. The empirical outcomes show that energy depletion has a progressive and significant influence on CO2 emission in MENA countries. Al-Mulali and Sab, (2012: 180) investigated the impact of energy consumption and carbon emissions on economic growth and monetary development in sub - Saharan African countries. The results demonstrated significant role played by energy consumption on economic growth and for increasing financial development however as a result generates high pollution.

Salahuddin, (2014) observes the link between energy utilization, carbon emissions and economic growth in the countries of the Gulf Cooperation Council. In the study, the Granger causality technique was used. The empirical result illustrates the significant and positive relationship between energy consumption and carbon emissions. In addition, one - way causality ranges from economic growth to energy consumption.

Saboori et al., (2014: 150) studied the association between energy consumption and carbon dioxide emissions in OECD countries' transportation sector. By applying the Fully Modified Ordinary Least Squares cointegration technique, empirical results show in all 27 OECD member countries, the long - term relationship between economic growth and emissions of CO2 from the transport and energy consumption in the road division is positive.

Joo, Kim and Yoo, (2015: 543) examine the short and long-term causality of energy utilization, release of carbon and economic growth in Chile. Empirical results show that one-way causality from energy consumption to economic growth and carbon emissions to energy consumption in Chile. This same model was applied to Korea. However, in case of Korea, authors found that energy consumption and economic growth are bifacial and between energy consumption and carbon emission Lee and Yoo, (2016: 412).

Begum et al., (2015: 594) examined the dynamic effect of consumption of energy and economic growth on CO2 emissions in Malaysia. Finding indicates that theory of a Kuznets environment curve from an environmental point of view is not effective in Malaysian case. Futhermore, Linear ARDL outcomes reveal that long - term positive effect of both energy consumption/capita and GDP per capita on CO2 emissions. By applying the same linear ARDL model for USA and UK, Çetintaş and Sarıkaya, (2015: 173) found that in both countries, there is an affirmative association between CO2 emission and energy consumption and adverse relationship between nuclear energy consumption and CO2 depletion. Similarly, Alam et al., (2016: 466) examined the influence of energy consumption, revenue and population growth on CO2 emissions in India, China, Indonesia and Brazil. The linear ARDL have been applied. Empirical results revealed that carbon emissions in India, Indonesia, China and Brazil have increased statistically significantly as a result of increased income and energy consumption.

In order to explore the correlation between energy consumption, economic growth and carbon emissions in developed and emerging countries, Chen et al., (2016: 420) practicalized the model of panel co-integration and vector error rectification. The empirical findings show that one-way causality runs in developed and emerging countries from energy consumption to carbon emissions. However, energy consumption per capita contributes more CO2 emissions to the environment in developing countries than in developed countries. The main finding of this paper is economical progression, energy consumption and CO2 emissions depend on the various levels of economic development. Moreover, both developed and emerging countries indicate that Higher GDP requires more energy consumption and rises, CO2 emission, which is harmful in short-run. However, in the long-run increase in CO2 emissions leads to more economic progression. In addition, they specify that consuming fossil fuel energy have more potential to damage the environment.

Wang et al., (2016: 184) scrutinized the cause of energy consumption, economic growth and carbon emissions. The Granger causality technique has been functionalized for the period of 1995 to 2012. The empirical result shows that energy consumption, economic growth and carbon emissions have a positive relationship. It was found out that there is two - way causality from economic growth to carbon emissions. In the same way, Magazzino, (2016: 844) applied Toda Yamamoto Granger causality technique to study the association between energy consumption, CO2 emission and economic growth in Italy. Empirical results show that the causality from carbon dioxide emissions to economic growth and carbon dioxide emissions to energy consumption is bidirectional. Nain, Ahmad, and Kamaiah, (2017: 807) applied Toda–Yamamoto causality technique applied to inspect the causal relationship between energy consumption, carbon emission and GDP. The result of the autoregressive distributed lag model shows that energy consumption, economic growth and carbon emissions have a long-run relationship.

Kais and Mbarek, (2017: 840) examined the association between energy consumption, CO2 and economic growth in North African countries. The panel cointegration technique has been applied to investigate the correlation between energy consumption, carbon emission, and economical progression. The empirical outcomes show that economical progression, consumption of energy and economic growth and CO2 emissions are unidirectional.

2.4. Research Gap

According to the conclusion obtained from previous literature, we have hardly found any study conducted in Turkey, which incorporate non-linearity with linearity while investigating the energy demand in studies. The subject is still open for further research. Only a few studies have examined the non-linearity senior with different economic issues as Non-linear is newly event. Therefore, the results provided by the previous studies that investigated the energy demand are ambiguous due to ignorance of asymmetries. These asymmetries are outcome of economic and financial reforms, changes in monetary and fiscal policies, global crisis and political instability etc. In such, circumstances, ignorance of asymmetries limits policymakers in the development of comprehensive financial and economic policies. Therefore, this issue is covered by applying NARDL approach. In this study, we seek to explore the contribution of macroeconomic variables on energy demand as measured by a specific set of macroeconomic indicators such as Foreign Direct Investment, Economic growth and Environment pollution.

2.5. Hypothesis

The hypothesis of the study is:

- H_1: There is no asymmetric association between Energy demand and FDI, CO2, GDP
- H_2: There is no symmetric association between Energy Demand and FDI, CO2, GDP

CHAPTER 3. DATA AND METHODOLOGY

The aim of this chapter is to discuss the data and methodology. In this study time series and secondary data has been used.

3.1. Data and Measurement

This study has selected the following model on the bases of reviewed literature. . We are using augmented the model of Sbia, Shahbaz, and Hamdi, (2014: 191), Saidi and Hammami, (2015: 62) Gökmenoğlu and Taspinar, (2016:706). Yearly data from time series for the period of 1980-2015 will be used to examine the symmetric and asymmetric long term and short-term impact of foreign direct investment (FDI), Economic Growth (GDP), and Carbon Dioxide (CO2) on Energy Demand in Turkey. Semblance with other analyses time series data of all variables are collected from the World Development Indicator (CD- ROM 2015). (For detail information of variables see Appendix).

A basic model for the estimation is given below;

$$ED_t = f(FDI_t, GDP_t, CO_{2,t})$$

3.1.1. Model Specification

In empirical analysis, normalization of the data series and transformation of entire variable data into the identical measuring unit is important because the emissions of carbon dioxide is measured in metric tons. However, current US dollars is the measurement unit of all variables. Therefore, by transforming the data series in natural log aids the elimination of the problems linked through dynamics characteristics of data series (Alam et al., (2017:635), Paramati et al., (2017:62)). To convert the series into log method is preferred by many economist, so series can be interpreted as elasticity for each resulting coefficient of regression

$$lnED_t = \beta_1 + \beta_2 lnFDI_t + \beta_3 lnGDP_t + \beta_4 lnCO_{2,t} + \mu_i$$

3.2. Methodology

Symmetric cointegration or standard ARDL test allow us to check simple linear relationship in which effects of the explanatory variables to endogenous variable is same. In contrast asymmetric in NARDL framework permit us to check partial sum of positive can have different effect on endogenous variable from partial sum of negative. Both approaches have multiple advantages. Irrespective of the integration of variables in *I(0)* and *I(1),* both tests can be applied. To determine cointegration on small sample size, Both ARDL, NARDL gives better result. (Romilly et al., 2001:1803). Dynamic unrestricted error correction model (UECM) can be derivated from simple linear transformation in ARDL. UECM incorporates the short-term dynamics along with long run balance without trailing long run statistics. NARDL allow us gauge the asymmetric and drives the dynamic adjustment.

Before applying linear and nonlinear autoregressive distributed lag model (NARDL) first, we evaluate the standing level of the variables. To check stationary level of the variables, apply unit root tests. The Augmented Dickey Fuller (ADF) and Philips Perron (PP) unit root test apply for checking the stationary level of the variables. The Philips Perron unit root test have non-parametric unit root test. After that we applied technique applied then used the bound testing approach by Shin, Yu and Greenwood-Nimmo, (2011) to examine long run cointegration between variables. Same procedure will apply for NARDL to check the non-linearity dynamics of energy demand. In the Wald test, long and short-term asymmetry among variables of macroeconomics and energy was examined.

3.2.1. Augmented Dickey Fuller (Adf) Test (1981)

For the examination of the stationary level of the variables, the Augmented Dickey Fuller test was applied. The simple regression model as follow:

$$\Delta Y_t = \gamma Y_{t-1} + \beta_t \Delta Y_{t-1} + \mu_t \quad (1)$$

Where Y_t is dependent variable, t show time period, β_t is independent variable and μ_t error term. There are three-stationarity property of the variables. These properties are trend, constant and trend and constant. The equations are follow:

$$\Delta Y_t = \alpha_o + \gamma Y_{t-1} + \beta_t \Delta Y_{t-1} + \mu_t \text{ (Constant)} \quad (2)$$

$$\Delta Y_t = \tau_o + \gamma Y_{t-1} + \beta_t \Delta Y_{t-1} + \mu_t \quad \text{(Trend)} \quad (3)$$

$$\Delta Y_t = \alpha_o + \tau_o + \gamma Y_{t-1} + \beta_t \Delta Y_{t-1} + \mu_t \text{ (Constant and Trend)} \quad (4)$$

In above equations where α (0)is constant, τ_o is time trend and (α_(o),τ_(o)) is constant and trend. Null Hypothesis is our series is non-stationary.

$H_0 : \phi < 0.10$

Alternative Hypothesis our series is stationary is:

$H_0 : \phi > 0.10$

Ho is null hypothesis, which explains that's if our critical value is less than 0.10 then we may accept the Null hypothesis this means that our variable has unit root problem. The alternative hypothesis H1 explains that if our critical value is greater than 0.10 then this means we may accept the alternative hypothesis and our series do not not have no unit root problem. ADF was the widely used unit root test but it does not have strong power. Due to this problem, it sometimes misleads the results. Therefore, Phillips and Perron, (1988:335) have modified ADF test and developed new unit root test named as Phillips and Perron Non-parametric unit root test.

3.2.2. Phillips and Perron Test (1988)

Phillips and Perron (PP) unit root test is non-parametric in nature. This test addresses heteroskedasticity and serial correlation problems. The regression equation of Phillips Perron test as follow:

$$\Delta Y_{t-1} = \alpha_0 + \gamma Y_{t-1} + \mu_t \quad (5)$$

Where μ_t is heteroscedasticity AR (1) process. Hypothesis are same as above Augmented Dickey Fuller (ADF) test.

3.2.3. Testing for Cointegration

Engle, R. F., & Granger, C. W., (1987: 251) used the most common single equational test to find co-integration between a set of I (1) variables and residual based tests. Johansen, S., (1991:1551, 1995) formed reduced rank approach for the calculation of cointegration tests. In recent times, to check cointegration, Autoregressive Distributed Lag (ARDL) test is used recently in applied empirical researches. ARDL test is based on Pesaran, Shin, (1999) and Pesaran, Shin and Smith, (2001:289). This method reportedly offers numerous advantages. Instead of VAR as in Johansen, this test is centered on a single ARDL equation; therefore, it reduces the number of parameters to be forecasted.

We also used the Non - linear Autoregressive Distributed Lag (NARDL) test, which was introduced for the first time by Shin, Yu and Greenwood-Nimmo (2014: 281), derivated from Pesaran, Shin and Smith's core work in 2001. It is now growing concern in the literature to study the non-stationarity and non-linearity together. To encounter this issue of non-stationarity and non-linearity, There are three econometric traditional models mentioned by Shin, Yu and Greenwood-Nimmo, (2014:281), the threshold ECM developed by Balke and Fomby, (1997:628). The Markov-switching ECM of Psaradakis, Sola and Spagnolo, (2004: 69) and the smooth transition regression ECM associated with Kapetanios, Shin and Snell, (2006: 279). However, most of these studies uphold the assumption that long-term relationship can be represented as a symmetrical with non-stationarity stochastic repressors (Shin, Yu and Greenwood-Nimmo. 2014:281). So for this reason NARDL introduced in the econometric literature.

3.2.3.1. The Auto Regressive Distribution Lag (ARDL) Model

In this research, Firstly Auto Regressive Distribution Lag (ARDL) Bound Testing Approach will be applied for finding out the short run and long run cointegration in the model separately Pesaran, Shin and Smith, (2001:289). The advantage of this approach. First, both short-term and long-term estimates can be estimated instantaneously. Secondly, if variables have a mixed integration order, this approach can be used to estimate the long - term association i.e. some variables can be immobilized at level and some are stationary at initial difference. Third, this approach gives better result in small data sets. Unrestricted Error Correction Model (UECM) equations are given below including short and long run relations;

$$\Delta lnED_t = \alpha_0 + \alpha_T T + \alpha_1 FDI_{t-j} + \alpha GDP_{t-j} + \alpha CO_{2,t-j} + \sum_{q=0}^{p} \xi \Delta\, FDI_{t-j} + \sum_{r=0}^{q} \vartheta\, GDP_{t-j} + \sum_{s=0}^{r} \Phi \Delta\, CO_{2,t-j} + \emptyset ECT + \eta_t \quad (6)$$

Where Δ is difference, $\xi, \vartheta, \Phi, \nu$ are the short run parameters of FDI, GDP and CO_2 respectively. α 1−4 are the long-term parameter.

ECT is an error correction term that shows speed of adjustment from short run to long run towards equilibrium. The linear ECT takes the following form:

$$\Delta lnED_t = \alpha_1 + \alpha_T T + \sum_{q=1}^{p} \delta_i\, \Delta lnFDI_{t-i} + \sum_{r=0}^{q} \delta_j\, \Delta LnGDP_{t-i} + \sum_{s=9}^{r} \delta_k\, \Delta LnCo2_{t-i} + \theta ECT + \mu_t \quad (7)$$

Where t is time-period in residual μ, Δ is difference operating variable, δ is the coefficient of the variable. Akaike information criterion (AIC) will be used to find the optimal lag length. F-test will be used to check the cointegration with the help of Wald test. Pesaran, Shin and Smith, (2001:289) have computed two critical bounds to check the long-run cointegration. These bounds are lower critical bounds and upper critical bounds. These bounds are used to compare the value of F-statistics of Wald test. If the value will greater than UCB then there will exist long-run relations and if the value will less than LCB then there will be no long-run co-integration in the model and if the value will occur somewhere between UCB and LCB then the results will be inconclusive.

3.2.3.2. The Non-Linear Autoregressive Distributed Lag Model (NARDL)

This study also examines the asymmetrical (nonlinear) long - term and short - term influence of FDI, GDP and CO2 on energy demand. Shin, Yu and Greenwood-Nimmo, (2014:281) have developed this approach. There are four reasons to use NARDL approach to cointegration. First, it allows the asymmetric cointegration relationship between the variables such as energy demand, foreign direct investment, and economic growth and carbon dioxide emission. Secondly, it explains the long - term and short - term nonlinear effects of independent variables on dependent variables. Third, irrespective of the integration order of variables with the NARDL long-run results can be achieved. Fourth, this approach uses the Wald test to check the long run and short run symmetry for variables.

The general functional form of NARDL can be expressed as:

$$ED = f(FDI^{+}, FDI^{-}, GDP^{+}, GDP^{-}, {CO_2}^{+}, {CO_2}^{-}) \quad (8)$$

The sign of + and – shows the fractional summation of positive and negative variations in FDI, GDP and CO_2. The long run asymmetric model can be expressed as:

$$ED_t = \beta_0 + \beta_1 FDI_t^{+} + \beta_2 FDI_t^{-} + \beta_3 GDP_t^{+} + \beta_4 GDP_t^{-} + \beta_5 CO_2^{+} + \beta_6 CO_{2,t}^{-} + \beta_7 ED_t^{+} + \beta_8 ED_t^{-} + \mu_t \quad (9)$$

Where βs show long run parameters to be assessed and μ_t is the white-noise error term. The constant term $\beta_0$captures all the constant, linear trend and the dummy variables for the structural break if any is applicable in the model.

To account long run and short-run asymmetric Shin, Yu and Greenwood-Nimmo, (2014:281) extended the linear ECM model as presented follow:

$$\Delta ED_t = \vartheta + \rho ED_{t-1} + \theta_1{}^{+} FDI_{t-1}^{+} + \theta_2{}^{-} FDI_{t-1}^{-} + \theta_3{}^{+} GDP_{t-1}^{+} + \theta_4{}^{-} GDP_{t-1}^{-} + \theta_5{}^{+} CO_{2}{}_{t-1}^{-} + \theta_6{}^{-} CO_{2}{}_{t-1}^{-} + \sum_{i=1}^{p-1} \gamma_i ED_{t-1} + \sum_{i=1}^{q-1} (\omega_i^{+} \Delta FDI_{t-i}^{+} + \omega_i^{-} \Delta FDI_{t-i}^{-}) + \sum_{i=1}^{q-1} (\omega_i^{+} \Delta GDP_{t-i}^{+} + \omega_i^{-} \Delta GDP_{t-i}^{-}) + \sum_{i=1}^{q-1} (\omega_i^{+} \Delta CO2_{t-i}^{+} + \omega_i^{-} \Delta CO2_{t-i}^{-}) + \mu_t \qquad (10)$$

The symbol p and q indicates the corresponding lag order of dependent and indecent variables. By applying Wald test the long run symmetric can be verified. The null hypothesis of symmetric is that $\theta^{+} = \theta^{-}$ and also estimate the long run asymmetric coefficients on the basis of $L_{mi} = -\frac{\theta^{+}}{\rho}$ and $L_{mi} = -\frac{\theta^{-}}{\rho}$. The short run adjustment of the shocks of positive and negative variable independent variable is captured by $\omega^{+} and\ \omega$- respectively. Using a standard Wald test short-term symmetry may also be tested by following the null hyphothesis that $\omega^{+} = \omega^{-}$ for all *i*=0 and q=-1. So if the null hypothesis of both Short run and long run symmetric is overruled, it will result in cointegrating The positive (θ^{+}) and negative(θ^{-}) sign in the above equation which indicates the decomposition of independent variables into positive and negative partial sums as an element of asymmetric in ARDL model that can be generated by computing:

$$\theta_1^{+} = \sum_{j=1}^{t} \Delta\, FDI_t^{+} = \sum_{j=1}^{t} \max(\Delta FDI_{t-1}^{+}\ 0)$$

$$\theta_2^{-} = \sum_{j=1}^{t} \Delta\, FDI_t^{-} = \sum_{j=1}^{t} \min(\Delta FDI_{t-1}^{-}\ 0)$$

$$\theta_1^{+} = \sum_{j=1}^{t} \Delta\, GDP_t^{+} = \sum_{j=1}^{t} \max(\Delta GDP_{t-1}^{+}\ 0)$$

$$\theta_2^{-} = \sum_{j=1}^{t} \Delta GDP_T^{-} = \sum_{j=1}^{t} \min(\Delta FDI_{t-1}^{-}\ 0)$$

$$\theta_1^{+} = \sum_{j=1}^{t} \Delta\, CO_{2,t}^{+} = \sum_{j=1}^{t} \max(\Delta CO_{2,t-1}^{+}\ 0)$$

$$\theta_1^- = \sum_{j=1}^{t} \Delta\, CO_{2,t}^- = \sum_{j=1}^{t} \min(\Delta CO_{2,t-1}^-\ 0)$$

There are two tests t-statistic by Banerjee, Dolado and Mestre, (1998: 267) and F-statistic by Pesaran, Shin and Smith, (2001:289). Test to check the asymmetric cointegration between the variables. The long run asymmetric cointegration are estimated with the null hypothesis$\rho = \theta^+ + \theta^- = 0$. The F-statistic that is denominated to F_{PPS} or Wald test denominated W_{PPS}. This test technique depends on two bounds same as ARDL. These bounds are upper and lower critical bounds. The long run balance relationship exists between dependent variable and descriptive variable if the estimated values of F_{PPS} exceed the upper bound this means the null hypothesis rejected. If F_{PPS} value lies under the lower critical bound, they are not cointegrated and if value are in between bounds then results are inconclusive.

Asymmetric was once found in the NARDL model (either long-term, short-term or both). Asymmetric reactions to positive and negative shocks (i.e. increase or decrease) are diagnosed with positive and negative dynamic multipliers related with variations in each unit in $FDI^+ and\ FDI^-, GDP^+\ and\ GDP^-, CO_2^+ nd\ CO_2^-$ addressed as follow:

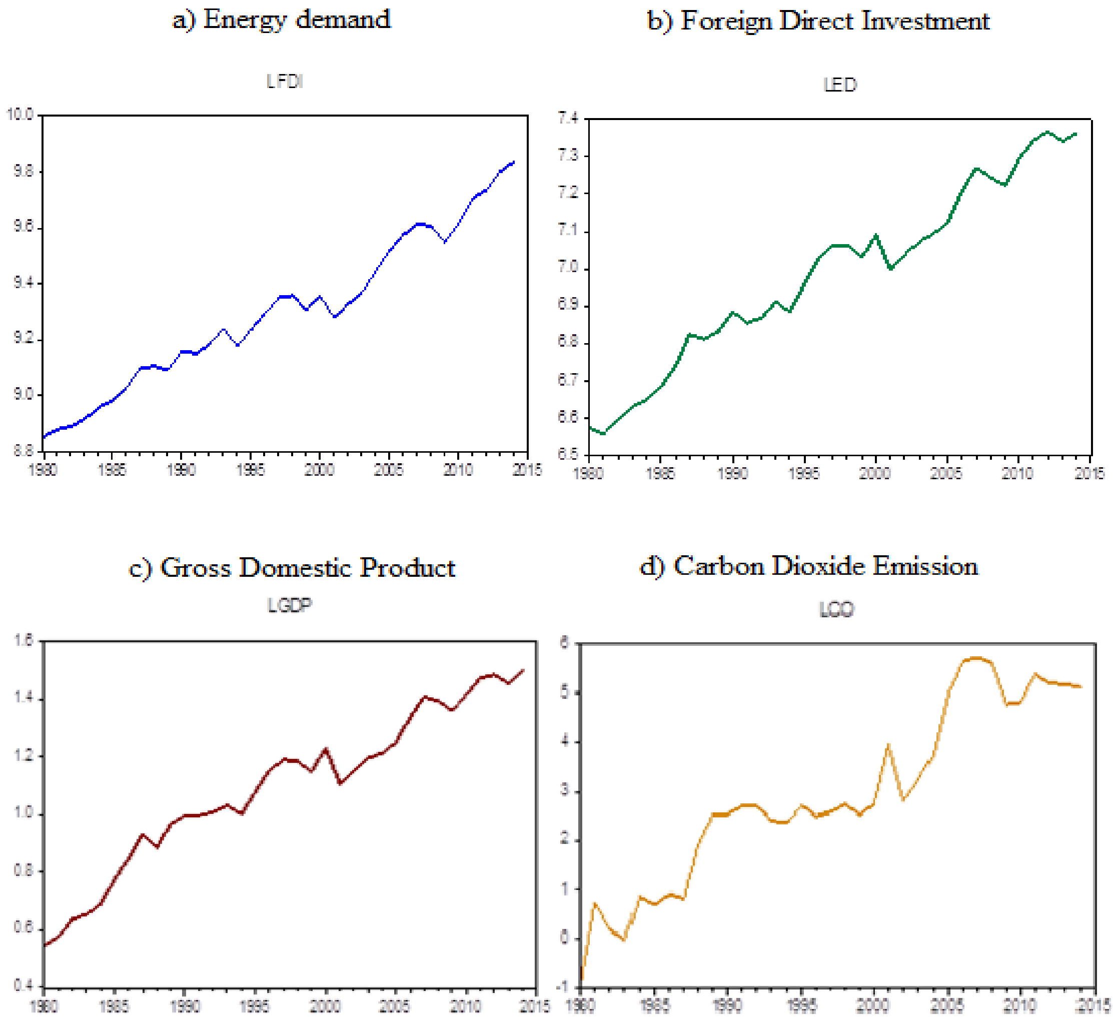
$$m_h^+ = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial FDI_t^+}, m_h^- = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial FDI_t^-}, m_h^+ = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial GDP_t^+}, m_h^- = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial GDP_t^-} m_h^+ = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial CO_{2,t}^+}, m_h^- = \sum_{j=0}^{h} \frac{\partial ED_{t+j}}{\partial CO_{2,t}^-} \quad (11)$$

For h = 0, 1, 2….

Where $h \to \infty$, then $m_h^+ \to Lm_{i^+}$ and $m_h^- \to Lm_{i^-}$ and when $Lm_{i^+}\ and\ Lm_{i^-}$ are asymmetric long run coefficient. On the bases of estimated multiplier we can see nonlinear dynamic adjustment among the two variables (energy demand associated with 1st FDI, 2nd with GDP and 3rd with CO_2) from its initial equilibrium to its new stable state in time, after a jolt that affects the cointegration system.

3.3. Empirical Analysis and Results Discussion

This part of study discusses the empirical analysis and result discussion. The yearly data is taken for the period of 1980-2015.The Time variation of the macroeconomic variables are shown in Graph 5.



Graph 5. Energy Demand, FDI, GDP and CO2 trend in Turkey

Source: Author estimation

Table: 1 shows descriptive and stochastic properties of the variables. The statistic value of J-bera test discloses that Energy Demand, Foreign Direct investment, Gross domestic product and CO_2 emission are normally distributed. Two variables are negatively skewed with the exception of Energy demand and GDP that is positively skewed. The standard deviation of FDI and GDP indicates highest variabilities over the time period versa energy demand and CO_2 are least volatile. The pairwise correlation indicates that a positive correlation exits between Energy demand, FDI, GDP and it is true for the CO_2.

Table 1.
Stochastic Properties of Energy demand

	lED_t	$lFDI_t$	$lGDP_t$	lCO_{2t}
Mean	6.986357	9.302602	1.093758	2.932748
Median	7.026588	9.292602	1.149764	2.716794
Maximum	7.368592	9.836008	1.502182	5.758206
Minimum	6.557903	8.85408	0.54398	-0.89327
Std.dev.	0.242447	0.275888	0.273282	1.826931
Skewness	-0.112302	0.193759	-0.368688	-0.082679
Kurtosis	2.021839	2.113849	2.267215	2.134855
J-B Stats	1.468901	1.364174	1.576016	1.131402
Probability	0.479769	0.505561	0.45475	0.567962

Sources: Author estimation

Given the condition of conducting the bound test where there are no variables integrated *I(2)*, we apply unit root tests. A number of unit root tests in existing applied economics literature, such as Dickey Fuller (DF), Augmented Dickey Fuller (ADF), Philips Perron (PP) and Kwiatkowski Phillips Schmidt Shin (KPS). This study applies Augmented Dickey Fuller and Philips Perron tests for empirical analysisIn order to identify single unknown structural breaks in series; the Kim and Perron ADF structural break unit root test is also used.

Table 2 and 3 show the unit root test analysis of Augmented Dickey Fuller and Philips Perron. The findings show that, apart from energy demand, not all other variables, foreign direct investment, GDP and CO2 are integrated at level, but at first difference. This implies that we have mixed cointegrated variables. (For details see Appendix).

Table 2
Augmented Dickey-Fuller Unit Root Test

	The equation type on Level			The equation type on 1st difference				
	none	intercept	Trend & Intercept	none	intercept	Trend & Intercept	(P-value)	İntegration level
ED		+	+				0.0965***	I(1)
FDI				+	+	+	0.0002*	I(1)
GDP				+	+	+	0.0001*	I(1)
CO_2				+	+	+	0.0001*	I(1)

Sources: Author estimation
Note: *, **, *** shows 1%, 5% and 10% respectively and + indicates the integration level.

Table 3
Philips Perron Unit Root Test

	The equation type on Level			The equation type on 1st difference				
	None	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	(P-value)	İntegration level
ED		+	+				0.0965***	I(1)
FDI				+	+	+	0.0001*	I(1)
GDP				+	+	+	0.0001*	I(1)
CO_2				+	+	+	0.0001*	I(1)

Sources: Author estimation
Note: *, **, *** shows 1%, 5% and 10% respectively and + indicates the integration level

Table 4 reports Kim and Perron (2009) ADF structural break unit root analysis. The finding show that Energy demand has a unit root problem at level in structural break 2010 as Turkey was facing high consumer price inflation that was upsurge up to 10%. Albeit, Foreign direct is not stationary at level and found structural break in 2000. That was because of banking crisis in Turkey. However, after taking first difference, foreign direct investment is stationary at 1% level of significance. Similarly, GDP is not integrated at level in the occurrence of 2002 because Turkey's banking system was collapsed and political system was changed. CO_2 have also unit root problem in 2005 but after taking 1st difference it become significant at 1%.

Table 4
Kim and Perron (2009) Structural Break Unit Root Test

Variables	ADF Test t-statistics value				Stationary
	Level	Break	1st Diff	Break	
$lnED$	-4.782358 (0.0187)**	2010	-6.79799 (0.0001) *	2006	I (1)
$lnFDI$	-3.730159 (0.2672)	2000	-6.587989 (0.0001) *	2002	I (1)
$lnGDP$	-2.343571 (0.9387)	2002	-6.3678981 (0.0100) *	1994	I (1)
$lnCO_2$	-2.764904 (0.8036)	2005	-6.805542 (0.0001)*	1999	I (1)

Sources: Author estimation
Note: *, **, *** illustrations of 1%, 5% and 10% level of significance correspondingly.

Optimal lag is the most important step in time series estimations and for forecasting. There are several lag length criterions like AIC, SC, HQ, LogL, LR, and FPE. Every criterion has different method and range. In this study, AIC is followed and according to AIC the optimal lag length of the model is 2 (-8.833631) showed in Table 5. Now, this study will use this optimal lag length for other econometric estimations.

Table 5
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	76.76544	NA	9.19E-08	-4.85103	-4.6642	-4.79126
1	147.7071	118.2362	2.39E-09	-8.51381	-7.579677*	-8.21497
2	168.5045	**29.11627***	**1.85e-09***	**-8.833631***	-7.15219	**-8.295725***
3	182.4878	15.84778	2.50E-09	-8.69919	-6.27045	-7.92221
4	192.8313	8.964332	5.24E-09	-8.32208	-5.14604	-7.30604

Sources: Author estimation
Note:* designates optimal lag order

3.4. Specification Testing

We estimate the symmetric and asymmetric dynamics of Energy demand using Equations (7) and (10).

3.4.1. Asymmetric Analysis

NARDL model is being adopted to check the asymmetric association between the variables. Following the works of Karamelikli, (2016:70), Bahmani-Oskooee, et al., (2016:23), Hammoudeh, et al., (2015:149), we used the bivariate equation for each of the explanatory variables. As in the original paper of Shin, Yu and Greenwood-Nimmo, (2014:281) they applied NARDL on single explanatory variable. The results of NARDL model is presented below:

Table 6
Dynamic Asymmetric Model

FDI-ED			GDP-ED			CO_2-ED		
Constant	-6.029548 (0.0015)		Constant	2.39E-05(0.0587)		Constant	-4.36908(0.0316)	
ED_{t-1}	-0.54988(0.0015)		ED_{t-1}	-1.36755(0.0648)		ED_{t-1}	-0.39268(0.0321)	
FDI^{+}_{t-1}	0.012377(0.2340)		GDP^{+}_{t-1}	1.22E-09(0.0102)		$CO2^{+}_{t-1}$	0.319221(0.0158)	
FDI^{-}_{t-1}	-0.002869 (0.8936)		GDP^{-}_{t-1}	3.66E-09(0.0028)		$CO2^{-}_{t-1}$	0.29487(0.0275)	
ΔFDI^{+}_{t-1}	-0.032526 (0.0930)		ΔGDP^{+}_{t}	3.05E-09(0.0072)		ΔED_{t-1}	-0.116454(0.3349)	
ΔFDI^{+}_{t-2}	-0.055277 (0.0277)					ΔED_{t-2}	-0.247738(0.0536)	
ΔFDI^{+}_{t-3}	-0.082067(0.0371)					$\Delta CO2^{+}_{t}$	0.613144(0.0000)	
ΔFDI_{t-2}	0.049169(0.1125)					$\Delta CO2^{-}_{t}$	0.905504(0.0000)	
ΔFDI_{t-3}	-0.055277(0.1691)					$\Delta CO2^{+}_{t-1}$	0.370967(0.0335)	
						$\Delta CO2^{+}_{t-2}$	0.292006(0.0842)	
Diagnostic Test								
D.W test	1.756918			1.882270			2.058786	
$\chi2$ Serial	0.668304 (0.5237)			0.941736(0.4066)			0.164309(0.8495)	
$\chi2$ BPG	0.646354 (0.7311)			0.673114(0.7372)			0.558689(0.8167)	
$\chi2$ RESET	0.837013 (0.412)			0.201587(0.8191)			1.247783(1.247783)	
	1 percent							
F-statistics	LB	UB		LB	UB		LB	UB
4.410701	6.84	7.84		6.84	7.84	2.955855	6.84	7.84

Sources: Author estimation
Note: The table presents the outcomes of evaluating the best NARDL specifications for energy demand sets with different variables. The positive and negative partial sum of series represented by subscript "+" and "-".p-value is in parenthesis. $\chi2$ serial, $\chi2$ BPG and $\chi2$ RESET denotes tests for serial correlation, heteroscedasticity and normality, respectively. The bound test described by Pesaran et al., (2001:289) used to calculate F-statistic values. Null hypothesis of no cointegration is $\rho = \theta^{+} = \theta^{-} = 0$.

From the estimated results from the Table 6, we compute long run equation for every variable separately, which is reported in the Table 7. The positive asymmetric long run coefficient of foreign direct investment has direct relationship with Energy Demand Theoretically analyzing, expanding foreign direct investment may help to boost economic growth, increase production efficiency and increase per capita income in a country. As well as rising living standards require higher quality of life for that demand of consumer for the energy products rise a hereby it will increase the energy demand. The positive partial sum of FDI indicates that an increase in FDI of one percent leads to an increment in energy demand in Turkey of 2.25 percent in the long term. The result are reliable with the findings of Sbia, Shahbaz, and Hamdi, (2014: 191), Ozturk and Acaravci, (2013: 262); Sadorsky, (2010a: 2528, 2011b: 999), Xu, (2012: 524). The FDI effect on the Energy demand is statistically insignificant which is also found in the finding of Çoban, and Topcu, (2013: 81). Omri and Kahouli, (2014: 913), Leit, (2015: 38) also discovered that FDI and economic growth have a positive influence on energy demand. Mentioning that along with positive shocks, FDI may leads to negative shocks that is represented by partial sum of negative change in FDI. The magnitude of reaction of decreasing in FDI is not same as positive partial sum of FDI. Negative parameter of FDI that shows 1% decrease in the FDI in Turkey will leads to decrease 0.5% energy consumption in the country. The rationale behind this finding that investor interest is to maximize profit in developing countries, exploited the resources, and misuse the energy-equipment. In the finding Aqeel, and Butt, (2001: 101). Mehrara, (2007: 2939), Huang, Hwang and Yang, (2008: 41), Bartleet and Gounder, (2010: 3505), Saatci and Dumrul, (2013: 20). Meanwhile, the negative shocks in economic growth also increases the utilization of energy. It is conceivable that building economic can be inhibited by political instability, mis-management of the possessions. So negative shocks rise the cost of production, excessive use of energy in non-productive sectors, or ineffective supply of energy and make inefficient use of energy Squalli, (2007: 1192). Carbon Dioxide emission have statistical significant on both positive and negative shocks. These results are consistent with Sbia, Shahbaz, and Hamdi, (2014: 191), Saidi and Hammami (2015: 62) findings.

Table 7
Asymmetric Long-Run Parameters

Variables	FDI-ED			GDP-ED			CO_2-ED	
	Coefficient	p-value		Coefficient	p-value		Coefficient	p-value
Constant	-6.029548	0.0015	Constant	-8.712012	0.0001	Constant	-7.858055	0.0004
ED_{t-1}	-0.549877	0.0015	ED_{t-1}	-0.795524	0.0001	ED_{t-1}	-0.702249	0.0004
FDI_{t-1}^{+}	0.0225087	0.2340	GDP_{t-1}^{+}	0.099571	0.0134	$CO2_{t-1}^{+}$	1.04579	0.0001
FDI_{t-1}^{-}	-0.005217	0.8936	GDP_{t-1}^{-}	0.109124	0.1941	$CO2_{t-1}^{-}$	1.058832	0.0001

Sources: Author estimation
Note: Estimated asymmetrical long - term coefficients of positive and negative changes, defined by $L_{mi} = -\frac{\theta^{+}}{\rho}$ and $L_{mi} = -\frac{\theta^{-}}{\rho}$.

Return to the study's main objective to check the energy demand function in Turkey is symmetric or asymmetric, we applied Wald test for detecting and long and short run symmetric among the variables. Table 8 shows the findings of Wald test.

Table 8
Presence of Asymmetries

	W_{LR}	W_{SR}	Conclusion
FDI-ED	1.281315 (0.21340)	2.369739 (0.1159)	Symmetric relationship exists between FDI and energy demand
GDP-ED	-0.200926 (0.8428)	2.486544 (0.1063)	Symmetric relationship exists between GDP and energy demand
CO_2-ED	-0.275748 (0.4337)	1.481142 (0.1528)	Symmetric relationship exists between CO_2 and energy demand

Sources: Author estimation
Note: This estimation is based on the equation (9). W_{LR} symbolizes Wald test for the long-run symmetric for the pair of energy demand and FDI, GDP or CO_2, which test the null hypothesis $\theta^{+} = \theta^{-}$.

Regarding the pair of variables for FDI-ED, GDP-ED and CO_2-ED, we perceive that null hypothesis is clearly accepted for long-term and short-term symmetry at 10%, 5% or 1% level. Methodologically, the conclusion drive from the Wald test, suggested that that an ARDL permitting long-term symmetry is most appropriate for regenerating dynamic interactions between energy demand and FDI, GDP or emissions.

3.4.2. Symmetric Analysis

Table 9 is showing the results of ARDL bound model. ED is dependent variable and FDI, GDP, CO_2 are independent variables. The calculated F-statistics are 7.497679, which is more than the upper critical limit at a significant level of 1 percent. We can therefore reject null hypothesis that is H_0 = there is no long-run cointegration. This shows that long-term cointegration exists in the model. In the short run, the coefficient of foreign direct investment is -0.01759 and statistically significant at 1%, which means that if foreign direct investment increases by 1 percent, Energy demand decreases by 1.75 percent in short-run. The result of these findings is consistent with Mielnik and Goldemberg, (2002: 87), Xiaoli.net al., (2007: 117), Chima, (2007: 17), Zheng and Chen, (2011: 2688) and Sbia, Shahbaz, and Hamdi, (2014: 191). This suggested that foreign direct investment is energy efficient in Turkey. Meanwhile, rising living standards require higher quality of life and more rigorous environmental management and FDI brings energy efficiency to the country and provides energy-saving technologies. The GDP has positive relationship with energy demand, which reveals that when GDP rises, production increases, more production rises the labor demand and per capita income in the country so does usage of energy rises. Consequently, GDP is source to increase in energy demand in Turkey. The coefficient of GDP is 0.035346 which means 1% increase in GDP increases demand for energy by 3.53 percent in short-run. This relationship is in accordance with the results of Aqeel and Butt, (2001: 101), De Vita, Endresen and Hunt, (2006: 3447), Mehrara, (2007: 2939), Huang, Hwang and Yang, (2008: 41), Bartleet and Gounder, (2010: 3505), Saatci and Dumrul, (2013: 20). CO_2 emission has positive effect on energy consumption Sbia, Shahbaz, and Hamdi, (2014: 191).

Table 9
Dynamic Symmetric Model

Estimate of the Linear ARDL model							
Panel A:Short-Run estimation							
	Lags						
	0	1	2	3	4		
ΔlnFDI	-0.01759	-0.01448	0.015931				
	0.0004	0.0392	0.0011				
ΔlnGDP	0.035346	-0.06529	-0.03578				
	0.0581	0.0166	0.0917				
ΔlnCO_2	0.662779	0.194475	0.075049				
	0.00000	0.0104	0.2087				
Panel B: Long-Run Estimation							
Constant	0.871556 (0.5511)						
ln FDI	-0.00591 (0.415)						
ln GDP	0.034509 (0.0809)					D.watson	
ln CO_2	0.716912 (0.000000)					2.307098	
Panel C: Diagnostic statistics							
	1 percent		ECMt−1	$\chi 2$ LM	$\chi 2$ BPG	$\chi 2$ RESET	Adj. R2
F-statistic	I(0)Bound	I(1) Bound	-0.6224	1.779853	0.711362	0.975654	0.986815
7.497679	4.29	5.61	(0.0002)	(0.2025)	(0.7301)	(0.338)	

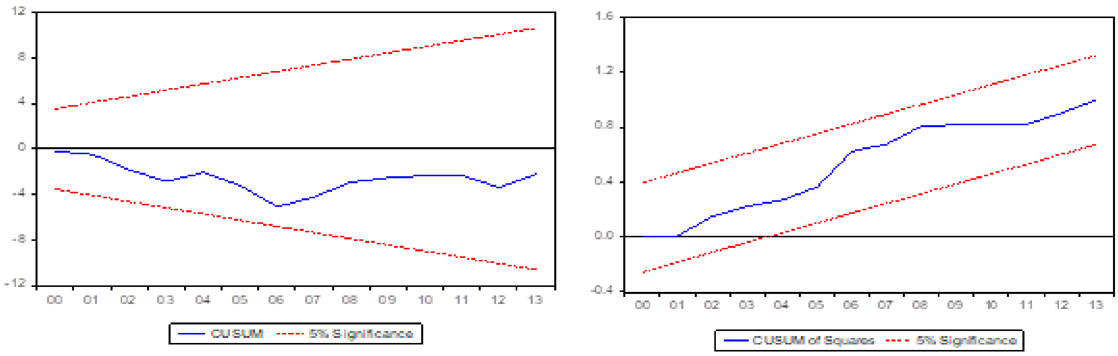
Sources: Author Estimation
Note: *, **, *** shows 1%, 5% and 10% respectively.

The ECM represent in the short term as a percentage of the disequilibirium inaccuracy and altered in every period. The estimated approach map the gradual adjustment towards the new equilibrium after the shocks from the initial equilibrium. The term correction of errors (ECT) is negative and statistically substantial at a level of 1 percent. ECT indicates that about 62% convergence towards the long run equilibrium is completed in a year following a shock in the economy. Adj-R-square of the model is 0.986815, which means that 98.68 percent dependent variable is described by independent variables. Adjusted R-square is confirming the specification of the model. Durbin-Watson test shows that no problem of autocorrelation in the series has been found and its value is 2.1586. Decision criteria of DW test is 1.5 to 2.5. If the value is between these boundaries, the series does not have an autocorrelation.

Diagnostic tests further confirm the stability of this model. $\chi 2\ LM$ checks the serial correlation in the series and If the LM serial correlation's probability value is greater than 0.10, the series does not have a serial correlation. The probability value is 0.2025, meaning that the series does not have a serial correlation. $\chi 2ARCH$ checks the problem of hetroskedasticity in the model. It shows that whether the variance of the error term is persistent over the time and mean of error term is zero or not. If the probability is, higher than 0.10, then we may say that the error term of variance is constant and mean is zero. In this model, calculated probability value is 0.7301, which means that there is no problem of hetroskedasticity in the error term and same in the case of WHITE hetroskedasticity. The RAMSEY RESET Test shows that our probability value is higher than 0.1 this show that the operational form of this model is well itemized and well formulated.

After, the short-run impacts of Energy demand, this study has estimated the long-run impacts of energy demand. In long-run foreign direct investment and energy demand has inverse relationship which means that increases in foreign direct investment saves energy demand but statistically it's insignificant. GDP has positively impact on the Energy Demand and responsible of increasing the energy demand in Turkey. Moreover, CO_2 is positively linked with energy demand.

For the testing the robustness of any statistical analysis, it is necessary to check the stability of the parameters; for this reason Brown, Durbin and Evans, (1975: 149) and Pesaran and Pesaran, (1997) suggested the use of the CUSUM or CUSUMQ parameters test constructed by Brown, Durbin and Evans, (1975: 149) after evaluating short-term and long-term coefficients.   Graph 6 indicated that our model is stable.



Graph 6. CUSUM and CUSUMQ
test for parameter stability: plot (left) indicate the cumulative sum and plot (right) indicates cumulative sum of squares of recursive residual
Note: straight lines refer to critical boundaries with a 5% of significance level
Source: Author estimation

CONCLUSION AND POLICY RECOMMENDATION

Despite several years of improvement in the literature of energy demand, foreign direct investment and economic growth and CO2, yet consensus of the previous studies remains elusive. We could not find any study that inspected the effect of FDI, GDP and CO_2 on the energy demand while using the framework of linear and non-linear models. This paper therefore attempts to examine the symmetric and asymmetric aspects of energy demand. The result is based on data from the 1980 - 2015 annual time series. We applied Linear ARDL and non-linear ARDL model that allows to check the potential of symmetric and asymmetric dynamics of energy demand in Turkey. This method can be applied to time series data regardless of the order of integration. This study found several interesting findings.

Firstly, for the purpose of empirical analysis, we apply ADF and PP to determine the integral properties of variables. Mix order integration level I (0) and I (1) have been found by both ADF and PP unit root test. Structural break unit root test is also applied for checking the single unknown structural breaks in the data. After ensuring that there is no integrated variables at I(2), lag-length criteria is applicable to find the optimal lag of the series, which is 2 that was confirmed by Akaike information criterion (AIC). After finding the optimal lag, with the latest advancement in the time series and cointegration analysis, the asymmetry of data can be estimated. The non-linear autoregressive distribution lag (NARDL) model is applied to check the asymmetric long-run cointegration in the model. The long run parameter of NARDL indicates that positive shocks (incentives, Investment Promotion and subsidies or lower tax) in Foreign direct investment mainly rises energy demand. Similarly, negative shocks (political instability, poor infrastructure, higher tax) in FDI also rises the energy demand but statistically it is insignificant. GDP shocks; both positive (increase in productivity, rising income level) and negative (using energy in non-productive sectors, inefficient use of energy) raise energy demand.. Carbon Dioxide emission rises the energy demand and is statistically significant on both positive and negative shocks. It is discovered that carbon dioxide emission mainly increases energy demand. After the Wald test was applied to check the occurrence of long run asymmetric relationship between energy demand, FDI, GDP and CO_2 emission. The results of the Wald test indicated the absence of asymmetry between variables.

After failing to reject the null hypothesis of H_1 that was; there is no asymmetric association between Energy demand and FDI, CO_2 and GDP. Linear Autoregressive Distribution Lag (ARDL) model was applied to find the short run and long run cointegration in the model. The ARDL bound test found that there have both short run and long run impact of FDI, GDP and emission on energy demand. The short-run analysis showed that FDI has negative and statistically significant relationship with energy demand. This indicates that foreign direct investment is energy efficient. It provides energy-saving technologies in Turkey. The GDP has a positive relationship with energy demand, which reveals that when GDP rises, production increases, more production rises the labor demand and per capita income in the country so eventually, usage of energy rises. Consequently, GDP is source to increase in energy demand in Turkey. Emissions of CO2 have an affirmative impact on energy consumption. The error correction term is adverse and statistically significant, which means that the rate of adjustment to the long-term equlibrium is 62 percent.

The long-run foreign direct investment is negatively related with energy demand, which indicates the increment in foreign direct investment saves energy demand but statistically it is insignificant. GDP has positively affected on the Energy Demand and is responsible for increasing the energy demand in Turkey. CO2 is positively linked with energy demand. The model's reliability is confirmed by CUSUM and CUSUM.

Many practical policy implications for decision makers to formulate macroeconomic strategies can be derived from this research. Energy consumption is a crucial need for any economy. Keeping the economy on the development path, discovering domestic energy sources, improving energy efficiency, discouraging imports energy dependency and improving environmental quality should be given priority.

The Turkish government should develop a comprehensive long-term energy model in order to maintain a sustainable growth model, climate and how to attract more FDI strategy. Government needs to identify which steps must be taken to achieve its goal and build the monitoring system to track their policy impact on the economy, and those policies should integrate with FDI inflows, economic growth and climate change with energy policy. Turkey’s policy is already focused on enormous energy-intensive projects, reducing the energy import dependency, increasing the usage of local resources and coping with the climate change, by ensuring huge domestic and foreign investment in energy-intensive projects, especially renewable energy and nuclear plants. Turkey is also expanding their Research and Development (R&D) sector on energy technology. The adoption of environmentally friendly technologies not only contributes to the long - term improvement of air quality, but also saves future generations energy.

REFERENCES

Akarca, A. T., & Long, T. V. (1980). On the relationship between energy and GNP: a reexamination. *The Journal of Energy and Development*, *5*(2), 326-331.

Alam, M. M., Murad, M. W., Noman, A. H. M., & Ozturk, I. (2016). Relationships among carbon emissions, economic growth, energy consumption and population growth: Testing Environmental Kuznets Curve hypothesis for Brazil, China, India and Indonesia. *Ecological Indicators,* 70, 466-479.

Alam, M. S., Paramati, S. R., Shahbaz, M., & Bhattacharya, M. (2017). Natural gas, trade and sustainable growth: empirical evidence from the top gas consumers of the developing world. *Applied Economics*, *49*(7), 635-649.

Alcántara, V., & Roca, J. (1995). Energy and CO_2 emissions in Spain: methodology of analysis and some results for 1980–1990. *Energy Economics*, *17*(3), 221-230.

Al-Iriani, M. A. (2006). Energy–GDP relationship revisited: an example from GCC countries using panel causality. *Energy policy*, *34*(17), 3342-3350.

Al-Mulali, U., & Sab, C. N. B. C. (2012). The impact of energy consumption and CO_2 emission on the economic growth and financial development in the Sub Saharan African countries. *Energy,* 39(1), 180-186.

Ang, B. W. (1999). Is the energy intensity a less useful indicator than the carbon factor in the study of climate change?. *Energy Policy*, *27*(15), 943-946

Ang, J. B. (2007). CO2 emissions, energy consumption, and output in France. *Energy Policy*, *35*(10), 4772-4778.

Ang, J. B. (2007). CO2 emissions, energy consumption, and output in France. *Energy Policy*, *35*(10), 4772-4778.

Ang, J. B. (2008). Economic development, pollutant emissions and energy consumption in Malaysia. *Journal of Policy Modeling*, *30*(2), 271-278.

Antweiler, W., Copeland, B. R., & Taylor, M. S. (2001). Is free trade good for the environment?. *American Economic Review*, *91*(4), 877-908.

Apergis, N., & Payne, J. E. (2009). Energy consumption and economic growth in Central America: evidence from a panel cointegration and error correction model. *Energy Economics*, *31*(2), 211-216.

Aqeel, A., & Butt, M. S. (2001). The relationship between energy consumption and economic growth in Pakistan. *Asia-Pacific Development Journal*, *8*(2), 101-110.

Arouri, M. E. H., Youssef, A. B., M'henni, H., & Rault, C. (2012). Energy consumption, economic growth and CO2 emissions in Middle East and North African countries. *Energy policy*, *45*, 342-349.

Arrow, K. J. (1971). The economic implications of learning by doing. In *Readings in the Theory of Growth* (pp. 131-149). Palgrave Macmillan, London.

Asafu-Adjaye, J. (2000). The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries. *Energy economics*, *22*(6), 615-625.

Bahmani-Oskooee, M., Halicioglu, F., & Hegerty, S. W. (2016). Mexican bilateral trade and the J-curve: An application of the nonlinear ARDL model. *Economic analysis and policy*, *50*, 23-40.

Balke, N. S., & Fomby, T. B. (1997). Threshold cointegration. *International economic review*, 627-645.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error‐ correction mechanism tests for cointegration in a single‐ equation framework. *Journal of time series analysis*, *19*(3), 267-283.

Bartleet, M., & Gounder, R. (2010). Energy consumption and economic growth in New Zealand: Results of trivariate and multivariate models. *Energy Policy*, *38*(7), 3508-3517.

Begum, R. A., Sohag, K., Abdullah, S. M. S., & Jaafar, M. (2015). CO2 emissions, energy consumption, economic and population growth in Malaysia. *Renewable and Sustainable Energy Reviews*, 41, 594-601.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 149-192.

Çamdali, Ü., & Edıger, V. Ş. (2007). Optimization of fossil fuel sources: an energy approach. *Energy Sources, Part A*, *29*(3), 251-259.

Campo, J., & Sarmiento, V. (2013). The relationship between energy consumption and GDP: evidence from a panel of 10 Latin American countries. *Latin american journal of economics*, *50*(2), 233-255.

Çetintaş, H., & Sarıkaya, M. (2015). CO2 Emissions, Energy Consumption and Economic Growth in the USA and the United Kingdom: ARDL Approach.

C-H., Kang, J-G., Yuan, J. (2008), *Oil Consumption and Economic Growth in China: A Multivariate Cointegration Analysis*. The 2008 International Conference on Risk Management & Engineering Management, 178-183.

Chang, S. C. (2015). Effects of financial developments and income on energy consumption. *International Review of Economics & Finance*, *35*, 28-44.

Chen, P. Y., Chen, S. T., Hsu, C. S., & Chen, C. C. (2016). Modeling the global relationships among economic growth, energy consumption and CO2 emissions. *Renewable and Sustainable Energy Reviews*, *65*, 420-431.

Cheng, B. S. (1995). An investigation of cointegration and causality between energy consumption and economic growth. *The journal of energy and development*, *21*(1), 73-84.

Cheng, B. S. (1999). Causality between energy consumption and economic growth in India: an application of cointegration and error-correction modeling. *Indian Economic Review*, 39-49.

Cheng, S.B., Lai, W.T.,(1997).An investigation of co-integration and causality between energy consumption and economic activity in Taiwan, province of China. *Energy Economics 19*,435–444.

Chima, C. M. (2007). Intensity of energy use in the USA: 1949–2003. *Journal of Business & Economics Research*, *5*(11), 17-30.

Choi, K. H., & Ang, B. W. (2001). A time-series analysis of energy-related carbon emissions in Korea. *Energy Policy*, *29*(13), 1155-1161.

Claessens, S., & Feijen, E. (2007). *Financial sector development and the millennium development goals*. The World Bank. World Bank Working Paper No. 89.

Çoban, S., & Topcu, M. (2013). The nexus between financial development and energy consumption in the EU: A dynamic panel data analysis. *Energy Economics*, *39*, 81-88.

Çoban, S., & Topcu, M. (2013). The nexus between financial development and energy consumption in the EU: A dynamic panel data analysis. *Energy Economics*, *39*, 81-88.

Cole, M. A. (2006). Does trade liberalization increase national energy use?. *Economics Letters*, *92*(1), 108-112.

De Vita, G., Endresen, K., & Hunt, L. C. (2006). An empirical analysis of energy demand in Namibia. *Energy Policy*, *34*(18), 3447-3463.

Dritsaki, C., & Dritsaki, M. (2014). Causal relationship between energy consumption, economic growth and CO2 emissions: A dynamic panel data approach. *International Journal of Energy Economics and Policy*, *4*(2), 125.

Dube, S. (2009). Foreign direct investment and electricity consumption on economic growth: evidence from South Africa. *Economia Internazionale/International Economics*, *62*(2), 175-200.

Eden, S. H., & Hwang, B. K. (1984). The relationship between energy and GNP: further results. *Energy economics*, *6*(3), 186-190.

Eden, S. H., & Hwang, B. K. (1984). The relationship between energy and GNP: further results. *Energy economics*, *6*(3), 186-190.

Ediger, V. Ş. (2003). Classification and performance analysis of primary energy consumers during 1980–1999. *Energy Conversion and management*, *44*(19), 2991-3000.

Ediger, V. S. (2004). Energy productivity and development in Turkey. *Energy and Cogeneration World*, *25*, 74-78.

Ediger, V. Ş. (2008). National energy report of Turkey: Energy situation, challenges, and policies for sustainable development. In *AASA Beijing Workshop on Sustainable Energy Development in Asia, Beijing, China, InterAcademy council* (pp. 77-93).

Elliott, R. J., Sun, P., & Chen, S. (2013). Energy intensity and foreign direct investment: A Chinese city-level study. *Energy Economics*, *40*, 484-494.

Elliott, R. J., Sun, P., & Chen, S. (2013). Energy intensity and foreign direct investment: A Chinese city-level study. *Energy Economics*, *40*, 484-494.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Engle, R., & Granger, C. W. J. (2001). Co-integration and error-correction: Representation, estimation, and testing. *Econometric Society Monographs*, *33*, 145-172.

Erol, U., & Yu, E. S. (1987). On the causal relationship between energy and income for industrialized countries. *The Journal of Energy and Development*, 113-122.

ERTUĞRUL, H. M. (2013). Türkiye'de Enerji Tüketimi GSYH İlişkisi: Dinamik Bir Analiz. *Sosyal Ekonomik Araştırmalar Dergisi*, (25), 249-266.

Farhani, S., & Ben Rejeb, J. (2012). Link between economic growth and energy consumption in over 90 countries. Farhani, Sahbi and Ben Rejeb, Jaleleddine, Link between Economic Growth and Energy Consumption in Over 90 Countries (March 1, 2012*). Interdisciplinary Journal of Contemporary Research in Business (IJCRB), 3(11),* 282-297.

Fatai, K., Oxley, L., & Scrimgeour, F. (2002, June). Energy consumption and employment in New Zealand: searching for causality. In *NZAE conference, Wellington* (Vol. 2).

Foon Tang, C. (2009). Electricity consumption, income, foreign direct investment, and population in Malaysia: new evidence from multivariate framework analysis. *Journal of Economic Studies*, *36*(4), 371-382.

Frankel, J. A., & Rose, A. K. (2005). Is trade good or bad for the environment? Sorting out the causality. *The Review of economics and statistics*, *87*(1), 85-91.

Ghali, K. H., & El-Sakka, M. I. (2004). Energy use and output growth in Canada: a multivariate cointegration analysis. *Energy economics*, *26*(2), 225-238.

Glasure, Y. U., & Lee, A. R. (1998). Cointegration, error-correction, and the relationship between GDP and energy: The case of South Korea and Singapore. *Resource and Energy Economics*, *20*(1), 17-25.

Gökmenoğlu, K., & Taspinar, N. (2016). The relationship between CO2 emissions, energy consumption, economic growth and FDI: the case of Turkey. *The Journal of International Trade & Economic Development*, *25*(5), 706-723.

Gürer, N., & Ban, J. (1997). Factors Affecting Energy- related CO2 Emissions: Past Levels and Present Trends. *OPEC Energy Review*, *21*(4), 309-350.

Halicioglu, F. (2009). An econometric study of CO 2 emissions, energy consumption, income and foreign trade in Turkey. *Energy Policy*, *37*(3), 1156-1164.

Hammoudeh, S., Lahiani, A., Nguyen, D. K., & Sousa, R. M. (2015). An empirical analysis of energy cost pass-through to CO 2 emission prices. *Energy Economics*, *49*, 149-156.

Hepbasli, A. (2005). Development and restructuring of Turkey's electricity sector: a review. *Renewable and Sustainable Energy Reviews*, *9*(4), 311-343.

Huang, B. N., Hwang, M. J., & Yang, C. W. (2008). Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. *Ecological economics*, *67*(1), 41-54.

Hübler, M., & Keller, A. (2010). Energy savings via FDI? Empirical evidence from developing countries. *Environment and Development Economics*, *15*(1), 59-80.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society*, 1551-1580.

Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford University Press on Demand.

Joo, Y. J., Kim, C. S., & Yoo, S. H. (2015). Energy consumption, Co2 emission, and economic growth: Evidence from Chile. *International journal of green energy*, *12*(5), 543-550.

Joyeux, R., & Ripple, R. D. (2007). Household energy consumption versus income and relative standard of living: a panel approach. *Energy Policy*, *35*(1), 50-60.

Jumbe, C. B. (2004). Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. *Energy economics*, *26*(1), 61-68.

Kais, S., & Ben Mbarek, M. (2017). Dynamic relationship between CO2 emissions, energy consumption and economic growth in three North African countries. *International Journal of Sustainable Energy*, *36*(9), 840-854.

Kapetanios, G., Shin, Y., & Snell, A. (2006). Testing for cointegration in nonlinear smooth transition error correction models. *Econometric Theory*, *22*(2), 279-303.

Karamelikli, H. (2016). Linear and Nonlinear Dynamics of the Turkish Trade Balance. *International Journal of Economics and Finance*, *8*(2), 70.

Karanfil, F. (2009). How many times again will we examine the energy-income nexus using a limited range of traditional econometric tools?. *Energy Policy*, *37*(4), 1191-1194.

Keleş, S., & Bilgen, S. (2012). Renewable energy sources in Turkey for climate change mitigation and energy sustainability. *Renewable and Sustainable Energy Reviews*, *16*(7), 5199-5206.

Kraft, J., & Kraft, A. (1978). On the relationship between energy and GNP. *The Journal of Energy and Development*, 401-403.

Lee, C. C. (2005). Energy consumption and GDP in developing countries: a cointegrated panel analysis. *Energy economics*, *27*(3), 415-427.

Lee, C. C., & Chang, C. P. (2008). Energy consumption and economic growth in Asian economies: a more comprehensive analysis using panel data. *Resource and energy Economics*, *30*(1), 50-65.

Lee, J. W. (2013). The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. *Energy Policy*, *55*, 483-489.

Lee, J. W., & Brahmasrene, T. (2013). Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. *Tourism Management*, *38*, 69-76.

Lee, S. R., & Yoo, S. H. (2016). Energy consumption, CO2 emissions, and economic growth in Korea: A causality analysis. *Energy Sources, Part B: Economics, Planning, and Policy*, *11*(5), 412-417.

Leit, N. C. (2015). Energy consumption and foreign direct investment: a panel data analysis for Portugal. *International Journal of Energy Economics and Policy*, *5*(1), 138.

Li, K., & Qi, S. (2016). Does FDI Increase Industrial Energy Consumption of China? Based on the Empirical Analysis of Chinese Provinces Industrial Panel Data. *Emerging Markets Finance and Trade*, *52*(6), 1305-1314.

Lise, W. (2006). Decomposition of CO2 emissions over 1980–2003 in Turkey. *Energy Policy*, *34*(14), 1841-1852.

Magazzino, C. (2016). The relationship between CO2 emissions, energy consumption and economic growth in Italy. *International Journal of Sustainable Energy*, *35*(9), 844-857.

Masih, A. M., & Masih, R. (1996). Energy consumption, real income and temporal causality: results from a multi-country study based on cointegration and error-correction modelling techniques. *Energy economics*, *18*(3), 165-183.

Masih, A. M., & Masih, R. (1998). A multivariate cointegrated modelling approach in testing temporal causality between energy consumption, real income and prices with an application to two Asian LDCs. *Applied Economics*, *30*(10), 1287-1298.

Mehrara, M. (2007). Energy consumption and economic growth: the case of oil exporting countries. *Energy policy*, *35*(5), 2939-2945.

Menyah, K., & Wolde-Rufael, Y. (2010). CO2 emissions, nuclear energy, renewable energy and economic growth in the US. *Energy Policy*, *38*(6), 2911-2915.

Menyah, K., & Wolde-Rufael, Y. (2010). Energy consumption, pollutant emissions and economic growth in South Africa. *Energy Economics*, *32*(6), 1374-1382.

Metz, B., Davidson, O., Bosch, P., Dave, R., & Meyer, L. (2007). *Climate Change 2007: Mitigation* (No. C048. 060). Intergovernmental Panel on Climate Change.

Mielnik, O., & Goldemberg, J. (2002). Foreign direct investment and decoupling between energy and gross domestic product in developing countries. *Energy policy*, *30*(2), 87-89.

Nain, M. Z., Ahmad, W., & Kamaiah, B. (2017). Economic growth, energy consumption and CO2 emissions in India: a disaggregated causal analysis. *International Journal of Sustainable Energy, 36*(8), 807-824.

Nguyen-Van, P. (2008). *Energy consumption and economic development: a semiparametric panel analysis* (No. 2008-03). THEMA (THéorie Economique, Modélisation et Applications), Université de Cergy-Pontoise.

Niu, S., Ding, Y., Niu, Y., Li, Y., & Luo, G. (2011). Economic growth, energy conservation and emissions reduction: A comparative analysis based on panel data for 8 Asian-Pacific countries. *Energy policy*, *39*(4), 2121-2131.

Oh, W., & Lee, K. (2004). Causal relationship between energy consumption and GDP revisited: the case of Korea 1970–1999. *Energy economics*, *26*(1), 51-59.

Oh, W., & Lee, K. (2004). Energy consumption and economic growth in Korea: testing the causality relation. *Journal of Policy Modeling*, *26*(8-9), 973-981.

Omri, A., & Kahouli, B. (2014). Causal relationships between energy consumption, foreign direct investment and economic growth: Fresh evidence from dynamic simultaneous-equations models. *Energy Policy*, *67*, 913-922.

Ozturk, H. K. (2005). Energy usage and cost in textile industry: A case study for Turkey. *Energy*, *30*(13), 2424-2446.

Ozturk, I., & Acaravci, A. (2010). The causal relationship between energy consumption and GDP in Albania, Bulgaria, Hungary and Romania: Evidence from ARDL bound testing approach. *Applied Energy*, *87*(6), 1938-1943.

Ozturk, I., & Acaravci, A. (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics*, *36*, 262-267.

Pagáaa, E., & Gürer, N. (1996). A comparative analysis of world energy- use patterns and related CO2 emissions. *OPEC Energy Review, 20*(4), 311-346.

Pao, H. T., Fu, H. C., & Tseng, C. L. (2012). Forecasting of CO2 emissions, energy consumption and economic growth in China using an improved grey model. *Energy*, *40*(1), 400-409.

Paramati, S. R., Apergis, N., & Ummalla, M. (2017). Financing clean energy projects through domestic and foreign capital: The role of political cooperation among the EU, the G20 and OECD countries. *Energy Economics*, *61*, 62-71.

Paul, S., & Bhattacharya, R. N. (2004). Causality between energy consumption and economic growth in India: a note on conflicting results. *Energy economics*, *26*(6), 977-983.

Pesaran MH, Shin Y (1999) An autoregressive distributed lag modelling approach to cointegration analysis. In: Storm S (ed) *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, Chapter 11. Cambridge University Press, Cambridge*

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Psaradakis, Z., Sola, M., & Spagnolo, F. (2004). On Markov error- correction models, with an application to stock prices and dividends. *Journal of Applied Econometrics*, *19*(1), 69-88.

Saatci, M., & Dumrul, Y. (2013). The relationship between energy consumption and economic growth: Evidence from a structural break analysis for Turkey. *International Journal of Energy Economics and Policy*, *3*(1), 20.

Saboori, B., Sapri, M., & bin Baba, M. (2014). Economic growth, energy consumption and CO2 emissions in OECD (Organization for Economic Co-operation and Development)'s transport sector: A fully modified bi-directional relationship approach. *Energy*, *66*, 150-161.

Sadorsky, P. (2009). Renewable energy consumption, CO 2 emissions and oil prices in the G7 countries. *Energy Economics*, *31*(3), 456-462.

Sadorsky, P. (2010). The impact of financial development on energy consumption in emerging economies. *Energy policy*, *38*(5), 2528-2535.

Sadorsky, P. (2011). Financial development and energy consumption in Central and Eastern European frontier economies. *Energy Policy*, *39*(2), 999-1006.

Sahir, M. H., & Qureshi, A. H. (2007). Specific concerns of Pakistan in the context of energy security issues and geopolitics of the region. *Energy Policy*, *35*(4), 2031-2037.

Saidi, K., & Hammami, S. (2015). The impact of CO_2 emissions and economic growth on energy consumption in 58 countries. *Energy Reports*, *1*, 62-70.

Salahuddin, M., & Gow, J. (2014). Economic growth, energy consumption and CO_2 emissions in Gulf Cooperation Council countries. *Energy*, 73, 44-58.

Sbia, R., Shahbaz, M., & Hamdi, H. (2014). A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. *Economic Modelling*, *36*, 191-197.

Schipper, L., Ting, M., Khrushch, M., & Golove, W. (1997). The evolution of carbon dioxide emissions from energy use in industrialized countries: an end-use analysis. *Energy Policy*, *25*(7-9), 651-672.

Shabbir, M. S., Shahbaz, M., & Zeshan, M. (2014). Renewable and nonrenewable energy consumption, real GDP and CO_2 emissions nexus: a structural VAR approach in Pakistan. *Bulletin of Energy Economics*, *2*(3), 91-105.

Shabbir, M. S., Shahbaz, M., & Zeshan, M. (2014). Renewable and nonrenewable energy consumption, real GDP and CO_2 emissions nexus: a structural VAR approach in Pakistan. *Bulletin of Energy Economics*, *2*(3), 91-105.

Shahbaz, M., & Lean, H. H. (2012). Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. *Energy policy*, *40*, 473-479.

Shahbaz, M., Hye, Q. M. A., Tiwari, A. K., & Leitão, N. C. (2013). Economic growth, energy consumption, financial development, international trade and CO_2 emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, *25*, 109-121.

Shahbaz, M., Loganathan, N., Zeshan, M., & Zaman, K. (2015). Does renewable energy consumption add in economic growth? An application of auto-regressive distributed lag model in Pakistan. *Renewable and Sustainable Energy Reviews*, *44*, 576-585.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2011). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In *Festschrift in Honor of Peter Schmidt* (pp. 281-314). Springer, New York, NY.

Sirin, S. M. (2017). Foreign direct investments (FDIs) in Turkish power sector: A discussion on investments, opportunities and risks. *Renewable and Sustainable Energy Reviews*, *78*, 1367-1377.

Soytas, U., & Sari, R. (2003). Energy consumption and GDP: causality relationship in G-7 countries and emerging markets. *Energy economics*, *25*(1), 33-37.

Soytas, U., & Sari, R. (2009). Energy consumption, economic growth, and carbon emissions: challenges faced by an EU candidate member. *Ecological economics, 68*(6), 1667-1675.

Soytas, U., Sari, R., & Ewing, B. T. (2007). Energy consumption, income, and carbon emissions in the United States. *Ecological Economics*, *62*(3), 482-489.

Soytas, U., Sari, R., & Ewing, B. T. (2007). Energy consumption, income, and carbon emissions in the United States. *Ecological Economics*, *62*(3), 482-489.

Squalli, J. (2007). Electricity consumption and economic growth: Bounds and causality analyses of OPEC members. *Energy Economics*, *29*(6), 1192-1205.

Stern, D. I. (1993). Energy and economic growth in the USA: a multivariate approach. *Energy economics*, *15*(2), 137-150.

Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World development*, *32*(8), 1419-1439.

Stern, D. I., & Cleveland, C. J. (2004). *Energy and Economic Growth. Rensselaer Polytechnic Institute* (No. 0410). Rensselaer Working Papers in Economics.

Tamazian, A., Chousa, J. P., & Vadlamannati, K. C. (2009). Does higher economic and financial development lead to environmental degradation: evidence from BRIC countries. *Energy policy*, *37*(1), 246-253.

Ting, Y. U. E., Yin, L. R., & Ying, Z. Y. (2011). Analysis of the FDI effect on energy consumption intensity in Jiangsu province. *Energy Procedia*, *5*, 100-104.

Topcu, Y. I., & Ulengin, F. (2004). Energy for the future: An integrated decision aid for the case of Turkey. *Energy*, *29*(1), 137-154.

Tunç, G. I., Türüt-Aşık, S., & Akbostancı, E. (2009). A decomposition analysis of CO2 emissions from energy use: Turkish case. *Energy Policy*, *37*(11), 4689-4699.

Tunc, M., Çamdali, Ü., & Parmaksizoğlu, C. (2006). Comparison of Turkey's electrical energy consumption and production with some European countries and optimization of future electrical power supply investments in Turkey. *Energy Policy*, *34*(1), 50-59.

Wang, S., Zhou, C., Li, G., & Feng, K. (2016). CO2, economic growth, and energy consumption in China's provinces: investigating the spatiotemporal and econometric characteristics of China's CO2 emissions. *Ecological indicators*, *69*, 184-195.

Weixian, W. (2002). Study on the determinants of energy demand in China. *Journal of Systems Engineering and Electronics*, *13*(3), 17-23.

Xiaoli, S., Junfeng, S., & Xuefei, S. (2007). Empirical of industry distribution of FDI impact on China’s energy consumption analysis. *Finance & Trade Economics*, *3*, 117-121.

Xu, S. J. (2012). The impact of financial development on energy consumption in China: based on SYS-GMM estimation. In *Advanced Materials Research* (Vol. 524, pp. 2977-2981). Trans Tech Publications.

Yang, H. Y. (2000). A note on the causal relationship between energy and GDP in Taiwan. *Energy economics*, *22*(3), 309-317.

Yu, E. S., & Choi, J. Y. (1985). The causal relationship between energy and GNP: an international comparison. *The Journal of Energy and Development*, *10*(2), 249-272.

Yuan, J. H., Kang, J. G., Zhao, C. H., & Hu, Z. G. (2008). Energy consumption and economic growth: evidence from China at both aggregated and disaggregated levels. *Energy Economics*, *30*(6), 3077-3094.

Zeng, K., & Eastin, J. (2012). Do developing countries invest up? The environmental effects of foreign direct investment from less-developed countries. *World Development*, *40*(11), 2221-2233.

Zhang, X. P., & Cheng, X. M. (2009). Energy consumption, carbon emissions, and economic growth in China. *Ecological Economics*, *68*(10), 2706-2712.

Zhang, Y. (2012). Scale, technique and composition effects in trade-related carbon emissions in China. *Environmental and Resource Economics*, *51*(3), 371-389.

Zheng, Y., Qi, J., & Chen, X. (2011). The effect of increasing exports on industrial energy intensity in China. *Energy Policy*, *39*(5), 2688-2698.

REPORTS

BP statistical review of world energy 2017-full-report

IMF, Country Information: Turkey, 2016, www.imf.org.tr, MFA, Ministry of Foreign Affairs, The Republic of Turkey, Turkey's Energy Strategy, 2006, http://www.econturk.org/Turkisheconomy/energy_turkey.pdf,

MENR, Ministry of Energy and Natural Resources 2010-201

TURKSTAT, Statistics, 2016, www.turkstat.gov.tr,

World Energy Outlook 2017, IEA

INTERNET RESOURCES

OECD (2012), *Economic Outlook,* Vol. 2012 (2), No. 92, www.oecd.org/eco/economicoutlook.

TurkStat. Foreign Trade Statistics; 2015.⟨www.tukstat.gov.tr⟩.

UN (2014), *World Economic Situation and Prospects 2014,* http://www.un.org/en/development/desa/policy/wesp/wesp_current/wesp2014.pdf, World Bank. World Bank Development Indicator. World Dev Indicator 2016. ⟨http://databank.worldbank.org/⟩

OTHER REFERENCES

Fidan, A. (2006). *Türkiye'de Enerji Tüketimi ve Ekonomik Büyüme İlişkisi.* (YL Tezi). Gazi Üniversitesi, Ankara.

Yılmaz, A. (2012). *Türkiye'de sektörel enerji tüketimini etkileyen faktörler ve alternatif enerji politikaları.* (YL Tezi). Adnan Menderes Üniversitesi, Aydın.

APPENDIX

Variables	Definition
***lnED**$_t$*	Natural log of energy consumption per capita (kg of oil equivalent). Total energy use as a proxy of energy demand refers to the consumption of primary energy before converting it to other end-use fuels (such as electricity and refined petroleum products).
***ln*FDI**$_t$	Foreign direct investment per capita (FDI): FDI is measured in current US dollars and this is the total of equity capital, reinvestment of earnings, and also other long-term and short-term capital as indicated in the balance of payments. These all indicators account for total FDI inflows into the country. The FDI inflows are divided by the total population of the country to get the per capita FDI inflows.
***ln*GDP**$_t$	GDP per capita is the gross domestic product divided by the population in the middle of the year. GDP is the sum of the gross value added of all resident producers in the economy plus any subsidies that are not included in the value of any product tax and products.
***ln*CO**$_{2t}$	Carbon dioxide emission per capita (Emissions): Carbon dioxide emissions are divided by the total population of the country to get the per capita CO_2 emissions in metric tons which accounts for entire country rather than tourism industry alone. The CO_2 emissions are produced through the consumption of energy includes petroleum, natural gas, coal and also from natural gas flaring.

UNIT ROOT TEST

Level

Null Hypothesis: LEN has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.222956	0.0965
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

First difference

Null Hypothesis: D(LEN) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	P
Augmented Dickey-Fuller test statistic		-6.528252	0.
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LFDI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.892417	0.0002
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LFDI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Pro
Augmented Dickey-Fuller test statistic		-2.554991	0.30
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Pro
Augmented Dickey-Fuller test statistic		-3.063693	0.13
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob
Augmented Dickey-Fuller test statistic		-5.972899	0.000
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LCO has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.860567	0.1872
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LCO) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.595246	0.0000
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

NARDL_ED-FDI

Dependent Variable: D(LEN)
Method: Stepwise Regression
Date: 08/31/18 Time: 15:29
Sample (adjusted): 1984 2014
Included observations: 31 after adjustments
Number of always included regressors: 4
Number of search regressors: 14
Selection method: Uni-directional
Stopping criterion: p-value = 0.1
Note: final equation sample is larger than stepwise sample (rejected regressors contain missing values)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-6.029548	1.668629	-3.613475	0.0015
LEN(-1)	-0.549877	0.151759	-3.623361	0.0015
LFDI_P(-1)	0.012377	0.010114	1.223764	0.2340
LFDI_N(-1)	-0.002869	0.021209	-0.135270	0.8936
DLFDI_P(-1)	-0.032526	0.018523	-1.755984	0.0930
DLFDI_P(-3)	-0.082067	0.036989	-2.218675	0.0371
DLFDI(-3)	0.044094	0.026766	1.647380	0.1137
DLFDI(-2)	0.049169	0.029742	1.653205	0.1125
DLFDI_P(-2)	-0.055277	0.038877	-1.421837	0.1691

R-squared	0.562035	Mean dependent var	0.007764
Adjusted R-squared	0.402775	S.D. dependent var	0.041731
S.E. of regression	0.032250	Akaike info criterion	-3.792896
Sum squared resid	0.022881	Schwarz criterion	-3.376577
Log likelihood	67.78988	Hannan-Quinn criter.	-3.657186
F-statistic	3.529041	Durbin-Watson stat	1.756918
Prob(F-statistic)	0.008962		

Selection Summary

Removed DLEN(-2)
Removed DLFDI_P
Removed DLFDI
Removed DLEN(-4)
Removed DLFDI(-1)
Removed DLFDI_P(-4)
Removed DLEN(-1)
Removed DLEN(-3)
Removed DLFDI(-4)

*Note: p-values and subsequent tests do not account for stepwise selection.

NARDL_ED_GDP

Dependent Variable: D(LEN)
Method: Stepwise Regression
Date: 08/31/18 Time: 16:27
Sample (adjusted): 1985 2015
Included observations: 31 after adjustments
Number of always included regressors: 4
Number of search regressors: 14
Selection method: Uni-directional
Stopping criterion: p-value = 0.1

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-8.712012	1.805098	-4.826338	0.0001
LEN(-1)	-0.795524	0.164591	-4.833329	0.0001
LGDP_P(-1)	0.079211	0.029182	2.714378	0.0134
LGDP_N(-1)	0.086811	0.064612	1.343569	0.1941
DLGDP_N	0.284138	0.057094	4.976686	0.0001
DLGDP_P(-1)	-0.165881	0.054648	-3.035435	0.0065
DLEN(-1)	0.627942	0.189444	3.314665	0.0035
DLEN(-4)	0.275702	0.124425	2.215812	0.0385
DLEN(-3)	0.282783	0.142738	1.981130	0.0615
DLGDP_P(-3)	-0.099659	0.055319	-1.801517	0.0867
DLGDP_N(-1)	-0.126866	0.083611	-1.517330	0.1448

R-squared	0.770776	Mean dependent var	0.008965
Adjusted R-squared	0.656164	S.D. dependent var	0.041906
S.E. of regression	0.024573	Akaike info criterion	-4.302947
Sum squared resid	0.012076	Schwarz criterion	-3.794113
Log likelihood	77.69568	Hannan-Quinn criter.	-4.137080
F-statistic	6.725082	Durbin-Watson stat	1.890267
Prob(F-statistic)	0.000158		

Selection Summary

Removed DLEN(-2)
Removed DLGDP_N(-3)
Removed DLGDP_N(-4)
Removed DLGDP_P(-4)
Removed DLGDP_N(-2)
Removed DLGDP_P(-2)
Removed DLGDP_P

*Note: p-values and subsequent tests do not account for stepwise selection.

NARDL_ED-CO2

Dependent Variable: D(LEN)
Method: Stepwise Regression
Date: 08/31/18 Time: 16:35
Sample (adjusted): 1985 2014
Included observations: 30 after adjustments
Number of always included regressors: 4
Number of search regressors: 14
Selection method: Uni-directional
Stopping criterion: p-value = 0.1

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-7.858055	1.753120	-4.482327	0.0004
LEN(-1)	-0.702249	0.157615	-4.455471	0.0004
LCO_P(-1)	0.734405	0.135978	5.400897	0.0001
LCO_N(-1)	0.743564	0.145552	5.108588	0.0001
DLCO_N	0.938744	0.095424	9.837583	0.0000
DLCO_P	0.861757	0.132929	6.482820	0.0000
DLCO_P(-1)	0.342848	0.121924	2.811978	0.0125
DLCO_P(-3)	0.524446	0.175921	2.981150	0.0088
DLCO_N(-2)	0.612024	0.190146	3.218712	0.0054
DLEN(-2)	-0.524116	0.163221	-3.211085	0.0054
DLEN(-3)	-0.228712	0.115890	-1.973517	0.0660
DLCO_N(-1)	-0.207251	0.115702	-1.791252	0.0922
DLCO_N(-4)	0.302368	0.140783	2.147756	0.0474
DLEN(-4)	-0.363010	0.114058	-3.182680	0.0058

R-squared	0.962627	Mean dependent var	0.008168
Adjusted R-squared	0.932261	S.D. dependent var	0.042383
S.E. of regression	0.011031	Akaike info criterion	-5.871517
Sum squared resid	0.001947	Schwarz criterion	-5.217625
Log likelihood	102.0728	Hannan-Quinn criter.	-5.662331
F-statistic	31.70123	Durbin-Watson stat	1.846468
Prob(F-statistic)	0.000000		

Selection Summary

Removed DLCO_P(-2)
Removed DLCO_P(-4)
Removed DLEN(-1)
Removed DLCO_N(-3)

*Note: p-values and subsequent tests do not account for stepwise selection.

ARDL

Dependent Variable: LEN
Method: ARDL
Date: 08/31/18 Time: 16:52
Sample (adjusted): 1983 2013
Included observations: 31 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LFDI LGDP LCO
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(1, 3, 3, 3)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LEN(-1)	0.377600	0.132028	2.860007	0.0108
LFDI	-0.017594	0.003979	-4.422261	0.0004
LFDI(-1)	0.015368	0.006065	2.533761	0.0214
LFDI(-2)	0.014476	0.006481	2.233602	0.0392
LFDI(-3)	-0.015931	0.004049	-3.934753	0.0011
LGDP	0.035346	0.017398	2.031625	0.0581
LGDP(-1)	-0.114943	0.021840	-5.263096	0.0001
LGDP(-2)	0.065292	0.024574	2.656911	0.0166
LGDP(-3)	0.035784	0.020018	1.787584	0.0917
LCO	0.662779	0.054516	12.15750	0.0000
LCO(-1)	0.052951	0.114887	0.460893	0.6507
LCO(-2)	-0.194475	0.067515	-2.880491	0.0104
LCO(-3)	-0.075049	0.057437	-1.306630	0.2087
C	0.542456	0.864412	0.627544	0.5386

R-squared	0.992529	Mean dependent var	-10.90825
Adjusted R-squared	0.986815	S.D. dependent var	0.078049
S.E. of regression	0.008962	Akaike info criterion	-6.289193
Sum squared resid	0.001365	Schwarz criterion	-5.641586
Log likelihood	111.4825	Hannan-Quinn criter.	-6.078090
F-statistic	173.7182	Durbin-Watson stat	2.307098
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL_Short-run

ARDL Cointegrating And Long Run Form
Dependent Variable: LEN
Selected Model: ARDL(1, 3, 3, 3)
Date: 08/31/18 Time: 16:52
Sample: 1980 2015
Included observations: 31

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI)	-0.017594	0.003979	-4.422261	0.0004
D(LFDI(-1))	-0.014476	0.006481	-2.233602	0.0392
D(LFDI(-2))	0.015931	0.004049	3.934753	0.0011
D(LGDP)	0.035346	0.017398	2.031625	0.0581
D(LGDP(-1))	-0.065292	0.024574	-2.656911	0.0166
D(LGDP(-2))	-0.035784	0.020018	-1.787584	0.0917
D(LCO)	0.662779	0.054516	12.157499	0.0000
D(LCO(-1))	0.194475	0.067515	2.880491	0.0104
D(LCO(-2))	0.075049	0.057437	1.306630	0.2087
CointEq(-1)	-0.622400	0.132028	-4.714168	0.0002

Cointeq = LEN - (-0.0059*LFDI + 0.0345*LGDP + 0.7169*LCO + 0.8716)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFDI	-0.005914	0.007078	-0.835560	0.4150
LGDP	0.034509	0.018594	1.855939	0.0809
LCO	0.716912	0.079572	9.009561	0.0000
C	0.871556	1.433112	0.608156	0.5511

ARDL_BOUND Test

ARDL Bounds Test
Date: 08/31/18 Time: 16:53
Sample: 1983 2013
Included observations: 31
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	7.497679	3

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

RESUME

Iqra AKRAM was born on June 21, 1992, in Lahore, Pakistan. She received her BS(Hons) degree in Economics with distinction from COMSATS UNIVERSITY ISLAMABAD, Lahore campus in April 2015. Later in 2015, She was awarded by TURKIYE BRUSLARI scholarship by Turkish Government and got admission in SAKARYA UNIVERSITY, to pursue her degree in Master of Economics in Turkey. As a multidisciplinary explorer, her research interest lies in the Development economics, Econometrics, and Forecasting.