Financial Development, CO_2 Emissions, Fossil Fuel Consumption and Economic Growth: The Case of Turkey

Mohammadesmaeil Sadeghieh

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Banking and Finance

Eastern Mediterranean University
February 2016
Gazimagusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Cem Tanova
Acting Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Banking and Finance.

Assoc. Prof. Dr. Nesrin Özataç
Chair, Department of Banking and Finance

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Banking and Finance.

Asst. Prof. Dr. Korhan Gökmenoğlu
Supervisor

Examining Committee

1. Prof. Dr. Salih Katırcıoğlu
2. Assoc. Prof. Dr. Bilge Oney
3. Asst. Prof. Dr. Korhan Gökmenoğlu

ABSTRACT

Many studies explored the relationship between income and CO_2 emissions, however most of them did not cover the possible effect of financial indicators on their framework. Therefore the present study aims to investigate the causal connection between financial development and ecological degradation in Turkey through a multivariate framework that uses economic growth and fuel consumption as additional determinants of environmental degradation from 1960–2011. To achieve this goal, a Zivot and Andrews (1992) unit root test was first conducted to check the integration order of data. Because variables were integrated at the same order (I[1]), co-integration analysis was applied in order to check the possible long-run equilibrium relationship between variables. Then, the Johansen co-integration test revealed that the variables under investigation are co-integrated in the long run. After establishing the long-run relationship between variables, error correction modeling applied to identify the long-run and short-run coefficients of the variables. The findings show that in the long-run, economic growth has negative and significant effect on carbon emissions (-0.069) while fuel consumption has positive and elastic impact on carbon emissions (2.82). However, the long run coefficient of financial development variable is not statistically significant. As expected, error correction term is negative in sign and statistically significant at 5% suggesting that whole error correction mechanism is working correctly. Therefore ECT implies that CO_2 converge to its long-run equilibrium level at 16.97% speed of adjustment by the contribution of GDP, fossil fuel consumption and financial development. Lastly, Granger causality test based on ECM is conducted to reveal the existence and direction of the causality among variables. The results show that there is unidirectional causality running from financial development and economic growth to carbon emissions and fuel consumption, and from carbon emissions to fuel consumption. Results suggest that by building up fundamental ecological norms and recognizing natural venture priorities, Turkey can coordinate feasible arrangements into its general financial improvement, in this way protecting its environment well towards the future.

Keywords: CO_2 emissions, Financial development, Economic growth, Fossil fuel consumption, Granger Causality

ÖZ

Bir çok çalişma bütçe ve CO_2 emisyonu arasındaki ilişkiyi arastırdı, fakat coğu çalışma mali göstergelerin taslaklarının üzerindeki olası etkisini kapsamıyordu. Bu sebeple mevcut çalısma Türkiye´deki finansal kalkınma ve çevre bozulma arasındaki nedensel ilişkiyi incelemeyi amaçlıyor. Bunuda ekonomik kalkınma ve yakıt tüketimini 1960 – 2011 arası çevre bozulmasına ek belirleyiciler olarak kullanan çok değiskenli bir taslak ile yapmayi amaclıyorlar. Bu amaca ulaşmak için, öncelikle verilerin tamamlama sırasını kontrol etmek için bir Zivot ve Andrew (1992) birim kök testi uygulandı. Değişkenler aynı düzende (I[1]) entegre edildikleri için degiskenler arasındaki olası uzun dönem denge ilişkisini kontrol etmek için eş-bütünleşim analizi uygulandı. Johansen es-bütünlesim testi araştırılan değişkenlerin uzun vadede es-bütünleşmiş oldugunu daha sonra ortaya çıkardı. Değişkenler arası uzun vade iliskisini kurduktan sonra, değiskenlerin uzun ve kısa vadeli katsayılarını belirlemek için hata düzeltme modellemesi uygulandı. Yakıt tüketimi karbon emisyonları (2.82) üzerinde olumlu ve esnek etki gösterirken, bulgular ekonomik büyümenin uzun vadede karbon emisyonları (-0.069) üzerinde olumsuz ve önemli etkisi oldugunu göstermektedir. Fakat, finansal kalkınmanın bu uzun dönem faktörü istatistiklerine göre önemli olmadığı beli lenmiştir. Beklenildiği gibi, hata düzeltme süresi isarette olumsuz ve sayisalda %5 olarak anlamlıdır ve bu tüm hata düzeltme mekanizmasının doğru çalıştıgını göstermektedir. ECT, bu nedenle GDP, fosil yakit tüketimi ve finansal kalkınmanın katkıları ile CO_2 nin kendi uzun dönem gelir düzeyine 16.97% adaptasyon hizinda yaklastigini belirtmektedir. Son olarak, ECM´e dayali Granger nedensellık testi değişkenler arası nedenselliğin varlığını ve yönünü ortaya çıkarmak için yürütülür. Sonuçlar finansal kalkınma ve ekonomik büyümeye karbon emisyonları ve yakıt tüketimine kadar, ve karbon emisyonlarından yakit tüketimine kadar çalısan tek yönlü nedenselliğın varlığını göstermekte. Sonuclara göre, Türkiye esas ekolojik normaları güçlendirerek ve doğal girişim önceliklerini tanıyarak genel finansal gelisimine makul anlaşmalar koordine edebilir ve böylece çevresini geleceğe yönelik iyi bir şekilde koruyabilir.

Anahtar kelimeler: CO_2 emisyonları, Finansal kalkınma, Ekonomik büyüme, Fosil yakıt tüketimi, Nedensellik

ACKNOWLEDGMENT

I would first like to express my sincere gratitude to my thesis supervisor Asst. Prof. Dr. Korhan Gökmenoğlu for the continuous guidance and support of my study. He consistently allowed this paper to be my own work, but steered me in the right direction whenever he thought I needed it.

I would also like to thank the experts who were involved in the validation survey for this research project. I owe quit a lot to Nigar Taspınar and Bezhan Rustamov since without their passionate participation and input, the validation survey could not have been successfully conducted.

Finally, I must express my very profound gratitude to my parents for providing me with unfailing support and endless encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVAITIONS

ADF	Augmented Dickey-Fuller
ADF-GLS	Augmented Dickey Fuller - Generalized Least Squares
ADF-WS	Augmented Dickey Fuller – Weighted Symmetric
ARDL	Auto Regressive Distributed Lag
BH	Bayer and Hanck
BRICS	Brazil, Russia, India, China and South Africa
CADF	Cross-sectionally augmented Dickey–Fuller
CDLM	Cross-sectionally Dependency Lagrange Multiplier
CIPS	Cross-sectionally Im- Pesaran- Shin
DFE	Dynamic Fixed Effect Model
DOLS	Dynamic Ordinary Least Squares
DSUR	Dynamic Seemingly Unrelated Regressions
ECM	Error Correction Mechanism
F-ADF	Fisher- Augmented Dickey Fuller
FMOLS	Fully Modified Ordinary Least Squares
GCC	Gulf Cooperation Council Countries: Saudi Arabia, United Arab Emirates (UAE), Qatar, Bahrain, Kuwait and Oman
GH	Gregory and Hansen
GMM	Generalized Method of Moments
G-20	Group of Twenty: Argentina, Australia, Brazil, Canada, China, France, Germany, Italy, India, Indonesia, Japan, Mexico, Saudi Arabia, South Africa, the Korean Republic, the Russian

	Federation, the United Kingdom, the United State of America and Turkey
IAA	Innovative Accounting Approach
IPS	Im- Pesaran- Shin
IRF	Impulse Response Functions
JF	Johansen and Fisher
JJ	Johansen and Juselius
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LLC	Levine-Lin-Chu
MENA	Middle East and North Africa region
MW	Maddala and Wu
NIC	Newly Industrialized Countries: Brazil, China, India, Malaysia, Mexico, Philippines, South Africa, Thailand and Turkey
NP	Ng and Perron
OECD	Organization for Economic Cooperation and Development: Brazil, France, Greece, Italy, Korea Republic, Mexico, Netherland, Poland, Spain, Turkey, UK, USA
PANKPSS	Panel Kwiatkowski-Phillips-Schmidt-Shin
PP	Philips and Perron
PVAR	Panel Vector Auto Regressive
SL	Saikkonen and Lütkepohl
TY	Toda-Yamamoto
VECM	Vector Error Correction Model
ZA	Zivot and Andrews

Chapter 1

INTRODUCTION

We live in a world that is so full of products that it is hard to imagine what life was like before machines. In the period of modernization, the Europeans were leaders. With ample access to resources such as coal, European nations initiated industrialization. Even despite a difficult beginning with many doubters, the Industrial Revolution became one of the most important transitions in human history. The Industrial Revolution began in Great Britain in the mid-1700s when manual laborers were replaced with machines. Fossil fuels and coal replaced water, wood, and wind, specifically in producing iron and textiles. Machines could do the same work as people, but cheaper and faster. This transition led to the more efficient use of water power, the increased use of steam power, the development of factories, and the large-scale production of manufactured goods. The Industrial Revolution drastically transformed each part of human life. By the 1800s, the Industrial Revolution had spread all over Europe and to North America. It came to mark defining moments in people's association with nature and their surroundings. Industrialization also led to the expansion of socioeconomic classes, and countries began to have distinct characters and develop national pride. The number of manufacturing plants that delivered quality items expanded quickly; this increase can be attributed to the advancement in hardware. Because of the large-scale manufacturing of goods, the cost of items decreased, leading to higher quality living. By increasing production, many job opportunities became available, which allowed countries to grow faster than ever before. Transportation and communication were also affected by the Industrial Revolution because they became cheaper, easier, and faster.

Although the Industrial Revolution led countries to expand their businesses quickly, which led to rapid economic growth and urbanization, it had some drawbacks. In order to get the good life that industrialization promised, families moved from their villages to newly industrialized towns. The huge numbers of migrants led to towns becoming overcrowded; unfortunately, the lack of adequate housing and sanitation created the first urban slums, which were a breeding ground for illnesses like Cholera. In addition to the deplorable living conditions, the demand for more and more goods and higher profits led to long working hours, worker exploitation, and child labor. Indeed, the hiring of children who were as young as five years old outraged the public. Today, because of the significant progress that has been made in society, many of these problems have been solved, though some problems still exist and are even getting worse. Although the Industrial Revolution brought wealth to factory owners and jobs to the public, it came with a price tag. The smoke from the coal-powered factories turned cities black. It is an undeniable fact that industrialization demands more fuel and coal, and this makes the global economy move from organic economies to inorganic economies (Kasman and Duman, 2015). The use of fossil fuel spread carbon dioxide (CO_2) emissions in the air and made the atmosphere warmer. Eventually it created a specific phenomenon that is called global warming today; this phenomenon has led to the degradation of the environment.

Global warming is one of the numerous natural challenges currently confronting the world. Since the 1990s, the amount of CO_2 emissions in recently industrialized nations is now higher than those in industrialized nations. Because CO_2 is known to be a main cause of global warming, the weakening of the ecological state has come to a warning stage, and disquiet about environmental degradation and global warming has been steadily increased. According to NASA’s (2016) data, atmospheric CO_2 had never been above almost 300 parts per million (ppm) for 650,000 years, and current level is almost 400 ppm, providing evidence that CO_2 has increased significantly since the Industrial Revolution. Although CO_2 exists naturally in the atmosphere, since the Industrial Revolution it has dramatically raised by one-third. This is very disturbing news because CO_2 causes the planet to heat up, which results in the greenhouse effect. The Intergovernmental Panel on Climate Change (IPCC) report shows that greenhouse gas (GHG) emissions and global average temperature are closely related (Kasman and Duman, 2015). Over the past three decades, GHG and CO_2 emissions have grown almost 1.6% annually from of the use fossil fuels, which is 1.9% per year. IPCC has also predicted that global temperatures will rise between 1.1 and 6.4° C over the next century (Kasman and Duman, 2015). Researchers and economists have thought about the genuine economic and ecological results of global warming on the off chance that we do not diminish worldwide carbon emissions rapidly and profoundly. The smallest consequences of global warming are damage to property and infrastructure, lost productivity, mass migration and security threats, and coping costs, among other concerns; these are really the smallest concerns. A much larger concern are the rising sea levels. If seawater levels continue to rise, low-lying nations like the Philippines as well as some parts of China and India are in real danger. Even major cities like Miami and New York are not safe from the rising seas. Floods and droughts can do massive damage to the world’s food supply, which could lead to widespread food shortages and starvation. Therefore in recent years, understanding the causes of environmental degradation and their connection with income has become essential.

The nexus between environmental degradation and economic growth can be seen in two groups of literature. The first group has focused on the possible relationship between economic growth and energy consumption because CO_2 emissions are created when fossil fuels are used. The discussion on the nexus of economic growth and energy consumption has centered on the expanding effects of energy on income advancement. Because global warming has reached an alarming level, countries are now forced to expend an adjusted level of energy to control their emissions while simultaneously guaranteeing their economic feasibility. This relationship suggests that increasing economic growth requires higher energy consumption, and more efficient energy utilization demands a larger amount of economic growth (Omri, 2013). Using the seminal work of Kraft and Kraft (1978) as a foundation, researchers have often investigated the co-integration and causality relationships between economic growth and energy consumption in different countries. Such as; Stern (1993), Masih and Masih (1996), Narayan and Singh (2007), Belloumi (2009), Ozturk (2010), Payne (2010), Ghosh (2010), Al-mulali (2011), Fallahi (2011).

The second group has focused on the environmental Kuznets curve system, which is known as the EKC hypothesis. Kuznets (1955) suggested that income inequality first increases and then declines as economic development proceeds. In the early 1990s, following the seminal work of Grossman and Krueger (1991), a similar inverted U-shaped connection emerged between environmental degradation and income. Ever since, the existence of the EKC hypothesis and links between income and emissions have been researched extensively; including Shafik and Bandyopadhyay (1992), Panayotou (1993), Selden and Song (1994), Agras and Chapman (1999), Galeotti and Lanza (1999), Friedl and Getzner (2003), Dinda (2004), Managi and Jena (2008), Akbostanci, Türüt-Aşık and Tunç (2009), Jaunky (2011). According to the EKC hypothesis, an inverted U-shaped relationship can be described as a situation in which an increase in the level of per capita income at early stages of economic development results in increased environmental degradation (e.g., CO_2 emissions) until a threshold income level is reached; after that point, pollutant numbers are ready to fall. This implies that after some turning points, economic growth may actually bring some ecological benefits. However, consequent factual examinations have demonstrated that while this relationship might exist in some cases, it does not cover an extensive variety of pollutants (Richmond, 2007). Reasons for the inverted U-shaped relationship are hypothesized to incorporate income-driven changes in (a) the composition of production and utilization, (b) the inclination for natural quality, (c) organizations that are expected to disguise externalities, and (d) expanding returns to scale connected with contamination reduction (Richmond, 2007). The principle constraint of this group is that these researchers have assumed the linkage between environment and income in a bivariate system based on the EKC hypothesis and, subsequently, suffered from omitted variable bias (Kasman and Duman, 2015).

Omitted variable bias (OVB) occurs when a model erroneously omits imperative variable(s). As a result, the model makes up for the missing variable(s) by overestimating or underestimating the impact of one of the alternate variables. Therefore, considering the OVB problem in the aforementioned literature, studies emerged that examined the connection between economic growth, energy consumption, and environmental degradation in a multivariate framework. As a result, researchers alleviated the OVB issue in econometric analysis. Following the pioneering work of Ang (2007) and Soytas, Sari, and Ewing (2007), researchers have debated this topic. Researchers often tend to expand their multivariate framework further by including extra variables. For instance, Halicioglu (2009) investigated the nexus of economic growth, energy consumption, environmental pollution, and foreign trade. This might reduce the problems of OVB in econometric analysis (Halicioglu, 2009).

Although the amount of CO_2 emissions in a country depends significantly on the amount of fossil fuels and other forms of energy used in the industrial, commercial, and residential sectors, there may be other sources as well. Financial development is a main source that can be taken into consideration (Gokmenoglu, Ozatac, and Eren, 2015). Along these lines, analysts have endeavored to consolidate the economic development factor as well as expand their examination of financial development indicators in different nations. The effects of financial development on CO_2 emissions have been a controversial subject among researchers in recent years. Frankel and Romer (1999); Dasgupta, Laplante, and Mamingi (2001); Sadorsky (2010); and Zhang (2011) have all asserted that CO_2 emissions can be prompted by financial development factors.

There are many reasons why financial development could cause air pollution to increase. First, by improving the stock market, listed companies are able to keep their financing costs as low as possible, expand their monetary channels, and hedge operational risks. As a result, firms tend to increase investments in new projects, which creates both new facilities and more goods. These all demand more energy consumption, which creates more CO_2 emissions. Second, developing financial sectors may pave the way for expanding direct foreign investment in order to prompt economic growth, which, subsequently, causes CO_2 emissions to increase. Third, efficient and successful financial interventions can allow consumers to purchase costly items by providing them with loans, but buying bigger homes and automobiles as along with air conditioners and other items can lead to a significant increase in CO_2 emissions (Gokmenoglu et al., 2015b ; Sadorsky, 2010; Zhang, 2011). On the contrary, One argument suggests financial development can provide protection for environment and help cut CO_2 emissions. Credit intermediation can play a vital role in helping to raise funds and expand firms. A firm that develops through financial development can execute better due to the more efficient use of its resources and energy. In this situation, the level of air pollution is expected to decrease (Claessens & Feijen, 2007; Tamazian, Chousa, & Vodlamannati, 2009).

The effects of contamination are more serious in developing nations because it can lead to the death of a substantial number of individuals every year. As a consequence of the dangers and the potential effects of environmental changes, there have been efforts to decrease contamination and increase public health and safety. Developing nations, having achieved considerable financial and economic success, can concentrate on ecological objectives. At each level of advancement, countries must settle on decisions among frequently conflicting objectives. Developing nations crave energy at a competitive price to obtain and maintain economic growth and reduce destitution. The energy destitution witnessed in these areas has been connected with neediness in their desire to create and enhance the lives of their citizens, these nations tend to select the objectives of monetary development and cheap energy, which can prompt ecological contamination and degradation. Furthermore, low-cost energy is important to increasing the aggressiveness of commercial ventures in developing nations and adding to monetary development, work creation, and advancement. Although this can help the country economically, it augments energy inefficiency and fuel environmental contamination.

The essential part of industrialization and liberalization in the improvement procedure of creating nations can't be overemphasized. There is requirement for structural transition from little agriculture to industrialization in developed country in order to encounter pro-poor growth. Although, industrialization demands monstrous utilization of energy resources that might result to contamination and natural degradation. For instance, if China had thought about environmental degradation at the beginning phase of advancement, it wouldn't have accomplished the noteworthy economic development. OECD is likewise concentrating on natural sustainability in the wake of accomplishing significant development. This sounds like EKC hypothesis indicating that developing nations want economic development towards industrialization with a tendency to spend more inexpensive energy.

After 1980s Turkey has witnessed the structure of economic growth has been changing through liberalization. Turkish economy has experienced high level of financial development and outstanding growth rates since 2002. As a quickly developing economy, Turkey fortifies industrialization which is for the most part reliant on fossil fuel utilization. According to the World Bank reports, nearly 90% of total energy consumption belongs to fossil fuel energy consumption as of 2012. By consuming such a large amount of fossil fuel energy, Turkey would expect more carbon emissions which cause environmental pollution. On the other hand, Turkey hosts a large number of tourist annually due to its tourism attractions. Travelers produce significant amount of carbon emissions in order to meet their daily needs which leads to damage to the environment. These are main reasons why Turkey has been criticized over the last years. According to Climate Change Performance Index (Burck, Bals and Rossow, 2014) there are 61 countries responsible for nearly 90% of total CO_2 emission in the world and Turkey is in 51st place between them due to its climate protection performance. It is pointed that the country suffers from lack of energy policies as its dominance of consuming fossil fuels in energy industry as well as growing inferior energy efficiencies contrast to other countries (Ediger, Akar and Ugurlu, 2006). Taking everything into account, developing nations in their mission for financial advancement and destitution reduction are required to put industrialization and monetary development at the forefront of their objectives before considering the ecological issues. Therefore, convincing developing nations like Turkey to seek after ecological objectives, especially lessening in carbon emissions, will demand significant economic, innovative and financial support from created nations and the worldwide group to make up for the economic losses connected with diminishing pollution. Given the discussion on the connections among environmental degradation and financial development together with both financial sector and industrial growth of Turkey and feedback for its atmosphere assurance execution, makes the study important and enjoyable.

This paper aims to investigate the causality between environmental degradation and financial development for the case of Turkey in a multivariate framework using economic growth and fuel consumption as additional determinants of environmental degradation. Time series data have been chosen covering the period of 1960-2011. In order to explore such relationship this study propose the model CO_2 = f (GDP, Fuel, FD), which CO_2 is dependent variable while GDP, fuel and financial development (FD) are independent variables. Because Turkey's economy was unstable; had volatile data, especially with its GDP; and had structural breaks during the period of

1960–2011, Zivot and Andrews (1992) unit root tests are employed for revealing number the integration order of data. The reason for choosing this methodology rather than conventional approaches is that conventional methodologies have pitfalls in that they often fail to take structural breaks into consideration, thus producing misleading results. After finding the number of integrating order of data, Johansen co-integration test is employed to explore whether variables are co-integrated in long-run. After establishing long-run connection between variables, it is required to determine the level (or long term) coefficients of our proposed model and its ECM in order to obtain short term coefficients and ECT. Finally Granger Causality test based on VECM model is conducted to reveal the direction of the causality between variables.

The rest of this thesis is planned as follows; a brief about literature review is discussed in the next section, section 3 presents the data, proposed model and methodology used in this paper and at last, conclusion and implications will be gathered in the section 4.

Chapter 2

LITERATURE REVIEW

2.1 Economic Growth and CO_2 Emissions

Global warming and environmental degradation have turned into the center of overall concerns, and carbon dioxide is thought to be one of the major contributors to climate change and famous greenhouse effects (Paul and Bhattacharya, 2004). Along these lines, the study on causes of carbon emissions and possible relationships with other factors has pulled in enormous consideration of academics over the world. It's been almost two centuries since most of countries convinced themselves to have rapid economic development through industrialization. Despite the fact that industrialization brought numerous conveniences to the nations, it also accelerated environmental degradation. A country need to consume more energy in order to achieve high growth and more energy consumption means more emissions which gradually lead to ecological pollution. As a result, the relationship between a country's development and environmental degradation seemed inseparable. That is why economic growth has been always considered an imperative factor, and has been significantly affected by the contribution of CO_2. Meanwhile, the idea of having environmentally sustainable growth encouraged many researchers to study the relationship between economic growth and pollution. Some early studies are: d'Arge (1971), d'Arge and Kogiku (1973), Buttel and Flinn (1976), Nordhaus (1977) , Walter and Ugelow (1979), Adams (1989), Jorgenson and Wilcoxen (1990), Barbier and Markandya (1990).

A new approach followed by many existing studies on the nexus between ecological conditions and economic growth has contended that levels of income and environmental degradation follow the inverted U-shaped relationship known as Environmental Kuznets Curve (EKC) in the literature. EKC hypothesis was first proposed by Simon Kuznets in 1955. Kuznets (1955) suggested that income inequality first increases and then declines as economic development proceeds. One clarification of such a movement indicates that right-on-time development opens doors for the individuals who have cash surpluses, while a flood of shoddy rustic work to the urban communities holds down wages. Though in developed economies, human capital accumulation, or an assessment of expenses that have been brought about but not paid for, means that physical capital gathering becomes the principle wellspring of development. Inequality moderates development by bringing down training levels because individuals need money to gain instruction in blemished credit markets.

In the early 1990s, a similar inverted U-shaped relationship between economic development and air quality based on EKC hypothesis theory was found by Grossman and Krueger (1991). They conducted study on the relationship between sulfur dioxide and “smoke” as a proxy of air quality and income through 42 countries. Their findings showed that as economic growth proceeds, sulfur dioxide levels increased in low-income countries. They observed sulfur dioxide reduction in countries with high income levels. More importantly, parts of the study dealt with pollution, trade, and investment in the United States and Mexico. Grossman and Krueger (1995) used the same methodology to investigate the relationship between per capita income and environmental indicators, including urban air pollution, oxygen, and fecal pollutants and heavy metal in rivers. Results did not establish a steady connection between variables. Empirical results proved that economic growth prompts a steady corruption of the earth in its beginning stages, and after a certain level of development, it prompts positive change in environmental conditions. This implies that after some turning points, economic growth may actually bring some benefits to ecological quality. Grossman and Krueger (1995) also showed that the turning point for most indicators occur when the per capita income reaches USD $8000.

As economic growth turned out to be a way to reduce environmental pollution, many researchers became interested in this topic, and as a result, numerous studies tested the EKC hypothesis. Some early studies are: Shafik and Bandyopadhyay (1992), Panayotou (1993), Wyckoff and Roop (1994), Selden and Song (1994), Holtz-Eakin and Selden (1995), Stern, Common and Barbier (1996), Stern (1998), Heil and Selden (1999), Agras and Chapman (1999), Galeotti and Lanza (1999). Shafik (1994) demonstrated that contamination discharges increase monotonically with different income levels. Wyckoff and Roop (1994) gauged that 13% of the aggregate CO_2 emissions in the six biggest OECD nations were epitomized in the level of imported merchandise. Cropper and Griffith (1994) and Selden and Song (1994) explored the possible connection between economic growth and CO_2 emissions and provided evidence to support the EKC hypothesis. Holtz-Eakin and Selden (1995) emphasized that the connection between income and CO_2 emissions is a monotonically increasing curve. In more recent studies Friedl and Getzner (2003) investigated the relationship between income and emissions. Their findings failed to support the EKC hypothesis because they found an N-shaped relationship rather than a U-shaped relationship. Dinda (2004) and Stern (2004) prepared well-functioned surveys regarding the EKC hypothesis.

Over the last decade, the EKC hypothesis was tested by numerous researchers, and these efforts have only intensified. Fodha and Zaghdoud (2010) conducted a study based on the EKC hypothesis on causal connections between economic growth and environmental pollutants in Tunisia. Jaunky (2011) examined the EKC hypothesis by studying 36 countries over the period of 1980–2005. The findings established the long-run co-integration between economic growth and CO_2 emissions. Jaunky found unidirectional causality from income to CO_2. Although the results did not support the EKC hypothesis, Jaunky emphasized the fact that CO_2 stabilized over time in rich countries. Wang (2012) led a similar study on the causality between income and CO_2 emissions, examining 98 countries between the period of 1971–2007. Again, the author's findings failed to support the EKC hypothesis. Saboori, Sulaiman and Mohd (2012) found support for the EKC hypotheses when investigating the relationship between CO_2 emissions and economic growth in Malaysia in the period of 1980–2009 Furthermore, the authors observed unidirectional causality from economic growth to CO2 emissions. Abid (2015) conducted a similar study in Tunisia during the period of 1980–2009. Although the results showed that economic growth prompted CO_2 emissions in both the short and long runs, Abid failed to find support for the EKC hypothesis. The empirical findings of many of these studies, especially early ones, are indeterminate, which means there is no consensus yet (Halicioglu, 2009).

There are several possible explanations for the lack of consensus. Differences in researcher's preferences when choosing pollutants create inconclusive results because every pollutant has a different turning point that is related to the country's per capita income. Most pollutants arrive at the turning point when a country's per capita income reaches to $8000 (Grossman and Krueger, 1995). The empirical findings on the relationship between economic growth and CO_2 emissions have some mixed results compared to other pollutants (Saboori et al., 2012). For instance, Shafik and Bandyopadhyay (1992) reported a linear relationship between economic growth and CO_2 emissions while Grossman and Krueger (1995) and Roberts and Grimes (1997) found the relationship to be N-shaped and inverted U-shaped, respectively. Another criticism is related to cross-country analysis and pooled panel data collection, both of which can lead to heterogeneity problems and contradictory results. However, a time series analysis addressed the heterogeneity issue by enabling researchers to localize their analysis to a specific country (Jalil and Feridun, 2011). De Bruyn, Bergh, and Opschoor (1998) tested the EKC hypothesis using a single-country time series. Their findings supported the empirical presence of the EKC for the Netherlands, West Germany, the United Kingdom, and the United States. Roca, Padilla, Farré and Galleto (2001) further found evidence that backed the EKC hypothesis in Spain. Once Lindmark (2002) noticed estimation localized into single country, analysis would move closer to the dynamic; this finding can emphasize the long-term aspects of the EKC for a development of an individual economy, which can mature towards different levels over time (Dinda, 2004). One important explanation of controversial findings can be OVB; because estimating the causality between environmental degradation and economic growth had been established in bivariate frameworks such as the EKC hypothesis, some studies suffered from OVB and results were then spurious.

2.2 Economic Growth and Fossil Fuel Consumption

Although studies on the relationship between environmental degradation and economic growth drew a lot of attention from researchers, there was a parallel study that was as important. Energy consumption can lead countries to experience rapid economic development, but in the meantime, it can be a massive threat for the environment because CO_2 emissions are frequently created when fossil fuels are used as a power source. The nexus between economic growth and energy consumption shows that to achieve a higher amount of economic growth, a country needs greater energy consumption and that more efficient energy use demands a large amount of economic growth (Omri, 2013). Kraft and Kraft (1978) first proposed the idea of the relationship between economic growth and energy consumption. They investigated the nexus between gross national product (GNP) and energy consumption in the United States from 1947–1974. Findings showed that GNP prompts energy consumption; however, they failed to secure either direction. This implies that highly developed economies can help energy utilization become more stable and efficient. Because economic development became a key factor in optimizing energy usage, many researchers have studied this topic, including Erol and Yu (1987), Stern (1993), Masih and Masih (1996), Cheng (1997), Soytas and Sari (2003). However, the link between economic growth and energy consumption was established in a bivariate framework, and as a result, the results might suffer from OVB (Kasman & Duman, 2015).

Recently, the relationship between economic growth and energy consumption has become a popular framework on numerous studies. Yuan, Zhao, Yu, and Hu (2007) conducted a study to reveal the causal relationship between economic growth and energy consumption in case of China during the period of 1978–2004. Their findings showed co-integration among these factors. Furthermore, their results showed unidirectional causality from energy consumption to economic growth. Belloumi (2009) led a similar study in Tunisia during the period of 1971–2004 that indicated a bidirectional causality between per capita energy consumption and per capita GDP.

Pao (2009) revealed that income prompted electricity consumption in Taiwan over both the short and long run. Ozturk, Aslan, and Kalyoncu (2010) applied the panel framework to examine the connection between income and energy consumption for 51 countries. They found co-integration among the series. More importantly, Granger causality results showed a unidirectional causality from economic growth to energy consumption in low-income countries and bidirectional causality for middle-income countries. Iyke (2015), who examined the causal link between GDP and electricity consumption in Nigeria over 1971–2011, found causality from electricity consumption to GDP in both the short and long run.

2.3 Economy – Energy – Environment

Because pursuing the connection between income and ecological degradation in a bivariate framework might create misleading results, there is a need for a new reliable system. Many researchers started to augment their studies by exploring the relationship between more variables simultaneously. This effort opened a door for a new era of studies. Many studies have proven that economic growth could prompt CO_2 emissions and that energy consumption has played an important role in the creation of CO_2 emissions (Omri, 2013). Therefore, it is likely that many scholars were excited to study the possible causal connection between CO_2 emissions and income with energy consumption in a multivariate framework. Ang (2007) completed a pioneering study in exploring the connection between income, energy consumption, and CO_2 emissions in France during 1960–2010. Using cointegration analysis and VECM modeling, the study established a long-run relationship between variables. The findings also showed a unidirectional causality from energy to output. In the meantime, Soytas et al. (2007) studied the economic-energy-environment debate and found no causality between economic growth and CO_2 emissions and a unidirectional causality from energy to CO_2. Ghosh (2010) applied cointegration and causality analysis to the link between CO_2 emissions, income, and energy supply in a multivariate framework, using the case of India from 1971–2006. The author's findings showed the absence of a long-run equilibrium connection among the variables. Lotfalipour, Falahi, and Ashena's (2010) study on the connection between income, CO_2 emissions and fossil fuel consumption in Iran supported the evidence of causality among the variables. Chang (2010) led a similar study using China as the case study; results showed that economic growth stimulates energy consumption then CO_2 emissions. Further examples include; Li, Dong, Xue, Liang and Yang (2011), Saboori and Sulaiman (2013), Omri (2013), Kasman and Duman (2015), Saidi and Hammami (2015).

2.4 Economy – Energy – Environment – Financial Development

The fundamental focus of this article is the effect of financial and economic development on the contamination–execution relationship. Researchers often tend to expand their multivariate framework by adding extra variables. This might reduce the OVB problem in econometric analyses (Halicioglu, 2009). For instance, Tang and Tan (2015) conducted a study on the causal relationship among income, energy consumption, and carbon emissions in Vietnam, incorporating foreign direct investment as an additional determinant. Kasman and Duman (2015) considered trade and urbanization as additional determinants when they used a similar framework to study EU (European Union) candidate countries. A vital inadequacy of the previously stated studies is their inability to consider the effect of financial development on the environment. Although the amount of CO_2 emissions in a country depends on the amount of fossil fuel and other energy used in industrial, commercial, and residential sectors, financial development may be an imperative source as well. (Gokmenoglu et al., 2015b). Tamazian et al. (2009) and Tamazian and Rao (2010) initiated this framework. Tamazian et al. (2009) explored the connection among financial development, economic growth, and environmental quality in the BRIC nations. They found financial development to be an imperative component to the reduction of CO_2 emissions. Tamazian and Rao (2010) found that financial development indicators have an obvious impact on CO_2 emissions in developing nations.

Sadorsky (2010) used a panel approach to examine the effects of financial development on energy consumption in 22 developing economies. The study discovered that financial development in these nations has a significant impact on energy consumption, which drives a greater transmission of CO_2. Zhang (2011) studied the possible connection between CO_2 emissions and financial development in China and found that monetary improvement played an imperative role in expanding CO_2 emissions. Zhang further pointed out that the impact of the money-related intermediation scale on CO_2 emissions exceeds that of other budgetary advancement pointers; however, its impact is far weaker even though it may lead to measurable changes in CO_2 emissions. Lastly, China's securities exchange scale has a moderately larger impact on CO_2 emissions, yet the impact of its effectiveness is exceptionally constrained. Jalil and Feridun (2011) conducted a similar study on China, examining the connection among financial development, energy consumption, income, and ecological quality. Results uncovered financial development has a negative sign coefficient, showing that financial development in China has not occurred to the detriment of environmental contamination. Despite what might be expected, the researchers found that monetary improvement has prompted an abatement in ecological contamination. Furthermore, the results affirmed the presence of the EKC in China. Shahbaz, Tiwari, and Nasir (2013) studied the relationship among financial development, economic growth, and CO_2 emissions in a multivariate framework, using coal consumption and trade openness as additional determinants in the case of South Africa. Findings pointed out that CO_2 emissions were negatively affected by financial development. Their empirical results also support the EKC hypothesis. Boutabba (2014) investigated if income, trade, energy, and financial development had an impact on CO_2 emissions in the case of the Indian economy. By using co-integration and dynamic VECM, the researcher found that financial development positively affects ecological contamination through CO_2 emissions. Likewise, a Granger causality test demonstrated a unidirectional causality from FD to CO_2 emissions in the long run.

2.5 Turkey

There is a multi-aspects requirement for considering energy circumstances in case of Turkey and to get knowledge into the improvement of carbon emissions (Lise, 2006). Turkey has been criticized for decade due to its behavior on environmental protection. Amount of energy consumption has considerably increased in last two decades suggesting that pollution would come to warning level soon. Beside Turkey continues to experience rapid economic development. Hence soon or late serious problem occur if they don't handle some preventive actions. Considering all, an interesting research field has risen which drew a lot of researcher's attention. Many studies on the causality among ecological degradation and income and have been conducted in case of Turkey.

Lise (2006) utilized decomposition analysis to examine the EKC hypothesis, using annual information from 1980–2003 as the data sample. The author dismissed the

EKC hypothesis and discovered a direct relationship between per capita GDP and per capita CO_2 emissions. Akbostanci et al. (2009) connected both panel data and time-series information procedures to examine for EKC in CO_2 emissions. Although their outcomes did not affirm the presence of the EKC, their results indicated an N-shaped connection between emissions and income. Halicioglu (2009) explored the connection among income, CO_2 emissions, energy consumption, and foreign trade by embracing the ARDL bounds testing to co-integration. The outcomes gave some backing to the EKC hypothesis, as the author found an inverted U-shaped connection between income and natural pollution. Additionally, the findings showed bidirectional causality between economic growth and emissions in both the short and long run. Soytas and Sari (2009) used co-integration and causality analysis to examine the relationship among economic growth, energy consumption, and carbon emissions during the period of 1960–2000. The authors observed unidirectional causality from CO_2 emissions to energy consumption. Ozturk and Acaravci (2010) studied the relationship among economic growth, energy consumption, and CO_2 emissions by incorporating employment ratio as an additional variable during the period of 1968–2005. The authors could not establish causality between the variables. However, most studies failed to consider financial development as a part of their analyses.

Although many studies in the academic literature have focused on an empirical examination of the financial–environment nexus, these studies are exceptionally restricted in the case of Turkey. Ozturk and Acaravci (2013) explored the long-run causal connection of economic growth, financial development, openness, and energy in Turkey. The study uncovered that there is a long-run connection among the variables. They also examined whether the EKC hypothesis is satisfied by the given variables. It was presumed that as income advances to an optimal level, emissions begin to decrease. Although the impact of financial development on CO_2 emissions is insignificant over the long run, the researchers proved that financial development does lead to energy consumption in the short run. A comparative study led by Gokmenoglu et al. (2015b) inspected conceivable associations among CO_2 emissions, financial development, and industrialization in Turkey. The findings of a Johansen co-integration test demonstrated that there is a long-run equilibrium relationship among the variables. Furthermore, the researchers found a unidirectional causality from FD to CO_2 emissions.

Chapter 3

DATA AND METHODOLOGY

3.1 Type and Source of Data

Data used in this study are annual basis which cover 1960-2011 period in Turkey and variables are Carbon dioxide emissions (CO_2), Gross Domestic Product (GDP), Fossil fuel consumption (FUEL) and Financial Development (FD). CO_2 are listed in kg per 2005 US$ of GDP, and the variable stems from the burning of fossil fuels and the manufacture of cement. It includes CO_2 produced during the consumption of solid, liquid, and gas fuels and gas flaring. GDP figures are in constant 2005 USD. FUEL comprises coal, oil, petroleum, and natural gas products, and the percentage of bank credit to bank deposits has been chosen as a proxy for FD. Data were collected from the World Bank (2015) online database. All series are changed into their natural logarithmic form due to capture growth impacts.

3.2 Methodology

In this study, methodology included three different stages of analysis. First, the Zivot and Andrews (1992) unit root test was employed in order to test the integration order of the variables. Second, the Johansen and Juselius (1990) co-integration test was used to investigate the possible long-run equilibrium relationship between variables. Last, the Granger causality test was applied for proving the existence and revealing the causality direction among series. In order to establish the relationship between CO2, GDP, FUEL and FD, the following model is proposed:

$$\mathbf{CO_2 = f(GDP, FUEL, FD)} \quad \mathbf{(1)}$$

This model suggests that GDP, FUEL and FD might be determinates of CO_2 in a case of Turkey. In other words CO_2 is a function of GDP, FUEL and FD. The variables are transformed into their logarithmic form due to capture growth impacts, therefore the functional model can be shown as follows:

$$\ln CO2_t = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln FUEL_t + \beta_3 FD_t + \varepsilon_t \quad (2)$$

where at period t, $\ln CO_2$ is the natural log of carbon dioxide emissions; lnGDP is the natural log of the real income; lnFUEL is the natural log of fossil fuel energy consumption; lnFD is the natural log of financial development indicator and error term is shown by ε. The β_1, β_2 and β_3 coefficients provide the elasticity of GDP, FUEL and FD respectively in the long term.

3.2.1 Unit Root Test

Unit root tests showed whether data are stationary or non-stationary. So before any analysis, unit root tests must be undertaken in order to identify the number of integrating order of variables. Various unit root tests are accessible in finance and economics to examine the integration order of the variables. Some well-known examples are provided by Dicky and Fuller (1981); Phillips and Perron (1988); Kwiatkowski, Phillips, Schmidt, and Shin (1992); Elliott, Rothenberg, and Stock (1996); and Ng and Perron (2001). The main problem with these tests is connected to their power and size. When the process is stationary with a root near the non-stationary boundary, the power of these tests is low. For example, ADF and PP tests are not strong enough to determine if $\phi = 1$ or $\phi = 0.95$, especially in small sample sizes. These tests give spurious, one-sided findings because they do not have data about all possible structural break points in the series. For example, Turkey's economy has witnessed period of expansion and recession during the period being examined, so it is quite natural that business cycles have different behaviors from one another. These impacts on the economy reflect some structural changes, and it is crucial to consider these breaks while doing unit root tests.

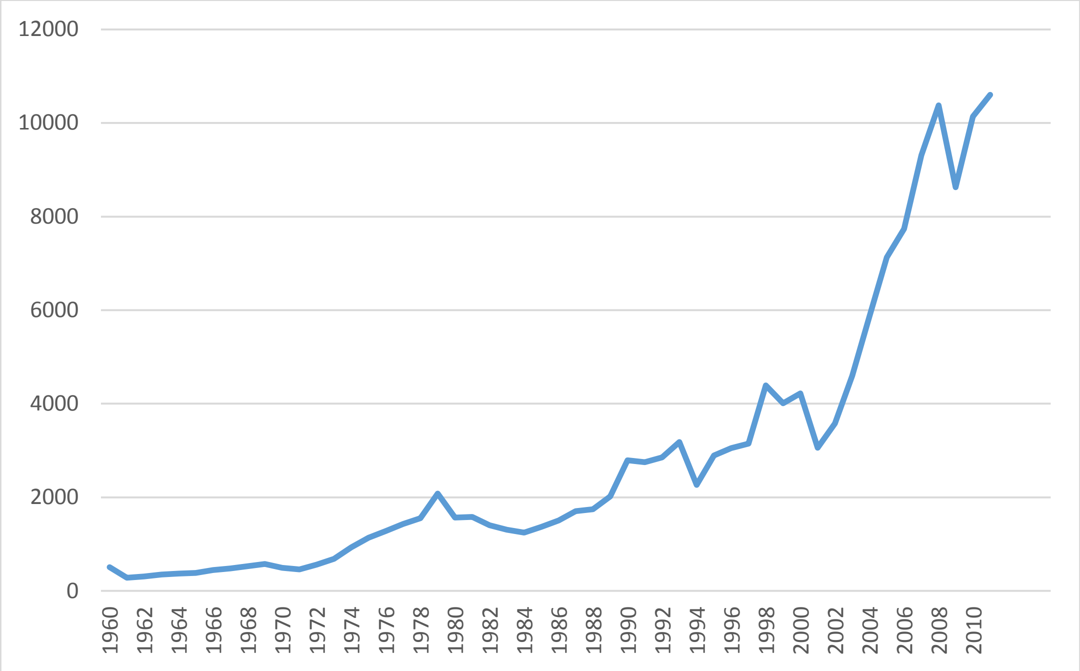

Figure 3.1: GDP Per Capita (USD) 1960-2011
Source: *World Bank (2015)*

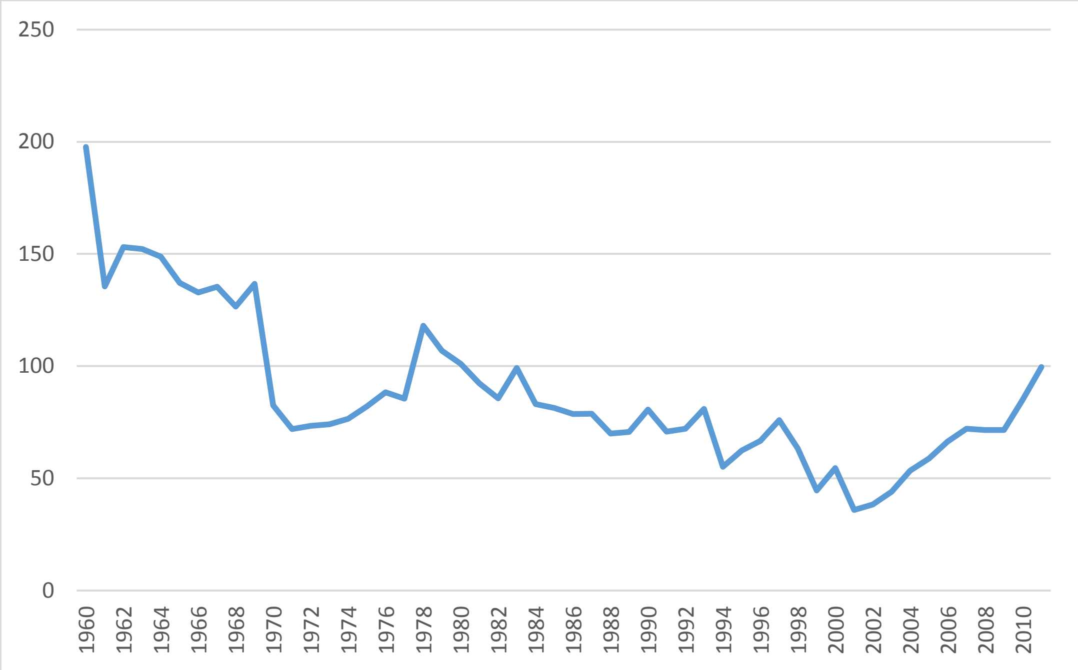

Figure 3.2: Bank Credit To Bank Deposit (%)
Source: *World Bank (2015)*

According to the Figure 3.1, GDP growth fluctuated during the time period under investigation suggesting that Turkey has not a stable economy.

In order to consider these structural breaks in unit root analysis, Zivot and Andrews (1992) constructed three models to examine the stationary attributes of the variables in the existence of a structural break point in series. The first model permits a one-time change in the series at the level form. The second model permits an exogenous change in the slopes of the series, and the third model combines the previous two models, with changes in both the trend and intercept functions of the series. Zivot and Andrews pursued three models in order to determine the hypothesis of exogenous structural break points in variables as follows:

$$\Delta X_t = a + ax_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (3)$$

$$\Delta X_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (4)$$

$$\Delta X_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (5)$$

Where DU_t shows dummy variables which indicate that mean shift happened at every point with time break however trend shift series are indicated by DT_t Therefore;

$$\boldsymbol{DU_t} = \begin{cases} \mathbf{1} \ldots \boldsymbol{if \;\; t > TB} \\ \mathbf{0} \ldots \boldsymbol{if \;\; t < TB} \end{cases} \quad \text{and} \quad \boldsymbol{DU_t} = \begin{cases} \boldsymbol{t - TB} \ldots \boldsymbol{if \;\; t > TB} \\ \mathbf{0} \ldots \boldsymbol{if \;\; t < TB} \end{cases}$$

The null hypothesis in this test is $c = 0$ which shows the variables are not stationary without any structural break point, meanwhile $c < 0$ illustrate that the series are stationary with one incognito time break. In other word the null hypothesis defines the presence of unit root in the variables.

3.2.2 Co-integration Tests

Because the variables were determined to be integrated of order one, co-integration between variables must, therefore, be examined, and the reliability of the long-run equilibrium connection should be investigated. This study applied the Johansen co-integration test in order to determine if a possible long-run relationship among the variables has the same order of integration. In other words, this test found if there were any or some variables that integrated each other in the long run. With the Johansen trace test, the number of co-integrating vectors can be identified. To have co-integration among variables, a minimum of one co-integrating vector is required. The Johansen (1988) and Johansen and Juselius (1990) methodologies provide a way to find the number of co-integrating equations among the arrangement of dependent and independent variables. Because the Engel and Granger (1987) approach has some pitfalls that may create unreliable results during estimation, the Johansen approach addresses these issues. The following equation demonstrates the Johansen approach and is based on VAR modeling:

$$\boldsymbol{y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t} \qquad \textbf{(for t = 1, … , T)} \qquad \textbf{(6)}$$

Where y_t , $y_{t-1}, \dots , y_{t-p}$ are vectors of level and lagged values of P variables respectively which are I(1) in the model; $A_1, \dots , A_p$ are coefficient matrices with (PXP) dimensions; μ is an intercept vector; ε_t is a vector of random errors (Katırcıoglu, Kahyalar and Benar, 2007). Assumption of non-auto-correlating error terms control the number of lagged values. The rank of A shows the co-integrating equations number which are found by estimating if the values of Eigen (λ_i) are statistically significant. Johansen (1988) and Johansen and Juselius (1990) suggest the trace statistics are determine by utilizing the Eigen values (Katırcıoglu et al. 2007). Following formula demonstrate the estimation of the trace statistic (λ_{trace}):

$$\boldsymbol{\lambda_{trace} = -T \sum \ln(1 - \lambda_i) \quad , \quad i = r + 1, \dots, n - 1} \qquad \textbf{(7)}$$

The null hypotheses are given as follows;

$\boldsymbol{H_0: v = 0}$ $\boldsymbol{H_1: v \geq 1}$

$\boldsymbol{H_0: v \leq 1}$ $\boldsymbol{H_1: v \geq 2}$

$\boldsymbol{H_0: v \leq 2}$ $\boldsymbol{H_1: v \geq 3}$

3.2.3 Error Correction Model

After establishing the long-run equilibrium connection among variables, Error Correction Model (ECM) was estimated in the instance that the CO_2 in equation (model) may not instantly acclimate to its long-run equilibrium level after an adjustment in any of its determinants. Error Correction Term (ECT) demonstrates the speed of adjustment indicating how rapidly series rebound to the long-run equilibrium and it ought to have a negative sign coefficient which is statistically significant. Following equation demonstrate the general ECM model:

$$\Delta \ln CO2_t =$$

$$\beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln CO2_{t-j} + \sum_{i=0}^{n} \beta_2 \Delta \ln GDP_{t-j} + \sum_{i=0}^{n} \beta_3 \Delta \ln Fuel_{t-j} + \sum_{i=0}^{n} \beta_4 \Delta \ln FD_{t-j} + \beta_5 \varepsilon_{t-1} + u_t \quad \textbf{(8)}$$

Where Δ indicates the change in the CO_2, GDP, fossil fuel and bank credit variables and ε_{t-1} shows the one period lagged error correction term (ECT) which is derived from the residuals by estimating co-integration model of Eq.

3.2.4 Granger Causality Tests

Johansen co-integration test only prove the absence or presence of the long-run relationships between series and it is unable to illustrate the direction of causality between variables. Therefore, Granger causality tests were undertaken in this study in order to reveal these directions among variables. Granger (1988) emphasizes that when the variables are co-integrated then the causality test should be determined based on Vector Error Correction Modeling (VECM) instead of Vector Autoregressive (VAR). Eagle and Granger (1987) caution that the Granger causality test, which is led in the first difference variables by a means of VAR, report a confusing results in the existence of co-integration. Thus, it is important to incorporate the Error Correction Term (ECT) as an extra variable to the VAR framework. The direction of causality can be recognized toward VECM of long-run co-integration. Furthermore, VECM is utilized to estimate the velocity of short-run values approach focused on long-run equilibrium values. Granger's outlook indicates that ECM are required to be augmented form of simple causality tests with EC framework. ECM are contained from the main co-integration models residuals and can be formulated as in the following equations:

$$\Delta \ln Y_t = C_0 + \sum_{i=1}^{k} \beta_i \Delta \ln Y_{t-i} + \sum_{i=1}^{k} a_i \Delta \ln X_{t-i} + \varphi_i ECT_{t-1} + u_t \quad \textbf{(9)}$$

$$\Delta \ln X_t = C_0 + \sum_{i=1}^{k} \gamma_i \Delta \ln X_{t-i} + \sum_{i=1}^{k} \varsigma_i \Delta \ln Y_{t-i} + \theta_i ECT_{t-1} + \varepsilon_t \quad \textbf{(10)}$$

It is required to mention estimating variables are X (independent variable) and Y (dependent variable); φ_i and θ_i measure the error correction term by standing as coefficients for ECT_{t-1}; Δ demonstrate that the variable are in their first differences. According to the first model, when φ_i become statistically significant in first equation suggesting that X Granger causes Y while in the second model θ_i become statistically significant Y Granger causes X. F-stat shows the examination of combined null hypothesis which is $a_i = \varsigma_i = 0$ and significance of the error correction coefficient is determined by t-stat.

Chapter 4

EMPIRICAL RESULTS

4.1 Unit Root Tests for Stationarity

Stationary nature of the variables is explored by ZA test whose details are given above. ZA test is undertaken in order to understand the number of integrated order. For instance variables may be integrated at I(0) or they can be I(1) or even I(0)/I(1). The findings of ZA unit root test are reported in the table 4.1. It is observed that the null hypothesis for all variables cannot be rejected at their level case (null hypothesis = existence of unit root) however, it can be rejected for all variables at their first differenced. In other word the findings reveal that the series have unit root problem at their level , but they are integrated at I(1). Therefore, all the series are stationary at their first difference.

Table 4.1: Zivot and Andrews (1992) Unit Root Test

	Statistics (Level)			Statistics (First Difference)			
	ZA_B	ZA_T	ZA_I	ZA_B	ZA_T	ZA_I	Conclusion
$lnCO_2$	-3.677	-3.590	-3.679	-10.615*	-6.380*	-10.716*	I(1)
Break Year	1971	1986	1970	1974	2002	1974	
Lag Length	0	0	0	0	1	0	
lnGDP	-4.074	-4.653	-3.440	-7.318*	-7.211*	-7.404*	I(1)
Break Year	1979	1976	1999	1977	1981	1978	
Lag Length	0	3	0	0	0	0	
lnFuel	-4.226	-3.808	-2.997	-9.008*	-8.184*	-8.000*	I(1)
Break Year	2001	1970	2004	1982	1979	1974	
Lag Length	1	0	0	0	0	0	
lnFD	-4.628	-3.915	-2.986	-9.400*	-9.116*	-9.235*	I(1)
Break Year	2001	2003	2003	1998	2002	2002	
Lag Length	0	0	0	0	0	0	

Note: CO_2 is carbon dioxide emissions; GDP is gross domestic product; FUEL is fossil fuel consumption; FD is financial development. All of the series are at their natural logarithms. ZA_B represents the model with a break in both the trend and intercept; ZA_T is the model with a break in the trend; ZA_I is the model with a break in the intercept. * denotes the rejection of the null hypothesis at 1 percent level of significance. Tests for unit roots were carried out in E-VIEWS 8.0.

Since the variables are integrated at order one, Co-integration analysis must be applied in order to check the possible equilibrium long-run relationship among variables.

4.2 Co-integration Analysis

The Johansen co-integration test was undertaken in this study in order to identify the long-run equilibrium relationship among variables. All four variables were integrated at the same order. CO2 was set as the dependent variable in my proposed model, and GDP, FUEL, and FD were independent variables. The findings of the Johansen co-integration test are reported in Table 4.2, which includes four hypotheses. First, non-co-integrating equations between series are set for the null hypothesis. Second, an alternative hypothesis indicates that the number of co-integrating equations were less than or equal to one. The third assumption refers to when the number of co-integrating equation was two at most. The last assumption was that there were at most three vectors. According to the tables, the null hypothesis of there being no co-integrating vector in the model could be rejected at the 1% level because the trace statistics value is greater than 1% critical value, which suggests that there was at least one co-integrating vector in the model. But when it comes to an alternative hypothesis, the alternative hypothesis could be rejected at the 5% level because the trace statistics value is greater than 5% critical value, meaning that there were at most two co-integrating vectors in the proposed model. Due to the results, the long-run equilibrium relationship could be proven among the variables.

Table 4.2: Johansen Test for Co-integration

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistics	5 Percent Critical Value	1 Percent Critical Value
None **	0.686810	94.29606	53.12	60.16
At most 1 *	0.360054	36.24886	34.91	41.07
At most 2	0.186041	13.93033	19.96	24.60
At most 3	0.070177	3.638061	9.24	12.97

Note: Trace test indicates 2 co-integrating equation(s) at the 5% level and 1 co-integration vector at the 1%level. *(**) denotes rejection of the hypothesis at the 5%(1%) level.

4.3 Level Coefficients and Error Correction Model Estimation

Co-integration results illustrated that each variable was co-integrated and they had a long-run equilibrium relationship. Because of that, it is required to determine the long-term coefficients of the proposed model, which were $CO2 = f(GDP, FUEL, FD)$, as well as its ECM (to obtain short-term coefficients) and ECT. Level equation findings and ECM results are gathered in Table 4.3. In this study, different lag selection criteria were tested until five lag (Pindyck & Rubinfeld, 1991). In Table 4.3, ε_{t-1} indicates the ECT and measures the speed of adjustment toward equilibrium. Both long- and short-run causality must be discussed. First, if ε_{t-1} is negative in sign and significant, then it could be said that there is long-run causality running from independent variables (GDP, FUEL, and FD) to the dependent variable (CO2). Table 4.3 set 16.9797% for ECT, which is negative and significant at α = 0.05. Therefore, 0.1697 indicated that 16.97% speed of adjustment by the contribution of GDP, FUEL, and FD was required for the short-run values of CO2 to move toward its long-run equilibrium level. The second issue is short-run causality, which the next section estimates using the Wald test. Additionally, Table 4.3 also covers short-run coefficients. GDP had a short-term coefficient on CO2 at lag 1, which was statistically significant at 0.05. Therefore, when GDP rose by 1%, CO2 increased by 0.4625 in the short run. The short-term coefficient of FUEL on CO2 at lag 3 was statistically significant at α = 0.05; hence, when FUEL had a 1% increase, CO2 decreased by 1.53% in the short run. The short-term coefficient of FD on CO2 at lag 1 was statistically significant at α = 0.01, indicating that if there was a 1% increase in FD, CO2 decreased by 0.157% in the short run.

Also level equation table shows that, while GDP increases by 1% CO_2 reduces by 0.69% in long-term. On the other hand if Fuel increases by 1% then CO_2 increases by 2.82% while if there is an increase in FD by 1%, CO_2 decreases by 0.015%.

Table 4.3: Error Correction Model

Dependent variable: $lnCO_2$ long-run covariance estimate (Barlett Kernel, Newey-West fixed bandwidth = 4000)			
Regressor	Coefficient	Standard error	p-Value
ε_{t-1}	-0.169797	0.06998	-2.42635
lnGDP(-1)	-0.069772	0.17365	-4.01803
lnFuel(-1)	2.827275	0.97451	2.90123
lnFD(-1)	-0.015893	0.15570	-0.10207
D($lnCO_2$(-1))	-0.004821	0.25412	-0.01897
D($lnCO_2$(-2))	-0.081376	0.24303	-0.33484
D($lnCO_2$(-3))	0.322952	0.23275	1.38758
D($lnCO_2$(-4))	0.262465	0.23248	1.12900
D($lnCO_2$(-5))	0.155419	0.21994	0.70664
D(lnGDP(-1))	0.462529	0.18944	2.44160
D(lnGDP(-2))	0.373632	0.21453	1.74161
D(lnGDP(-3))	0.317370	0.21372	1.48501
D(lnGDP(-4))	0.407502	0.24211	1.68314
D(lnGDP(-5))	0.263391	0.24302	1.08380
D(lnFUEL(-1))	-0.713818	0.64622	-1.10461
D(lnFUEL(-2))	0.023199	0.65306	0.03552
D(lnFUEL(-3))	-1.535976	0.56653	-2.71118
D(lnFUEL(-4))	-0.242388	0.61943	-0.39131
D(lnFUEL(-5))	-0.643683	0.46278	-1.39089
D(lnFD(-1))	-0.157458	0.04220	-3.73086
D(lnFD(-2))	-0.129274	0.05500	-2.35024
D(lnFD(-3))	-0.044369	0.05771	-0.76885
D(lnFD(-4))	-0.050561	0.06549	-0.77206
D(lnFD(-5))	-0.030471	0.05707	-0.53397
Intercept	-0.043997	0.02063	-2.13265
R-squared	0.597097	Akaike AIC	-3.755833
Adj. R-squared	0.244557	Schwarz SC	-2.881266
S.E. equation	0.031751	Akaike info. criterion	-14.04559
F-statistic	1.693699	Schwarz info. criterion	-10.38831
Mean dependent	0.009607	S.D. dependent	0.036531

4.4 Granger Causality Tests

After establishing long-run equilibrium relationship between series and estimating long-run and short-run coefficient based on error correction modeling, Granger causality tests should be employed under the VECM as its said earlier. Table 4.4 illustrate the findings of Granger causality tests based on Block Exogeneity Wald test. The null hypothesis of the model refers to non-causality among variables and they can be rejected at given levels of critical values. Meaning that when the null hypothesis is rejected then the alternative hypothesis can be accepted which is the causality running from independent variable to dependent variable. Findings in table 4.4 indicates that there is uni-directional causality running from real income and financial development to carbon dioxide emissions (GDP, FD → CO_2), and from real income, financial development and carbon dioxide emissions to fossil fuel consumption (CO_2, GDP, FD → Fuel).

Table 4.4: Granger Causality Tests under Block Exogeneity Approach

Dependent Variable	X^2-Statistics [prob.]				
	ΔlnCO_2	ΔlnGDP	ΔlnFuel	ΔlnFD	Overall X^2-stat [prob.]
ΔlnCO_2	-	10.36*** [0.065]	9.19 [0.101]	17.68* [0.003]	26.75 [0.0308]
ΔlnGDP	3.16 [0.6745]	-	4.61[0.464]	3.61 [0.606]	15.60 [0.408]
ΔlnFuel	14.11** [0.014]	16.32* [0.006]	-	35.44* [0.000]	67.21* [0.000]
ΔlnFD	1.31 [0.932]	2.70 [0.745]	3.91 [0.561]	-	7.51 [0.941]

Note: *, ** and *** denote rejection of the hypothesis at 1%, 5% and 10% recpectively.

In the econometric literature, some techniques are utilized for optimal lag selection. For instance, Schwartz Information Criterion (SIC), Akaike Information (AIC), Hannan-Quinn Information (HQ), Final Prediction Error (FPE) and sequential modified LR test statistic. In order to be certain that finding are not effected by optimum lag order selection criteria, Pindyck and Rubinheld (1991) emphasized that performing test with random lag selection may give more precise findings. In this thesis, the test were tried until 5 lag since the number of observations are sufficient.

Chapter 5

CONCLUSION

The Industrial Revolution brought about conditions that led to rapid economic growth and financial development for many countries. However, one side effect of rapid economic development is that the environment has been weakened to the point where there are concerns about environmental degradation and global warming. Because industrialization demands more fuel consumption in order to promote high economic growth and development, and more fuel being utilized leads to more CO2 emissions, it is important to understand the causes for environmental degradation and their connection with income and financial development because the relationship between the two has become more important in recent years.

As a rapidly developing county, Turkey's economy has witnessed rapid growth. The nation's improvement in industrial generation has led to release of larger amounts of pollutants, creating more serious dangers to both people and the environment. The percentage of people who get a long-term disease (e.g., lung cancer, heart attack, disabilities, etc.) is increasing annually. Indeed, according to recent estimates, 28,924 people in Turkey died prematurely from ambient PM and ozone exposure in 2010 ("The Cost Of Air Pollution"). In addition to these premature deaths, air pollution creates increases the chance of acid rain, which damages vegetation and marine life. Besides, stockpiling fuel brings additional problems—Turkey has to import more gas and oil because of increasing domestic demand; as a result, they expect to have more oil tankers in the Bosporus Straits and Black Sea. With the large amounts of fuel being shipped in that region, it is quite likely that a tanker accident will occur, which will further damage the marine environment.

With these concerns in mind, this study aimed to investigate the causal connection between financial development and ecological degradation in Turkey through a multivariate framework that uses economic growth and fuel consumption as additional determinants of environmental degradation from 1960–2011. To achieve this goal, a Zivot and Andrews (1992) unit root test was first conducted to check the integration order of data. Because variables were integrated at the same order (I[1]), co-integration analysis was applied in order to check the possible long-run equilibrium relationship between variables. Then, the Johansen co-integration test revealed that the variables under investigation are co-integrated in the long run. ECT suggests that by the contribution of GDP, FUEL, and FD, the short-run values of CO2 moved toward its long-run equilibrium level with 16.97% adjustment speed. The ECT was negative and significant, as expected. To understand the existence of causality among these variables, a Granger Causality test based on VECM model was undertaken. According to the results, unidirectional causalities ran from FD and GDP to CO2 and FUEL, and from CO2 to FUEL.

As mentioned earlier, no prior study has investigated the relationship among financial development, CO_2 emissions, fossil fuel consumption, and economic growth for Turkey. However, several studies have investigated the determinants of environmental degradation for the case of Turkey using similar models. So I can only partially compare my results with other studies. Accordingly, the results of this study were generally consistent with other studies in the literature. While some studies focused on the relationship between economic growth and CO_2 emissions individually, they did not measure the impact of financial development in their analysis. Seker and Cetin (2015) explored the effect of economic growth on CO_2 emissions in Turkey and found that economic growth prompts CO_2 emissions, which aligns with this study's findings. However, Halicioglu (2009) conducted a similar study and found bidirectional causality between economic growth and CO_2 emissions while Soytas and Sari (2009) found no causal link between these variables.

Recently, a few studies have considered the impact of financial development on CO_2 emissions. Gokmenoglu et al. (2015b) investigated any conceivable association among CO_2 emissions, financial development, and industrialization in Turkey. The findings of the Johansen co-integration test demonstrated that there was a long-run equilibrium relationship among these variables. They further found a unidirectional causality from financial development to CO2 emissions. Ozturk and Acaravci (2013) conducted a similar study to explore the causal relationship among several variables, including financial development, carbon emissions, and economic growth. They concluded that there was a long-term causal relationship running from financial development and economic growth to carbon emissions. Furthermore, their study supported the EKC hypothesis.

This study has revealed that environmental degradation in Turkey is prompted mainly by financial development, and this result has policy implications. As Turkey prepares to meet EU enrollment criteria, it should see expanded energy effectiveness. EU climate legislation aims to protect the ozone layer and cut carbon emissions. If Turkey wishes to join the union, it must obey the rules. As a result, Turkey is forced to pave the way for better financial development and to optimize its growth capacity to meet EU standards and eventually accept some binding requirements for reducing future CO_2 emissions. Yet there will be many opportunities to get better, and Turkey's cautiousness in protecting the environment will be critical to its economic and financial development. As long as natural gas gains prevalence over more carbon-intensive fuels, it will diversify Turkey's energy supply and provide relief from urban contamination and CO_2 emissions. By enacting separate taxes to advance the use of cleaner energy, particularly low-sulfur fuel oil, Turkey can stem the rising tide of CO_2 emissions. Turkey's government and economy will further benefit from consistent public education about the advantages of saving energy as well as engaging in clean and renewable commercial energy projects. However, Turkey's financial regulatory bodies must consider practical ways to channel financial development into an environmentally friendly and sustainable system. Financial institutions should also take the initiative in protecting the environment (Gokmenoglu et al., 2015b). For example, financial institutions can recommend special loans with low interest rates for clean investments that produce products with low carbon emissions; such a policy may encourage investors to begin using renewable energy items. While renewable energy sources have made extraordinary advances in Turkey's energy market, more innovative work on renewable energies is needed to expand their usage. Although hydroelectric energy is being produced, the broad use of wood fuels in family homes has added considerably to urban air contamination and has also created deforestation issues. Furthermore, Turkey needs to raise the price of conventional fuels to market levels, which would broaden and expand the use of other energies for transportation such as electricity-based railways.

Developing nations like Turkey, in their mission for financial advancement and destitution reduction, are required to choose industrialization and monetary development before considering ecological issues. Therefore, convincing developing nations like Turkey to pursue ecological objectives, especially lessening CO_2 emissions, will demand significant economic and creative support from developed nations and international organizations to make up for the economic losses connected with diminishing pollution. By building up fundamental ecological norms and prioritizing natural ventures, Turkey can coordinate feasible arrangements into its general financial improvement, protecting its environment well into the future.

REFERENCES

Abid, M. (2015). The Close Relationship between Informal Economic Growth and Carbon Emissions in Tunisia since 1980: The (Ir) Relevance of Structural Breaks. *Sustainable Cities and Society*, 15, 11-21.

Adams, R. M. (1989). Global Climate Change and Agriculture: An Economic Perspective. *American Journal of Agricultural Economics*, 71(5), 1272-1279.

Agras, J., & Chapman, D. (1999). A Dynamic Approach to the Environmental Kuznets Curve Hypothesis. *Ecological Economics*, 28(2), 267-277.

Akbostancı, E., Türüt-Aşık, S., & Tunç, G. I. (2009). The Relationship Between Income and Environment in Turkey: is There an Environmental Kuznets Curve?. *Energy Policy*, 37(3), 861-867.

Alam, M. J., Begum, I. A., Buysse, J., & Van Huylenbroeck, G. (2012). Energy Consumption, Carbon Emissions and Economic Growth Nexus in Bangladesh: Cointegration and Dynamic Causality Analysis. *Energy Policy*, 45, 217-225.

Alam, M. J., Begum, I. A., Buysse, J., Rahman, S., & Van Huylenbroeck, G. (2011). Dynamic Modeling of Causal Relationship between Energy Consumption, CO2 Emissions and Economic Growth in India. *Renewable and Sustainable Energy Reviews*, 15(6), 3243-3251.

Al-Mulali, U. (2011). Oil Consumption, CO2 Emission and Economic Growth in MENA Countries. *Energy*, 36(10), 6165-6171.

Al-Mulali, U., & Sab, C. N. B. C. (2012a). The Impact of Energy Consumption and CO2 Emission on the Economic Growth and Financial Development in the Sub Saharan African Countries. *Energy*, 39(1), 180-186.

Al-mulali, U., & Sab, C. N. B. C. (2012b). The Impact of Energy Consumption and CO2 Emission on the Economic and Financial Development in 19 Selected Countries. *Renewable and Sustainable Energy Reviews*, 16(7), 4365-4369.

Alshehry, A. S., & Belloumi, M. (2015). Energy Consumption, Carbon Dioxide Emissions and Economic Growth: The Case of Saudi Arabia. *Renewable and Sustainable Energy Reviews*, 41, 237-247.

Ang, J. B. (2007). CO2 Emissions, Energy Consumption, and Output in France. *Energy Policy*, 35(10), 4772-4778.

Apergis, N., & Payne, J. E. (2009). CO2 Emissions, Energy Usage, and Output in Central America. *Energy Policy*, 37(8), 3282-3286.

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.

Arvin, M. B., Pradhan, R. P., & Norman, N. R. (2015). Transportation Intensity, Urbanization, Economic Growth, and CO2 Emissions in the G-20 Countries. *Utilities Policy*, 35, 50-66.

Barbier, E. B., & Markandya, A. (1990). The Conditions for Achieving Environmentally Sustainable Development. *European Economic Review*, 34(2), 659-669.

Bastola, U., & Sapkota, P. (2015). Relationships among Energy Consumption, Pollution Emission, and Economic Growth in Nepal. *Energy*, 80, 254-262.

Belloumi, M. (2009). Energy Consumption and GDP in Tunisia: Cointegration and Causality Analysis. *Energy policy*, 37(7), 2745-2753.

Boutabba, M. A. (2014). The Impact of Financial Development, Income, Energy and Trade on Carbon Emissions: Evidence from the Indian economy. *Economic Modelling*, 40, 33-41.

Bozkurt, C., & Akan, Y. (2014). Economic Growth, CO2 Emissions and Energy Consumption: The Turkish Case. *International Journal of Energy Economics and Policy*, 4(3), 484-494.

Burck, J., Bals, C., Rossow, V., 2014. The Climate Change Performance Index: Results 2014. Germanwatch Nord-Süd Initiative eV.

Buttel, F. H., & Flinn, W. L. (1976). Economic Growth versus the Environment: Survey Evidence. *Social Science Quarterly*, 57(2), 410-420.

Chang, C. C. (2010). A Multivariate Causality Test of Carbon Dioxide Emissions, Energy Consumption and Economic Growth in China. *Applied Energy*, 87(11), 3533-3537.

Cheng, B. S. (1997). Energy Consumption and Economic Growth in Brazil, Mexico and Venezuela: A Time Series Analysis. *Applied Economics Letters*, *4*(11), 671-674.

Claessens, S., & Feijen, E. (2007). *Financial Sector Development and the Millennium Development Goals* (No. 89). World Bank Publications.

Cowan, W. N., Chang, T., Inglesi-Lotz, R., & Gupta, R. (2014). The Nexus of Electricity Consumption, Economic Growth and CO2 Emissions in the BRICS Countries. *Energy Policy*, 66, 359-368.

Cropper, M., & Griffiths, C. (1994). The Interaction of Population Growth and Environmental Quality. *The American Economic Review*, 84(2), 250-254.

d'Arge, R. C. (1971). Essay on Economic Growth and Environmental Quality. *The Swedish Journal of Economics*, 73(1), 25-41.

d'Arge, R. C., & Kogiku, K. C. (1973). Economic Growth and the Environment. *The Review of Economic Studies*, 40(1), 61-77.

Dasgupta, S., Laplante, B., & Mamingi, N. (2001). Pollution and Capital Markets in Developing Countries. *Journal of Environmental Economics and Management*, 42(3), 310-335.

De Bruyn, S. M., van den Bergh, J. C., & Opschoor, J. B. (1998). Economic Growth and Emissions: Reconsidering the Empirical Basis of Environmental Kuznets Curves. *Ecological Economics*, 25(2), 161-175.

Demirhan, E., Aydemir, O., & Inkaya, A. (2011). The Direction of Causality between Financial Development and Economic Growth: Evidence from Turkey. *International Journal of Management*, 28(1), 193-198.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root. Econometrica: *Journal of the Econometric Society*, 49(4), 1057-1072.

Dinda, S. (2004). Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics*, 49(4), 431-455.

Ediger, V. Ş., Akar, S., & Uğurlu, B. (2006). Forecasting Production of Fossil Fuel Sources in Turkey Using a Comparative Regression and ARIMA Model. *Energy Policy,* 34(18), 3836-3846.

Elliott, G., Rothenberg, T. J., & Stock, J. H. (1992). Efficient Tests for an Autoregressive Unit Root. *The National Bureau of Economic Research*, 64(4), 813-836.

Engle, R. F., & Granger, C. W. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica: Journal of the Econometric Society*, 55(2), 251-276.

Erol, U., & Yu, E. S. (1987). On The Causal Relationship between Energy and Income for Industrialized Countries. *Journal of Energy and Development*, 13(1), 113-122.

Fallahi, F. (2011). Causal Relationship between Energy Consumption (EC) and GDP: A Markov-Switching (MS) Causality. *Energy*, 36(7), 4165-4170.

Farhani, S., & Ozturk, I. (2015). Causal Relationship between CO2 Emissions, Real GDP, Energy Consumption, Financial Development, Trade Openness, and Urbanization in Tunisia. *Environmental Science and Pollution Research*, 22(20), 1-14.

Farhani, S., Chaibi, A., & Rault, C. (2014). A Study of CO2 Emissions, Output, Energy Consumption, and Trade. *Ipag Working Paper Series*, No. 2014-056.

Fodha, M., & Zaghdoud, O. (2010). Economic Growth and Pollutant Emissions in Tunisia: An Empirical Analysis of the Environmental Kuznets Curve. *Energy Policy*, 38(2), 1150-1156.

Frankel, J. A., & Romer, D. (1999). Does Trade Cause Growth? *American Economic Review*, 89(3), 379-399.

Friedl, B., & Getzner, M. (2003). Determinants of CO2 Emissions in a Small Open Economy. *Ecological Economics*, 45(1), 133-148.

Galeotti, M., & Lanza, A. (1999). Richer and Cleaner? A Study on Carbon Dioxide Emissions in Developing Countries. *Energy Policy*, 27(10), 565-573.

Ghosh, S. (2010). Examining Carbon Emissions Economic Growth Nexus for India: A Multivariate Cointegration Approach. *Energy Policy*, 38(6), 3008-3014.

Gokmenoglu, K. K., Amin, M. Y., & Taspinar, N. (2015a). The Relationship among International Trade, Financial Development and Economic Growth: The Case of Pakistan. *Procedia Economics and Finance*, 25, 489-496.

Gokmenoglu, K., Ozatac, N., & Eren, B. M. (2015b). Relationship between Industrial Production, Financial Development and Carbon Emissions: The Case of Turkey. *Procedia Economics and Finance*, 25, 463-470.

Govindaraju, V. C., & Tang, C. F. (2013). The Dynamic Links between CO2 Emissions, Economic Growth and Coal Consumption in China and India. *Applied Energy*, 104, 310-318.

Granger, C. W. (1988). Some Recent Development in a Concept of Causality. *Journal of Econometrics*, 39(1), 199-211.

Grossman, G. M., & Krueger, A. B. (1991). Environmental Impacts of a North American Free Trade Agreement (No. w3914). *National Bureau of Economic Research.*

Grossman, G., & Krueger, A. (1995). Economic Environment and the Economic Growth. *Quarterly Journal of Economics*, 110(2), 353-377.

Güngör, H., Katircioglu, S., & Mercan, M. (2014). Revisiting the Nexus Between Financial Development, FDI, and Growth: New Evidence from Second Generation Econometric Procedures In The Turkish Context. *Acta Oeconomica*, 64(1), 73-89.

Halicioglu, F. (2009). An Econometric Study of CO2 Emissions, Energy Consumption, Income and Foreign Trade in Turkey. *Energy Policy*, 37(3), 1156-1164.

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial Development and Economic Growth: New Evidence from Panel Data. *The Quarterly Review of Economics and Finance*, 51(1), 88-104.

Heil, M. T., & Selden, T. M. (1999). Panel Stationarity with Structural Breaks: Carbon Emissions and GDP. *Applied Economics Letters*, 6(4), 223-225.

Holtz-Eakin, D., & Selden, T. M. (1995). Stoking the Fires? CO2 Emissions and Economic Growth. *Journal of Public Economics*, 57(1), 85-101.

Hossain, M. S. (2011). Panel Estimation for CO2 Emissions, Energy Consumption, Economic Growth, Trade Openness and Urbanization of Newly Industrialized Countries. *Energy Policy*, 39(11), 6991-6999.

Iyke, B. N. (2015). Electricity Consumption and Economic Growth in Nigeria: A Revisit of the Energy-Growth Debate. *Energy Economics*, 51, 166-176.

Jalil, A., & Feridun, M. (2011). The Impact of Growth, Energy and Financial Development on the Environment in China: A Cointegration Analysis. *Energy Economics*, 33(2), 284-291.

Jaunky, V. C. (2011). The CO2 Emissions-Income Nexus: Evidence from Rich Countries. *Energy Policy*, 39(3), 1228-1240.

Jedidia, K. B., Boujelbène, T., & Helali, K. (2014). Financial Development and Economic Growth: New Evidence from Tunisia. *Journal of Policy Modeling*, 36(5), 883-898.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, 12(2), 231-254.

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Jorgenson, D. W., & Wilcoxen, P. J. (1990). Environmental Regulation and US Economic Growth. *The Rand Journal of Economics*, 21(2), 314-340.

Kasman, A., & Duman, Y. S. (2015). CO2 Emissions, Economic Growth, Energy Consumption, Trade and Urbanization in New EU Member and Candidate Countries: A Panel Data Analysis. *Economic Modelling*, 44, 97-103.

Katircioglu, S.T., Kahyalar, N., & Benar, H. (2007). Financial Development, Trade and Growth Triangle: The Case of India. *International Journal of Social Economics*, 34(9), 586-598.

Kivyiro, P., & Arminen, H. (2014). Carbon Dioxide Emissions, Energy Consumption, Economic Growth, and Foreign Direct Investment: Causality Analysis for Sub-Saharan Africa. *Energy*, 74, 595-606.

Kraft, J., & Kraft, A. (1978). Relationship between Energy and GNP. *J. Energy Dev.(United States)*, 3(2), 401-403.

Kumar, R. R., Stauvermann, P. J., Loganathan, N., & Kumar, R. D. (2015). Exploring the Role of Energy, Trade and Financial Development in Explaining Economic Growth in South Africa: A Revisit. *Renewable and Sustainable Energy Reviews*, 52, 1300-1311.

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review*, 45(1), 1-28.

Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing The Null Hypothesis of Stationarity Against The Alternative of a Unit Root: How Sure Are We That Economic Time Series Have a Unit Root?. *Journal of Econometrics*, 54(1), 159-178.

Kyophilavong, P., Uddin, G., & Shahbaz, M. (2014). The Nexus between Financial Development and Economic Growth in Laos, *Ipag Working Paper Series*, No. 2014-447.

Lau, L. S., Choong, C. K., & Eng, Y. K. (2014). Carbon Dioxide Emission, Institutional Quality, and Economic Growth: Empirical Evidence in Malaysia. *Renewable Energy*, 68, 276-281.

Lean, H. H., & Smyth, R. (2010). CO2 Emissions, Electricity Consumption and Output in ASEAN. *Applied Energy*, 87(6), 1858-1864.

Li, F., Dong, S., Xue, L., Liang, Q., & Yang, W. (2011). Energy Consumption-Economic Growth Relationship and Carbon Dioxide Emissions in China. *Energy Policy*, 39(2), 568-574.

Lindmark, M. (2002). An EKC-Pattern in Historical Perspective: Carbon Dioxide Emissions, Technology, Fuel Prices and Growth in Sweden 1870–1997. *Ecological economics*, *42*(1), 333-347.

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

Lotfalipour, M. R., Falahi, M. A., & Ashena, M. (2010). Economic Growth, CO2 Emissions, and Fossil Fuels Consumption in Iran. *Energy*, 35(12), 5115-5120.

Managi, S., & Jena, P. R. (2008). Environmental Productivity and Kuznets Curve in India. *Ecological Economics*, 65(2), 432-440.

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.

Mercan, M., & Karakaya, E. (2015). Energy Consumption, Economic Growth and Carbon Emission: Dynamic Panel Cointegration Analysis for Selected OECD Countries. *Procedia Economics and Finance*, 23, 587-592.

Narayan, P. K., & Singh, B. (2007). The Electricity Consumption and GDP Nexus for the Fiji Islands. *Energy Economics*, 29(6), 1141-1150.

Nasir, M., & Rehman, F. U. (2011). Environmental Kuznets Curve for Carbon Emissions in Pakistan: An Empirical Investigation. *Energy Policy*, 39(3), 1857-1864.

Ng, S., & Perron, P. (2001). Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power. *Econometrica*, 69(6), 1519-1554.

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.

Nordhaus, W. D. (1977). Economic Growth and Climate: The Carbon Dioxide Problem. *The American Economic Review*, 67(1), 341-346.

Omri, A. (2013). CO2 Emissions, Energy Consumption and Economic Growth Nexus in MENA Countries: Evidence from Simultaneous Equations Models. *Energy Economics*, 40, 657-664.

Omri, A., Daly, S., Rault, C., & Chaibi, A. (2015). Financial Development, Environmental Quality, Trade and Economic Growth: What Causes What in MENA Countries. *Energy Economics*, 48, 242-252.

Omri, A., Nguyen, D. K., & Rault, C. (2014). Causal Interactions between CO2 Emissions, FDI, and Economic Growth: Evidence from Dynamic Simultaneous-Equation Models. *Economic Modelling*, 42, 382-389.

Ozturk, I. (2010). A Literature Survey on Energy–Growth Nexus. *Energy Policy*, 38(1), 340-349.

Ozturk, I., & Acaravci, A. (2010). CO2 Emissions, Energy Consumption and Economic Growth in Turkey. *Renewable and Sustainable Energy Reviews*, 14(9), 3220-3225.

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.

Ozturk, I., Aslan, A., & Kalyoncu, H. (2010). Energy Consumption and Economic Growth Relationship: Evidence from Panel Data for Low and Middle Income Countries. *Energy Policy*, 38(8), 4422-4428.

Panayotou, T. (1993). Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development (No. 292778). *International Labour Organization.*

Pao, H. T. (2009). Forecast of Electricity Consumption and Economic Growth in Taiwan by State Space Modeling. *Energy*, 34(11), 1779-1791.

Pao, H. T., & Tsai, C. M. (2010). CO2 Emissions, Energy Consumption and Economic Growth in BRIC Countries. *Energy Policy*, 38(12), 7850-7860.

Pao, H. T., Yu, H. C., & Yang, Y. H. (2011). Modeling the CO2 Emissions, Energy Use, and Economic Growth in Russia. *Energy*, 36(8), 5094-5100.

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.

Payne, J. E. (2010). A Survey of the Electricity Consumption-Growth Literature. *Applied Energy*, 87(3), 723-731.

Phillips, P. C., & Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrika*, 75(2), 335-346.

Pindyck, R. S., & Rubinfeld, D. L. (1991). *Econometric Models and Economic Forecasts* (Vol. 4). Boston: Irwin/McGraw-Hill.

Richmond, Amy. "Environmental Kuznets Curve". *www.eoearth.org*. Np., 2007. Web. 19 Jan. 2016.

Roberts, J. T., & Grimes, P. E. (1997). Carbon Intensity and Economic Development 1962–1991: A Brief Exploration of the Environmental Kuznets Curve. *World Development*, 25(2), 191-198.

Roca, J., Padilla, E., Farré, M., & Galletto, V. (2001). Economic Growth and Atmospheric Pollution in Spain: Discussing the Environmental Kuznets Curve Hypothesis. *Ecological Economics*, 39(1), 85-99.

Saboori, B., & Sulaiman, J. (2013). CO2 Emissions, Energy Consumption and Economic Growth in Association of Southeast Asian Nations (ASEAN) Countries: A Cointegration Approach. *Energy*, 55, 813-822.

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.

Saboori, B., Sulaiman, J., & Mohd, S. (2012). Economic Growth and CO2 Emissions in Malaysia: A Cointegration Analysis of the Environmental Kuznets Curve. *Energy Policy*, 51, 184-191.

Sadorsky, P. (2010). The Impact of Financial Development on Energy Consumption in Emerging Economies. *Energy Policy*, 38(5), 2528-2535.

Saidi, K., & Hammami, S. (2015). The Impact of CO2 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 CO2 Emissions in Gulf Cooperation Council Countries. *Energy*, 73, 44-58.

Salahuddin, M., Gow, J., & Ozturk, I. (2015). Is the Long-Run Relationship Between Economic Growth, Electricity Consumption, Carbon Dioxide Emissions and Financial Development in Gulf Cooperation Council Countries Robust? *Renewable and Sustainable Energy Reviews*, 51, 317-326.

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.

Sebri, M., & Ben-Salha, O. (2014). On The Causal Dynamics between Economic Growth, Renewable Energy Consumption, CO2 Emissions and Trade Openness: Fresh Evidence from BRICS Countries. *Renewable and Sustainable Energy Reviews*, 39, 14-23.

Seker, F., & Cetin, M. (2015). The Relationship between Renewable Energy Consumption and Carbon Emissions in Turkey: An ARDL Bounds Testing Approach. *Proceedings of the 17th International Academic Conference*, No 2604535, 382-397.

Selden, T. M., & Song, D. (1994). Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution Emissions? *Journal of Environmental Economics and management*, 27(2), 147-162.

Shafik, N. (1994). Economic Development and Environmental Quality: An Econometric Analysis. *Oxford Economic Papers*, 46, 757-773.

Shafik, N., & Bandyopadhyay, S. (1992). *Economic Growth and Environmental Quality: Time-Series and Cross-Country Evidence* (Vol. 904). World Bank Publications.

Shahbaz, M., Hye, Q. M. A., Tiwari, A. K., & Leitão, N. C. (2013a). Economic Growth, Energy Consumption, Financial Development, International Trade and CO2 Emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, 25, 109-121.

Shahbaz, M., Lean, H. H., & Shabbir, M. S. (2012). Environmental Kuznets Curve Hypothesis in Pakistan: Cointegration and Granger Causality. *Renewable and Sustainable Energy Reviews*, 16(5), 2947-2953.

Shahbaz, M., Tiwari, A. K., & Nasir, M. (2013b). The Effects of Financial Development, Economic Growth, Coal Consumption and Trade Openness on CO2 Emissions in South Africa. *Energy Policy*, 61, 1452-1459.

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.

Stern, D. I. (1993). Energy and Economic Growth in the USA: A Multivariate Approach. *Energy Economics*, 15(2), 137-150.

Stern, D. I. (1998). Progress on the Environmental Kuznets Curve? *Environment and Development Economics*, 3(2), 173-196.

Stern, D. I. (2004). The Rise and Fall of the Environmental Kuznets Curve. *World Development*, 32(8), 1419-1439.

Stern, D. I., Common, M. S., & Barbier, E. B. (1996). Economic Growth and Environmental Degradation: The Environmental Kuznets Curve and Sustainable Development. *World Development*, 24(7), 1151-1160.

Tamazian, A., & Rao, B. B. (2010). Do Economic, Financial and Institutional Developments Matter for Environmental Degradation? Evidence from Transitional Economies. *Energy Economics*, 32(1), 137-145.

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.

Tang, C. F., & Tan, B. W. (2015). The Impact of Energy Consumption, Income and Foreign Direct Investment on Carbon Dioxide Emissions in Vietnam. *Energy*, 79, 447-454.

The Cost of Air Pollution, Health Impacts of Road Transport, http://www.oecd.org/environment/the-cost-of-air-pollution-9789264210448-en.htm

Uddin, G. S., Sjö, B., & Shahbaz, M. (2013). The Causal Nexus between Financial Development and Economic Growth in Kenya. *Economic Modelling*, 35, 701-707.

Walter, I., & Ugelow, J. L. (1979). Environmental Policies in Developing Countries. *Ambio*, 8(2/3), 102-109.

Wang, K. M. (2012). Modelling the Nonlinear Relationship between CO2 Emissions from Oil and Economic Growth. *Economic Modelling*, 29(5), 1537-1547.

Wang, S. S., Zhou, D. Q., Zhou, P., & Wang, Q. W. (2011). CO2 Emissions, Energy Consumption and Economic Growth in China: A Panel Data Analysis. *Energy Policy*, 39(9), 4870-4875.

Wyckoff, A. W., & Roop, J. M. (1994). The Embodiment of Carbon in Imports of Manufactured Products: Implications for International Agreements on Greenhouse Gas Emissions. *Energy Policy*, 22(3), 187-194.

Yang, Z., & Zhao, Y. (2014). Energy Consumption, Carbon Emissions, and Economic Growth in India: Evidence from Directed Acyclic Graphs. *Economic Modelling*, 38, 533-540.

Yuan, J., Zhao, C., Yu, S., & Hu, Z. (2007). Electricity Consumption and Economic Growth in China: Cointegration and Co-Feature Analysis. *Energy Economics*, 29(6), 1179-1191.

Yucel, F. (2009). Causal Relationships Between Financial Development, Trade Openness and Economic Growth: The Case of Turkey. *Journal of Social Sciences*, 5(1), 33-42.

Zhang, X. P., & Cheng, X. M. (2009). Energy Consumption, Carbon Emissions, and Economic Growth in China. *Ecological Economics*, 68(10), 2706-2712.

Zhang, Y. J. (2011). The Impact of Financial Development on Carbon Emissions: An Empirical Analysis in China. *Energy Policy*, 39(4), 2197-2203.

Ziaei, S. M. (2015). Effects of Financial Development Indicators on Energy Consumption and CO2 Emission of European, East Asian and Oceania Countries. *Renewable and Sustainable Energy Reviews*, 42, 752-759.

Zivot, E., & Andrews, D. W. (1992). Further Evidence on the Great Crash, The Oil-Price Shock, and The Unit-Root. *Journal of Business & Economic Statistics*, 10(3), 251-270.

APPENDICES

Appendix A: E-Views Output

Error Correction Model

Co-integrating Eq:	CointEq1
LNCO2(-1)	1.000000
LNGDP(-1)	-0.0697720 (0.17365) [-4.01803]
LNFUEL(-1)	2.827275 (0.97451) [2.90123]
LNFD(-1)	-0.015893 (0.15570) [-0.10207]
C	6.770169
Error Correction:	**D(LNCO2)**
CointEq1	-0.169797 (0.06998) [-2.42635]
D(LNCO2(-1))	-0.004821 (0.25412) [-0.01897]
D(LNCO2(-2))	-0.081376 (0.24303) [-0.33484]
D(LNCO2(-3))	0.322952 (0.23275) [1.38758]
D(LNCO2(-4))	0.262465 (0.23248) [1.12900]
D(LNCO2(-5))	0.155419 (0.21994) [0.70664]
D(LNGDP(-1))	0.462529 (0.18944) [2.44160]
D(LNGDP(-2))	0.373632 (0.21453) [1.74161]
D(LNGDP(-3))	0.317370 (0.21372) [1.48501]

Error Correction Model (continued)

D(LNGDP(-4))	0.407502 (0.24211) [1.68314]
D(LNGDP(-5))	0.263391 (0.24302) [1.08380]
D(LNFUEL(-1))	-0.713818 (0.64622) [-1.10461]
D(LNFUEL(-2))	0.023199 (0.65306) [0.03552]
D(LNFUEL(-3))	-1.535976 (0.56653) [-2.71118]
D(LNFUEL(-4))	-0.242388 (0.61943) [-0.39131]
D(LNFUEL(-5))	-0.643683 (0.46278) [-1.39089]
D(LNFD(-1))	-0.157458 (0.04220) [-3.73086]
D(LNFD(-2))	-0.129274 (0.05500) [-2.35024]
D(LNFD(-3))	-0.044369 (0.05771) [-0.76885]
D(LNFD(-4))	-0.050561 (0.06549) [-0.77206]
D(LNFD(-5))	-0.030471 (0.05707) [0.53397]
C	-0.043997 (0.02063) [-2.13265]
R-squared	0.597097
Adj. R-squared	0.244557
Sum sq. resids	0.024195
S.E. equation	0.031751
F-statistic	1.693699
Log likelihood	108.3842
Akaike AIC	-3.755833
Schwarz SC	-2.881266
Mean dependent	0.009607

S.D. dependent	0.036531
Determinant resid covariance (dof adj)	2.31E-12
Determinant resid covariance	1.71E-13
Log likelihood	415.0486
Akaike information criterion	-14.04559
Schwarz criterion	-10.38831

Granger Causality Tests under Block Exogeneity Approach

Dependent variable: D(LNCO2)

Excluded	Chi-sq	df	Prob.
D(LNGDP)	10.36382	5	0.0656
D(LNFUEL)	9.194732	5	0.1015
D(LNFD)	17.68913	5	0.0034
All	26.75712	15	0.0308

Dependent variable : D(LNGDP)

Excluded	Chi-sq	df	Prob.
D(LNCO2)	3.16740	5	0.6745
D(LNFUEL)	4.613191	5	0.4649
D(LNFD)	3.610404	5	0.6068
All	15.60275	15	0.4089

Dependent variable: D(LNFUEL)

Excluded	Chi-sq	df	Prob.
D(LNCO2)	14.11081	5	0.0149
D(LNGDP)	16.32962	5	0.0060
D(LNFD)	35.44697	5	0.0000
All	67.21628	15	0.0000

Dependent Variable: D(LNFD)

Excluded	Chi-sq	df	Prob.
D(LNCO2)	1.325117	5	0.9323
D(LNGDP)	2.704144	5	0.7455
D(LNFUEL)	3.916009	5	0.5616
All	7.512803	15	0.9

Appendix B: List of Articles

Recent Articles on Financial Development and CO_2 Emissions (except Turkey)

Seyed Mahdi Ziaei (2015)	1989-2011	PVAR	13 European and 12 East Asia and Oceania countries	Financial development variables and CO_2 emission is driven by both feedback and growth hypothesis.
Sahbi Farhani, Ilhan Ozturk (2015)	1971-2012	ADF-GLS, ADF-WS, ARDL, ECM Granger causality test	Tunisia	Long-run relationship between variables, $CO_2 \leftrightarrow$ FD (long-run) $CO_2 \rightarrow$ FD (short-run)
Mohammad Salahuddin, Jeff Gow, Ilhan Ozturk (2015)	1980-2012	CIPS, Pedroni co-integration test, DOLS , FMOLS, DFE, VECM Granger causality test, Variance decomposition	GCC	Long-run relationship between variables, FD has negative effect on CO_2 in long-run, No causal link between FD and CO_2
Mohamed Amine Boutabba (2014)	1971-2008	LM , ADF, KPSS, (ADF-GLS), ARDL, VECM Granger causality test	India	Long-run relationship between variables, FD has positive significant effect on CO_2 in long-run, FD $\rightarrow CO_2$ (long-run)
Muhammad Shahbaz, Qazi Muhammad Adnan Hye, Aviral Kumar Tiwari, Nuno Carlos Leitão (2013)	1975Q1 - 2011Q4	ZA, ARDL, VECM Granger causality test, IAA	Indonesia	FD $\rightarrow CO_2$
Muhammad Shahbaz, Aviral Kumar Tiwari, Muhammad Nasir (2013)	1965-2008	ARDL, ECM Granger causality test	South Africa	FD has negative effect on CO_2, No causal link between FD and CO_2
Usama Al-mulali, Che Normee Binti Che Sab (2012)	1980-2008	IPS, F-AFD, Pedroni co-integration test, Panel Granger causality test	Thirty Sub Saharan African countries	FD $\leftrightarrow CO_2$ (long-run and short-run)

Usama Al-mulali, Che Normee Binti Che Sab (2012)	1980-2008	IPS, F-ADF, F-PP, Pedroni co-integration test, Panel Granger causality test	19 selected countries	Long-run relationship between variables, CO2 has positive effect on FD in both short-run and long-run
Abdul Jalil, Mete Feridun (2011)	1953-2006	ADF, ARDL, ECM, Granger causality test	China	Long-run relationship between variables, FD ↔ CO2

Recent articles on Financial Development and CO2 Emissions (case of Turkey)

Korhan Gokmenoglu, Nesrin Ozatac, Baris Memduh Eren (2015)	1960-2010	ADF, PP, JJ co-integration test, Granger causality test	Turkey	FD → CO2
Ilhan Ozturk, Ali Acaravci (2013)	1960-2007	ADF-GLS, AFD-WS, ARDL, Granger causality test	Turkey	FD → CO2 (long-run)

Recent articles on Economic Growth and CO2 Emissions (except Turkey)

Mehmet Mercan, Etem Karakaya (2015)	1970-2011	CDLM, CADF, PANKPSS, DSUR	OECD	GDP has negative effect on CO2
Mak B. Arvin, Rudra P. Pradhan, Neville R. Norman (2015)	1961-2012	LLC, IPS, Pedroni panel co-integration test, Johansen Fisher panel co-integration test, VECM Granger causality test	G-20	Long-run relationship between variables, No causal link between GDP and CO2 in long-run, GDP → CO2 (short-run)

Mohammad Salahuddin, Jeff Gow, Ilhan Ozturk (2015)	1980-2012	CIPS, Pedroni co-integration test, DOLS , FMOLS, VECM Granger causality test, variance decomposition	GCC	GDP has positive significant effect on CO2 in long-run, GDP ↔ CO2
Atef Saad Alshehry, Mounir Belloumi (2015)	1971-2010	ADF, PP, Johansen co-integration test, VECM Granger causality test	Saudi Arabia	CO2 → GDP (short-run) CO2 ↔ GDP (long-run)
Sahbi Farhani, Ilhan Ozturk (2015)	1971-2012	ADF-GLS, ADF-WS, ARDL, ECM Granger causality test	Tunisia	Long-run relationship between variables, GDP → CO2 (short-run and long-run)
Umesh Bastola, , Pratikshya Sapkota (2015)	1980-2011	ADF, PP, ARDL, Johansen co-integration test, VECM Granger causality test	Nepal	GDP → CO2
Mehdi Abid (2015)	1980–2009	ADF, PP, Johansen co-integration test, VECM Granger causality test	Tunisia	GDP → CO2 (short-run and long-run)
Chor Foon Tang, Bee Wah Tan (2015)	1976-2009	ADF, KPSS, Johansen co-integration test, VECM Granger causality test	Vietnam	GDP ↔ CO2 (short-run)
Maamar Sebri, Ousama Ben-Salha (2014)	1971-2010	ADF-MAX, ZA, ARDL, VECM Granger causality test	BRIC	CO2 → GDP (short-run)
Anis Omri, Duc Khuong Nguyen, Christophe Rault (2014)	1990–2011	IPS, GMM, Panel	54 countries	CO2 → GDP CO2 ↔ GDP (Middle Eastren, North African, and sub-Saharan)

Behnaz Saboori, Maimunah Sapri, Maizan bin Baba (2014)	1980-2008	ADF, PP, FMOLS	OECD	CO_2 ↔ GDP (long-run)
Lin-Sea Lau, Chee-Keong Choong, Yoke-Kee Eng (2014)	1984–2008	PP, ARDL, VECM Granger causality test	Malaysia	Long-run relationship between variables, The linkage between CO_2 and GDP is sensitive to the quality of institutions.
Wendy N. Cowan , Tsangyao Chang, Roula Inglesi-Lotz, Rangan Gupta (2014)	1990–2010	Panel Granger causality test	BRICS	GDP → CO_2 (South Africa) CO_2 → GDP (Brazil)
Rashid Sbia , Muhammad Shahbaz, Helmi Hamdi (2014)	1975Q1–2011Q4	ARDL, VECM Granger causality test	UAE	CO_2 ↔ GPD (long-run)
Pendo Kivyiro, Heli Arminen (2014)	1971-2009	ADF, PP, ARDL, VECM Granger causality test	Sub-Saharan Africa	CO_2 → GDP (Republic of the Congo, short-run) GDP → CO_2 (DRC, Kenya)
Zihui Yang, Yongliang Zhao (2014)	1970–2008	ADF, PP, DAG, Granger causality test	India	CO_2 ↔ GDP
Mohammad Salahuddin, Jeff Gow (2014)	1980-2012	CIPS, Pedroni co-integration test, Panel Granger causality test, SUR	GCC	GDP has positive effect on CO_2 in long-run, GDP has negative effect on CO_2 in short-run, No causal link between GDP and CO_2
Sahbi Farhani, Anissa Chaibi, Christophe Rault (2014)	1971-2008	ARDL, VECM Granger causality test	Tunisia	GDP → CO_2

V.G.R. Chandran Govindaraju, Chor Foon Tang (2013)	1965-2009	ADF, PP, BH, VECM Granger causality test	India, China	GDP → CO_2 (China, short-run and long-run), GDP ↔ CO_2 (India, short-run)
Anis Omri (2013)	1990–2011	ADF, PP, GMM	MENA	GDP ↔ CO_2
Muhammad Shahbaz, Qazi Muhammad Adnan Hye, Aviral Kumar Tiwari, Nuno Carlos Leitão (2013)	1975Q1–2011Q4	ZA, ARDL, VECM Granger causality test, IAA	Indonesia	Long-run relationship between variables, GDP ↔ CO_2
Behnaz Saboori , Jamalludin Sulaiman (2013)	1971–2009	ADF, PP, ARDL, VECM Granger causality test	Southeast Asian Nations	In short-run: GDP ↔ CO_2 (Indonesia, Singapore, Thailand) CO_2 → GDP (Philippines) In long-run: GDP ↔ CO_2 (Indonesia, Malaysia, Philippines) GDP → CO_2 (Singapore, Thailand)
Behnaz Saboori, Jamalludin Sulaiman, Saidatulakmal Mohd (2012)	1980-2009	ADF, PP, ARDL, VECM Granger causality test	Malaysia	GDP → CO_2 (long-run), Inverted U-shaped relationship in both short-run and long-run

Mohammad Jahangir Alam, Ismat Ara Begum, Jeroen Buysse, Guido Van Huylenbroeck (2012)	1972-2006	ADF, PP, JJ, ARDL, ECM Granger causality test	Bangladesh	GDP ↔ CO2 (short-run and long-run)
Muhammad Shahbaz, Hooi Hooi Lean, Muhammad Shahbaz Shabbir	1971-2009	Bounds test for co-integration, Granger causality test	Pakistan	GDP → CO2
S.S. Wang, D.Q. Zhou, P. Zhou, Q.W. Wang (2011)	1995–2007	LLC, IPS, MW, Pedroni co-integration test, ECM Granger causality test	China	Long-run relationship between variables, Inverted U-shaped relationship, GDP → CO2 (long-run)
Mohammad Jahangir Alam, Ismat Ara Begum, Jeroen Buysse, Sanzidur Rahman, , Guido Van Huylenbroeck (2011)	1971-2006	ADF, PP, ZA, Granger causality test	India	No causal link between GDP and CO2 in either direction
Hsiao-Tien Pao, Hsiao-Cheng Yu, Yeou-Herng Yang (2011)	1990-2007	KPSS, NP-GLS, Johansen co-integration test, ECM Granger causality test	Russia	Long-run relationship between variables, CO2 → GDP (short-run) CO2 ↔ GDP (long-run)
Md. Sharif Hossain (2011)	1971–2007	ADF, LLC, IPS, MW, JF panel co-integration test, ECM Granger causality test	NIC	GDP → CO2 (short-run)
Usama Al-mulali (2011)	1980–2009	IPS, F-ADF, F-PP, Pedroni co-integration test, VECM panel Granger causality test	MENA	GDP ↔ CO2 (short-run and long-run)

Abdul Jalil, Mete Feridun (2011)	1953-2006	ADF, ARDL, ECM, Granger causality test	China	Long-run relationship between variables, GDP → CO_2
Shuwen Niu, Yongxia Ding, Yunzhu Niu, Yixin Li, Guanghua Luo (2011)	1971 - 2005	LLC, IPS, F-ADF, F-PP, Pedroni co-integration, VECM Granger causality test	8 Asian-Pacific countries	Long-run relationship between variables, GDP → CO_2 CO_2 → GDP (long-run)
Muhammad Nasir, Faiz Ur Rehman (2011)	1972–2008	ADF, PP, Johansen co-integration test, JJ, VECM Granger causality test	Pakistan	GDP → CO_2 (short-run and long-run)
Ching-Chih Chang (2010)	1981-2006	PP, Johansen co-integration test, VECM Granger causality test	China	GDP → CO_2
Mohammad Reza Lotfalipour, , Mohammad Ali Falahi , Malihe Ashena (2010)	1967–2007	ADF, PP, TY Granger	Iran	GDP → CO_2
Hsiao-Tien Pao, , Chung-Ming Tsai (2010)	1990–2005	LLC, IPS, F-ADF, Breitung unit root test, Pedroni co-integration test, Granger causality test, Wald test	BRIC	CO_2 → GDP (short-run and long-run)

Sajal Ghosh (2010)	1971–2006	ADF, PP, KPSS, JJ, ARDL, Granger causality test	India	CO_2 ↔ GDP (short-run)
Xing-Ping Zhang, , Xiao-Mei Cheng (2009)	1960–2007	ADF, PP, KPSS, ZA, TY Granger causality test	China	No causal link between CO_2 and GDP

Recent articles on Economic Growth and CO2 Emissions (case of Turkey)

Fahri Seker, Murat Cetin (2015)	1960-2010	PP, KPSS, ARDL, VECM Granger causality test	Turkey	GDP → CO_2 (long-run)
Cuma Bozkurt, Yusuf Akan (2014)	1960-2010	ADF, JJ, VEC Granger	Turkey	CO_2 has negative effect on GDP,
Ilhan Ozturk, Ali Acaravci (2013)	1960-2007	ADF-GLS, AFD-WS, ARDL, Granger causality test	Turkey	GDP → CO_2 (long-run)
Ilhan Ozturk, Ali Acaravci (2010)	1968–2005	ARDL, Granger causality test	Turkey	No causal link between CO_2 and GDP
Ferda Halicioglu (2009)	1960-2005	ADF, PP, ARDL, JJ co-integration test, ECM Granger causality test	Turkey	GDP ↔ CO_2 (long-run and short-run)

Ugur Soytas, Ramazan Sari (2009)	1960–2000	ADF, PP, KPSS, VAR, TY Granger causality test	Turkey	No long-run causal link between CO2 and GDP

Recent articles on Financial Development and Economic Growth (except Turkey)

Anis Omri, Saida Daly, Christophe Rault, Anissa Chaibi (2015)	1990–2011	LLC, IPS, Pedroni co-integration test, GMM	MENA	FD → GDP FD has significant effect on GDP, GDP has insignificant effect on FD
Ronald Ravinesh Kumar, Peter Josef Stauvermann, Nanthakumar Loganathan, Radika Devi Kumar (2015)	1972-2012	ADF, PP, KPSS, ARDL, BH co-integration, CD, TY Granger causality test	South Africa	No causal link between GDP and FD
Korhan K. Gokmenoglu, Muhammad Yusuf Amin, Nigar Taspinar (2015)	1967-2013	ADF, PP, Johansen co-integration, VEC Granger causality test	Pakistan	Long-run relationship between variables, FD ↔ GDP
Phouphet Kyophilavong, Gazi Salah Uddin, Muhammad Shahbaz (2014)	1971-2011	ADF, PP, ARDL, ECM	Laos	FD has positive effect on GDP
Khoutem Ben Jedidia, Thouraya Boujelbène, Kamel Helali (2014)	1973-2008	ARDL, ECM	Tunisia	FD ↔ GDP (short-run)

Gazi Salah Uddin, Bo Sjö, Muhammad Shahbaz (2013)	1971-2011	ADF, PP, ZA, ARDL, GH co-integration, ECM	Kenya	FD has positive effect on GDP
M. Kabir Hassan , Benito Sanchez, Jung-Suk Yu (2011)	1980-2007	Panel regression, VAR, Variance decomposition, Granger causality test	Low- and middle-income countries	In short-run: FD ↔ GDP (except Sub-Saharan and East Asia & Pacific) GDP → FD (Sub-Saharan and East Asia & Pacific)

Recent article on Financial Development and Economic Growth (case of Turkey)

Hasan Güngör, Salih Katircioglu, Mehmet Mercan (2014)	1960–2011	CIS unit root test, Maki co-integration test	Turkey	Long-term equilibrium relationship between FD and GDP
Erdal Demirhan, Oguzhan Aydemir, Ahmet Inkaya (2011)	1987-2006	VECM, IRF	Turkey	FD ↔ GDP
Fatih Yucel (2009)	1989-2007	ADF, JJ, Granger causality test	Turkey	FD ↔ GDP FD has negative effect on GDP.

Articles on Financial Development, CO_2 Emissions, Economic Growth

Sahbi Farhani, Ilhan Ozturk (2015)	1971-2012	ADF-GLS, ADF-WS, ARDL, ECM Granger causality test	Tunisia	Long-run relationship between variables, CO_2 ↔ FD (long-run) CO_2 → FD (short-run) GDP → CO_2 (short-run and long-run)

Anis Omri, Saida Daly, Christophe Rault, Anissa Chaibi (2015)	1990–2011	LLC, IPS, Pedroni co-integration test, GMM	MENA	CO_2 ↔ GDP FD → GDP FD has significant effect on GDP, GDP has insignificant effect on FD
Muhammad Shahbaz, Aviral Kumar Tiwari, Muhammad Nasir (2013)	1965-2008	SL, ARDL, ECM Granger causality test	South Africa	Long-run relationship between variables, FD has negative effect on CO_2, No causal link between FD and CO_2
Muhammad Shahbaz, Qazi Muhammad Adnan Hye, Aviral Kumar Tiwari, Nuno Carlos Leitão (2013)	1975Q1 - 2011Q4	ZA, ARDL, VECM Granger causality test, IAA	Indonesia	FD → CO_2 GDP ↔ CO_2
Ilhan Ozturk, Ali Acaravci (2013)	1960-2007	ADF-GLS, AFD-WS, ARDL, Granger causality test	Turkey	Long-run: GDP → CO_2 FD → CO_2 Short-run: FD → GDP
Usama Al-mulali, Che Normee Binti Che Sab (2012)	1980-2008	IPS, F-AFD, Pedroni co-integration test, Panel Granger causality test	Thirty Sub Saharan African countries	FD ↔ CO_2 (long-run and short-run)
Usama Al-mulali, Che Normee Binti Che Sab (2012)	1980-2008	IPS, F-ADF, F-PP, Pedroni co-integration test, Panel Granger causality test	19 selected countries	Long-run relationship between variables, CO_2 has positive effect on FD in both short-run and long-run CO_2 → GDP CO_2 → FD