NEAR EAST UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
ECONOMICS PROGRAM

TESTING THE ROLE OF EXTERNAL DEBT IN AUGMENTED ENVIRONMENTAL KUZNETS CURVE: EVIDENCE FROM TURKEY

AYŞEM ÇELEBİ

PhD THESIS

NICOSIA
2019

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NICOSIA
2019

ACCEPTANCE / APPROVAL

We as the jury members certify the “Testing the Role of External Debt Augmented Environmental Kuznets Curve: Evidence from Turkey” prepared by Ayşem Çelebi defended on 08/January/2019 has been found satisfactory for the award of degree of PhD in Economics

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DECLARATION

I Ayşem Çelebi, hereby declare that this dissertation entitled 'Testing The Role Of External Debt In Environmental Kuznets Curve: Evidence From Turkey' has been prepared myself under the guidance and supervision of "Prof. Dr. Salih KATIRCIOGLU" in partial fulfilment of The Near East University, Graduate School of Social Sciences regulations and does not to the best of my knowledge breach any Law of Copyrights and has been tested for plagiarism and a copy of the result can be found in the Thesis.

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To My Family

ACKNOWLEDGMENTS

I would like to thank my supervisor Prof. Dr. Salih Katırcıoğlu for his continuous directions and guided in the preparation of this thesis. Without his invaluable supervision, all my efforts could have been short sighted. His precious support always puts me one step forward in every stage of my life.

I would like to extend my gratitude to my friends Ceylan Hassan and Server Yavaş for their invaluable support and patience throughout my studies. Without their endless support, it would not be possible to overcome the most difficult times during my studies.

I would like to dedicate this thesis to my husband, my son and my daughter as an indication of their significance in this study as well as in my life. Finally I owe extremely to my mum and dad who supported me throughout my studies.

ABSTRACT

TESTING THE ROLE OF EXTERNAL DEBT IN AUGMENTED ENVIRONMENTAL KUZNETS CURVE: EVIDENCE FROM TURKEY

This thesis explores the role of external debt stock of Turkey in environmental concerns and quality, which has experienced from substantial domestic and external debt stock for a long time. It is aimed to establish a link between debt and Environmental Kuznet's Curve (EKC) of Turkey that is considered as highly foreign energy dependent country. The argument puts forward in this study is that debt (domestic and/or foreign) might be a significant determinant of real income; thus, it might exert significant effects on the level of energy consumption through real income. This raises a question if debt might also be a crucial for energy consumption and therefore it might yield environmental degradation. Thus, the effects of debt on these two aggregates will be examined via extended version of the EKC model. Time series analysis is used to examine the annual data set between the period of 1960 and 2013. The findings revealed that the conventional Environmental Kuznets curve exists in Turkey's case. On the other hand, the relations between foreign debt, energy consumption, CO2 emissions and real income in the short term periods have been examined under the vector autoregressive framework; the results from two different methodological approaches (vector error correction and generalized method of moments) suggest that the effect of external debt is insignificant in the EKC behavior of Turkey.

Keywords: CO2 emissions, Energy Consumption, Debt, Turkey, Causality

ÖZ

TESTING THE ROLE OF EXTERNAL DEBT IN AUGMENTED ENVIRONMENTAL KUZNETS CURVE: EVIDENCE FROM TURKEY

Bu tez, uzun yıllardır ağır (dış ve iç) borç stoğundan zarar gören Türkiye'deki dış borç stoğunun rolünü araştırmaktadır. Dolayısıyla, mevcut çalışma, Türkiye kapsamında, borç ile Çevresel Kuznet Eğrisi arasında bir bağ kurmayı amaçlıyor. Türkiye, enerji bağımlılığı yüksek bir ülkedir. Bu çalışmada öne sürülen argüman, özellikle gelişmekte olan ülkelerde borç (yerli ve/veya yabancı) reel gelirin önemli bir belirleyicisi olabilir; dolayısıyla, gerçek gelir yoluyla enerji tüketiminin seviyesine dolaylı etkiler gösterebilir olmasıdır. Borcun aynı zamanda enerji tüketiminin ve dolayısıyla çevresel bozulmanın bir belirleyicisi olabilecek olması bir soru ortaya çıkarmaktadır. Böylece, borçların bu iki kütle üzerindeki etkileri EKC modelinin genişletilmiş versiyonu üzerinden incelenecektir. 1960 - 2013 yılları arasındaki yıllık veriler, bunu incelemek için zaman serileri analizi kullanılarak analiz edilmiştir. Bu tezde, borcun GSYİH'nın belirleyicilerinden biri olabileceği ve dolayısıyla enerji tüketiminin seviyesi, CO2 emisyonu üzerinde dolaylı bir etkisi olacağı vurgulanmaktadır. Sonuçlar, Türkiye örneğinde geleneksel çevresel Kuznets eğrisinin (EKC) geçerliliğini doğrulamaktadır. Bununla birlikte, bu çalışma aynı zamanda Türkiye'nin dış borç stoğununTürkiye ekonomisinin uzun vadeli çevresel Kuznets eğrisinin (EKC) davranışını etkilemediğini ortaya koymuştur. Çalışmanın sonuçları, dış borç stoğu, CO2 emisyonları, enerji tüketimi ve reel gelir arasında önemli etkileşimlerin olduğunu göstermektedir; dış borç hacmindeki değişiklikler, bu toplamların hacimlerindeki değişimlerden önce gelmektedir.

Anahtar Kelimeler: CO2 emisyonları, Enerji Tüketimi, Borç, Türkiye, Nedensellik

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ABBREVIATION

AIC	**:**Akaike information criterion
ARDL	**:**Autoregressive distributed lag
ASEAN	**:**Association of Southeast Asian Nations
CO2	**:**Carbon dioxide
ECM	**:** Error correction model
ECT	**:**Error correction term
EKC	**:**Environmental Kuznets Curve
FDI	**:**Foreign direct investments
GDP	**:**Gross Domestic Produce
GLS	**:**Generalized least squares
NAFTA	**:**North America Free Trade Agreement
OECD	**:**Organization for Economic Co-operation and Development
VAR	**:**Vector Autoregressive

CHAPTER 1
INTRODUCTION

1.1 Brief Overview

Several authors have mentioned that economic progress and trade liberalization are vital elements for the states. Arrow et al. (1995) had indicated that policies which are employed to accelerate economic growth might have detrimental impact to the environment. In addition to these, environmental issues such as depletion on ozone layer which could also named as greenhouse effect yield scholars to pay more attention to advance their knowledge on the likelihood impacts of economic progress to the environment. Likely Neumayer (2003) also mentioned that sustainable economic progress in advanced economies might be obtained by degrading environment. To be more accurate, there is a close linkage among economic growth and pollution. Numerous scholars had arranged scholarly studies in the relevant field (Ozcan & Ari, 2017; De Vita et al., 2015; Heidari et al., 2015; Katircioglu et al., 2016; Cetin & Ecevit, 2017; Katircioglu & Katircioglu, 2017; Istaiteyeh, 2016; Kalayci & Koksal, 2015).

Moreover, Binder & Monch (1997) had stressed that a rise in income may yield an upward trend for service sector and old fashioned manufacturing sector which in turn sustainable economic progress could be achieved. Besides, raised income may act as a mechanism to reduce rates of population hence environmental degradation. Several scholarly researches had been designed to investigate the association among economic growth and environmental pollution (Cole & Neumayer, 2005; Stern, 2003). To test this linkage scholars had preferred to employ Environmental Kuznets Curve as theoretical foundation, that was introduced and had became popular with the findings of Grossman & Kruger's conducted in 1991. It could be stressed that Environmental Kuznet Curve has some vital hypotheses. To be more precise, Neumayer (2003) and Stern (2004) had lamented that the preliminary phases of economic growth could generate environmental pollution until it reaches specified level of income that is also called as "turning point". Then, economic progress could begin. Furthermore, the association between pollution and income has exhibited an inverse U - shape relationship as scheduled namely as the EKC. John & Peccehenio (1994) had mentioned that quality of environment could decrease by the time until engaging the investments which might have positive impacts on environmental quality. Besides, environmental investment could be identified as a phenomena which the superiority of environment starts to recover by the development of the economy. Grossman & Krueger (1995) outlined that with the help of an improved economy, it could be easier to engage with the environment friendly activities or investments which then play a vital role to reduce level of the pollution.

Furthermore, Neumayer (2003) had expressed that advanced nations are sensitive about the approaches to protect environment; thus they are more likely to favor environment friendly innovations. Likely, Huan et al. (2008) had highlighted that advanced nations are more likely to rely on effective electricity utilization, hence promoting development in environmental quality as CO2 emissons are decreasing. Similarly, Gielan et al (2008) had stressed that increasing the scale of using renewable energy sources at industrial era would act as one the major drivers to generate better environment as CO2 emissions would decrease. Energy sources are considered to be one of a nation's key economic forces (Altinbas & Kapusuzoglu, 2011), and additionally being one of the main issues which might cause wars. Ayan and Pabuçcuoğlu (2013) suggested that the energy sector is one of the promiment drivers to stimulate economic growth. Moreover, Güler (2006) expressed that non-renewable energy resources could have detrimental impact on the nature. Furthermore, it might be indicated that most of the nations are becoming energy dependent countries over time (Altinbas & Kapusuzoglu, 2011). Therefore, nations may focus on discovering non-renewable energy resources and replace them with renewable energy resources.

However, for the most recent decade, most advanced and developing countries have been expected to manage issues identified with their economy, currently captivating with borrowing concern and winding up with high levels of debt subsequently. Various reasons forming the borrowing need have been expressed by Zeud and Awawdeh (2014) as well. On the other hand, the most basic reasons behind borrowing are to reduce the investment-saving gap, reduce deficits of current account, make large amounts of investments, and intend to help economic development.

Various researchers had emphasized causal correlation between debt and economic growth. In other words, the necessity of performing larger sums of investments, budget deficit, and an external debt component which could be considered as public debt are the major aspects which are shaping borrowing activities of the government. It could be mentioned that these aspects could have various effects on the nation's economic growth (GDP). Several scholars conducted studies to investigate relations between debt and economic growth. Results of many studies revealed that there is an inverse relationship between debt and growth (Fosu, 1996; Şenet al., 2007; Atique & Malik, 2012).

Abdurahman (2012) presented debt in the form of public debt that might be simply described as `securities of government` which failed to compensate former budget deficit. In addition to this, Mankin (2013) identified that public debt occurs when the expenditures of government is higher than its tax revenues which could be compensated either by stock of foreign debt or borrowings from private institutions. Le and Ng (2015) stressed that stock of debt is more likely to arise in developing nations which then might be used as a source to trigger economic growth or put a financial burden for the next generation.

As previously mentioned, external debt another form of debt arising from external borrowing from overseas institutions such as International Monetary

Fund. Various authors had designed empirical researches to explore causal correlation between economic growth and external debt. Studies revealed miscellaneous results. As an example, Moreir (2003), Javed & Sahinoz (2005), and Fayissa, ElKaissy (1999), expressed that stock of foreign debt have positive contribution on the economic growth. Additionally, Jayaraman & Choong (2006) had discovered bi-directional correlation among variables (growth and debt), while some different scholars have found an inverse relation among the two (Uysal et al., 2009; Cordella et al, 2005 Sharek,2004; Clements et al; 2003).

On the other hand, Lyoba (2011) mentioned that external debt can negatively effect on economic growth, as it can reduce magnitude of potential investments and yields borrowing capital misallocation and waste of consumption. This negative causality between external debt and economic growth were also supported by the various scholars' studies (Karagöl, 2002; Pattilio et al., 2004; Doğruel, 2007; Saad, 2012).

Le and NG (2015) had conducted a study and emphasized that public debt spending might be executed specially in health and education sectors. From this framework public debt could trigger economic development as it might promote well-being of the nation. Study also documented that spending on education sector will accelerate productivity of the workforce; therefore, economic growth will be achieved.

As discussed previously, the nature of borrowing will also affect the nature of the nation's economic position and investments (Zeud & Awawdeh, 2014). To be more precise, if the debt is directed towards investments on renewable energy sources for instance; hydropower, wind, solar energy etc. as well as incentives which provided to the entrepreneurs to motivate them to construct environment friendly institutions (green jobs) and which in turn generates vacancy opportunities thus will reduce the level of unemployment. In addition to these, Leman (2011) indicated that engaging in a trading renewable energy sources among nations will also positively contribute to the nations' economic growth.

Several authors highlighted a linkage between availability of energy sources and composition of the governmental spending. To be more accurate, energy dependent nations might choose to purchase non-renewable energy sources from energy abundant nations (Al-Abdulhadi, 2014). This trading are more likely to be financed by governmental borrowing which is one of the prominent denominator to boost external debt and reducing the quality of environment of the nations. Consistently with this argument, scholars had explored that there is close relationship between government spending and environmental quality and investments (Halkos and Paizonos, 2013; Zhang et al 2017). Aside of these, it can be expressed that environment friendly energy sources are creating chances to reduce carbon- dioxide emissions as well as it promotes economic growth (Nasr, 2015). Panizza and Presbitero (2014) outlined association between debt and GDP, and found negative relationship. Therefore, it could be interesting to examine linkage among energy sector and environment pollution level through debt stock of countries. Examining a linkage among debt and environmental quality and energy sector would add new insights to the related literature.

1.2 Aim of the Study

As previously mentioned, debt stocks are likely to effect on macroeconomic activity either directly or indirectly. Moreover, it could be stated that such effects could also shape the overall energy consumption levels and therefore carbon dioxide emissions in the states. Therefore, the primary objective of the present study is to explore a linkage between debt and EKC for Turkey, which could be identified as a developing economy with rich renewable energy resources. To provide a better understanding, it could be stated that Turkey aims to put intensive efforts to execute policies which are removing non-renewable energy sources but supporting environment friendly renewables for instance wind, hybrid and so forth owing to its rising foreign energy dependency over the years (Katircioglu & Katircioglu, 2018). Therefore, it can be outlined that Turkey became more foreign energy dependent nation which deteriorates current account balance as well. For all these reasons, it is expected Turkey will engage in more renewable energy sources to reduce its dependency on foreign energy and therefore environmental deterioration (Turkey Energy Report, 2013). From this perspective, this study will act as one of the initial scholarly research to provide interesting findings to the literature and also provide a guidance for the policy makers.

1.3 Methodology, Model and Data

Time series econometric approaches will be adopted to estimate the proposed research model. Unit Root Tests that also consider the series which has structural breaks and it will be employed to test if variables are stationary as a rule of Classical Linear Regression Models.

In the case of non-stationary series, co integration tests will be added to the analyses to investigate if proposed research model could be estimated for the long-run inference. If so, then after, short and long-run dynamics will be estimated for the proposed research model of this study.

Annual data is constructed from World Bank (2017) and it covers carbon-dioxide emission (kt), use of energy (E) (kt of oil equivalent), constant GDP (USD), (2005 = 100), and external debt (D) of Turkey between the years 1960 and 2013.

1.4 Contributions of the Thesis

This thesis attempts to contribute to existing literature as far as conceptual argument is concerned. There is extensive literature regarding the role of external debt stock by applying similar techniques in real income of many countries but we will establish a link between debt and environmental degradation in the case of Turkey. To the best of our knowledge, this study is the first of its kind in the relevant literature. In this thesis, we investigate if the debt is one of the determinants of GDP and have an indirect effect on the level of energy consumption, therefore, CO2 emissions. Findings of the research will also test the validity of the EKC in the Turkish case.

Contemporary econometric techniques will be utilized as mentioned above to analyze interactions among real income, energy consumption, external debt stock, and lastly CO_2 emissions.

1.5 Structure of the Study

This research is organized as follows: Section 2 will indicate Environmental Kuznets Curve theory and Literature Review of the study. Energy, debt history and Turkish economy in retrospect will be outlined in Section 3. Section 4 will present Data, Model and Methodology of the study. Role of External Debt in EKC will be explained by employing MAKI Co-integration and VECM Approaches in Section 5. In Section 6, Role of External Debt in EKC will be presented by appointing GMM method. Finally in Section 7, Conclusion and Policy Implications of the current study will be mentioned.

CHAPTER 2
LITRERATURE REVIEW

2.1 Sectoral Effects on the Environmental Kuznets Curve

This chapter discusses and indicates a comprehensive review of both empirical and theoretical recent developments on Environmental Kuznets Curve. Numerous scholars have conducted various empirical studies regarding Environmental Kuznets Curve (EKC) on different fields such as tourism (Paramati, Alam and Chen, 2017; Zaman, Shahbaz and Loganathan, Reza, 2015; Katırcıoğlu, 2014; Katırcıoğlu, Feridun and Kılınç, 2014); country specific studies are also available (Zhang and Cheng; 2009; Soytaş and Sari, 2009; Halıcıoğlu, 2009; Erdal et al., 2008; Ang, 2008; Karanfil, 2008; Lee and Chang, 2005; Oh and Lee, 2004; Wolde and Rafael, 2004; Gleasure, 2002; Fatai et al., 2002; Aqeel and Butt, 2001; Soytaş, 2001).

Several scholars conducted scholarly researches to investigate the effect of energy consumption on economic growth multi country basis (Erol & Yu, 1987; Lee, 2005; Al Irani, 2006; Huang et al, 2008; Lee & Chang, 2008; Mohammadi and Parvaresh, 2014; Jammazi and Aloui, 2015; Margues et al, 2016; Alper and Oğuz, 2016). Besides of these, numerous scholars aimed to investigate causality among pollution variables and economic growth (Ang, 2007; Zhang and Cheng, 2007; Lean and Smyth, 2010; Fodha and Zaghdoud, 2010; Saboori, Sulaiman and Mohd, 2012; Yavuz , 2014; Apergis and Öztürk, 2015; Jula, Dumitrescu, Lie, Dobrescu,2015;). Moreover, numerous empirical studies were conducted on how economic growth and CO2 emissions can be effected by FDI (Elliott, Sun and Chen, 2013; Lau et al, 2014; Ren et al, 2014; Kivyiro&Arminen, 2014; Tang and Tan, 2015). Furthermore, recently various studies conducted to discover relationship among usage of renewable and non-renewable energy sources and CO2 emissions (Jebli, Youssef, S. B. and Ozturk; Doğan and Şeker, 2016; Bilgili, Koçak and Bulut, 2016).

Table 1: Summary of Empirical Studies on Tourism EKC on Economic Growth

Name of Scholar(s)	Aim of research	Findings
Katırcıoğlu et al (2014)	To explore long-run equilibrium correlations between energy consumption, international tourism, and CO_2 and direction of causality among these variables in Cyprus by appointing Error Correction models and conditional Granger Causality mode. l	International tourists will have positive and significant and inelastic impacts on the level of energy consumption and CO_2 emissions and energy consumption will increase CO_2 emissions in Cyprus.
Katırcıoğlu (2014)	To study the relationship among the developments in tourism and along with CO_2 emissions in Singapore by employing Granger causality method	Study concluded that there is a uni-directional causality which runs from tourism development to CO_2growth of economy of Singapore.
Zhang and Gao (2015)	Panel data is applied to determine the effect of international Tourism on economic growth, energy consumption and environmental pollution in China during 1995-2011.	Findings revealed that tourism causality affects economic growth and CO_2 emissions in Long Run and there is a bi-directional causality among economic growth and CO_2 emissions.
Zaman et al (2015)	To test relationship among economic growth and CO2 emissions, tourism development, energy demand, domestic investment and health expenditures on 34 developed and developing nations during 2005-2013.	Study revealed that inverted U shaped relationship among CO_2 emissions per capita income in the regions.
Vita et al (2015)	investigated an enlarged version of the EKC model that commands the tourism development	Findings states that EKC hypothesis indicate thatCO_2 emissions decline at exponential levels of growth.
Paramati et al (2017)	Examined relationship among tourism, economic growth and CO2 and also compared impact of tourism and CO2 emissions with the light of robust econometric analysis.	Results signified that tourism has substantive contribution on economic growth both for developing and developed nations. Moreover results also indicated that volume of CO_2 decreases faster in developed nations when compared with developing nations.

Several studies had been conducted to test relationship among tourism and economic growth. Scholars had employed different methods to investigate the direction and linkage among tourism-led growth in context of economic growth and Co2 emissions. Many studies have been applied to define the presence of the EKC in the economies since the beginning of 1990s and there have been new studies that searches the role of particular sectors for this area. The following part defines the literature related with different fields that has been applied in this study. Several studies had been conducted to test relationship among tourism and economic growth. Scholars had employed different methods to investigate the direction and linkage among tourism led growth in context of economic growth and CO_2 emissions. As mentioned in the previous part, first the results of these studies indicated in table 1.

Katırcıoğlu et al (2014) conducted a study to analyze the correlation between energy consumption, tourism and CO_2 emission as well as the way of causality between these variables in Cyprus at the long run equilibrium. Researcher employed Error Correction models and conditional Granger Causality model. Study stressed that international tourists will have significant and inelastic as well as positive effect on the level of energy consumption and CO_2 emissions will cause CO_2 emissions to raise in Cyprus.

Katırcıoğlu (2014) conducted a research to examine linkages among CO_2 emissions and tourism development in Singapore with the light of Granger causality method. Results illustrated that there is a uni-directional causality that comes from development in tourism and CO_2 growth in Singapore’s long-term economy.

Zhang and Gao (2015) conducted a study to investigate how China’s economic growth, energy consumption and environmental pollution can be the effected by international Tourism on by executing panel data during 1995-2011. Findings of the study signaled that tourism causality influences economic growth and CO_2 emissions in Long Run and there is a bi-directional causality among CO_2 emissions and economic growth.

Zaman et al (2015) arranged a research to explore the relationships among tourism development, economic growth and CO_2 emissions, health expenditures, energy demand, and domestic investment on 34 developed and developing nations during 2005-2013.

Vita et al (2015) conducted a study by relying extended version of EKC. Study portrayed that tourist arrivals into Turkey alongside income, squared income and energy consumption, integrate with CO2emissions. Tourist arrivals, growth, and energy consumption exert a positive and significant impact on CO2 emissions in the long-run. Results indicated that empirical support to EKC hypothesis showing that at exponential levels of growth, CO2 emissions decline. The findings suggest that despite the environmental degradation stemming from tourism development, policies aimed at environmental protection should not be pursued at the expense of tourism-led growth.

Paramati et al (2017) conducted a study to analyze the correlation among CO2, economic growth and tourism and also compared the impact of CO2 and tourism emissions with the light of robust econometric analysis. Results showed that tourism has substantive contribution on economic growth both for developing and developed nations. In addition all these, findings also expressed that volume of CO2 decreases faster in developed nations when compared with developing nations.

Secondly, several studies have applied to investigate causality among FDI, CO2 and economic growth. Those studies are indicated below in table 2

Table 2: Summary of Empirical Studies to Investigate Causality Among FDI, CO2 and Economic Growth

Name of Scholar(s)	Method(s)/Findings
Elliot et al.(2013)	Had tested relationship among FDI and economic growth. The correlation between city-level per capita income and energy intensity shows that there is a a nonlinear inverted-U shaped relationship in the most of the cities on the downward slope of the curve. In addition the results show the relationship significant and negative between the FDI flows and energy intensity. One of the important reason for international companies to invest in energy dependent sectors is accepted as to have relatively small economic effect on FDI ; such as China
Lau et al (2014)	Investigate the causal relationship among FDI, economic growth and CO2 in Malaysia by employing Granger Causality method. Results highlighted that FDI accelerates economic growth which causes a more environmental degradation. It is shown that FDI and trade directly affect Co2 emissions and economic growth. Study advised to engage more with technology-oriented FDI to increase quality of environment.
Ren et al (2014)	Used input and output analysis to test the international trade and CO_2 emission in China, between the years 2000 and 2010. The findings suggest that, the two-step GMM method is used to analyze the effect of CO2 is dramatically increasing because of the growing trade in China. Moreover, larger sums of FDI inflows further aggravate China's CO_2 emission and lastly CO_2 emission and the industrial sector's per capita income and CO2 relationship will exert inverted-U EKC. Thus, to succeed environmentally sustainable economical development, there should be transform in trade growth mode, energy efficiency should be strenghten, adjust foreign investment, and develop a low-carbon economy in China.
Kivyiro&Arminen (2014)	Has examined the relationship among CO_2 emissions, energy consumption, economic development and FDI in Sub-Saharan countries. Scholars had employed Granger causality test. Study found that FDI raises CO2 emission
Tang and Tan (2015)	Had conducted a study to explore the connection among CO_2 emissions, energy consumption, FDI and economic growth between the period 1976 – 2009 in Vietnam. Granger causality method had been assigned to investigate the correlation among the variables. The findings showed that the presence of long-run equilibrium between the variables of interest. Moreover, CO_2 emissions positively effected by consumption and income, however CO_2 emissions are negatively effected by square of income. Results stressed that two-way causalities has approved between CO_2 emissions and income, and between FDI and CO_2 emissions in Vietnam. Moreover, in the short and long run energy consumption has Granger-causality effect on CO_2 emissions. In addition energy consumption, income and FDI are the most important drivers of CO_2 emissions. Thus, the use of environmental friendly technologies by foreign investors is significant in diminishing CO_2 emissions level in Vietnam.

In addition, several studies also investigate FDI, economic growth and energy. Elliot et al. (2013) had designed a study to analyze the interaction among FDI and economic growth. Study revealed that there was a nonlinear inverted-U shaped interaction among city-level per capita income and the majority of cities on the downward sloping and energy intensity. In addition study stated that there was an important and negative relationship among the FDI flows and energy intensity. But, it can led to a changes by geographically which refers the ability of regions to absorbing and benefiting from environmental spillovers.

Lau et al (2014) had conducted a study to explore causality between CO2, FDI, and economic growth in Malaysia with the light of Granger Causality method. Results signaled that FDI promotes economic growth which also yields higher environmental degradation. Moreover, study also stressed that CO2 emissions and economic growth are shaped directly by trade and FDI. Study recommended to focus more technology-oriented FDI to stimulate quality of environment.

Ren et al (2014) had arranged a study to analyze CO2 emission in international trade in China by performing an input–output tests, between the 2000 and 2010. In order to measure the two-step GMM method he applied panel data to measure the effect of FDI, trade openness, exports and imports as well as per capita income on CO2 emissions. Study revealed that growing trade surplus in China can be accepted as one of the critical cause for the rise of CO2 emissions. Moreover, larger sums of FDI inflows further provoke China's CO2 emission. In the meanwhile per capita income in industry and CO2 emission correlation will exhibit inverted-U environmental Kuznets curve. Thus to succeed economical development, China should put intensive attempt to change the mode of trade growth and adapt a structure of foreign investment, rises of energy efficiency as well as a low-carbon economy strategy should be applied.

Kivyiro&Arminen (2014) had studied on Sub-Saharan countries by considering the relationship between CO2 emissions, energy consumption, economic development and FDI in Sub-Saharan countries by applying granger causality test. And the results show that that there is a proportional relationship among CO_2 emission and FDI.

Tang and Tan (2015) had designed a research in Vietnam to determine the interaction among energy consumption, CO_2 (carbon dioxide) emissions, FDI and economic growth based on the period through 1976 to 2009. Granger causality method had been assigned. Study outlined long-run equilibrium among the variables of interest. In addition to all these, income and energy consumption positively impact on CO_2 emissions, however square of income negatively affect CO_2 emissions in Vietnam. Results stressed that EKC assumptions which accepts the existence of U-shapes between economic growth and CO_2 emissions in Vietnam. The findings of the current thesis also stressed that two-way causalities exists between CO_2 emissions and FDI income, and between income and CO_2 emissions in Vietnam. Moreover, according to the results energy consumption has a Granger causality effect on CO_2 emissions both in the short and long-run. FDI, energy consumption and income are the main drivers of CO_2 emissions in Vietnam. Thus, use of environment friendly technologies through international investors is significant in diminishing CO_2 emissions and economic development in the country.

Besides, some researchers investigate the advantages of renewable energy for energy development. Bilen et.al (2008) defines how the renewable energy resources is important to have sustainable energy development. In addition he argues that Turkey is very dependent on expensive imported energy resources as oil, gas and fuel that all contribute an air pollution problem in the country. And this problem can be easily solved by Turkey because of geographic position that has several advantages for renewable energy resources.

2.2 Recent Debate on the Environmental Kuznets Curve

Recent analyses on the EKC are demonstrated in the below following table 3.

Table 3: Summary of Empirical Studies on Energy Consumption and Growth Nexus

Name of Scholar(s)	Time period/ Country	Method(s)/Findings
Soytaş et al (2001)	1960-1995, Turkey	Investigate the linkage between energy consumption and economic growth by applying Co-integration and Granger causality test . The results revealed there is a causality from energy consumption to economic growth.
Aqeel and Butt (2001)	1955–1996, Pakistan	The study proves the causality exist, runs from economic growth to energy consumption by applying Granger causality and Co-Integration test
Fatai et al (2002)	1960–1999, New Zealand	The study revealed that no causality exists in relation from economic growth to energy consumption by applying Granger causality, ARDL, Toda and Yamamoto.
Gleasure (2002)	1961–1990, Korea	The study argues that bi- directional causality runs from energy consumption and economic development by applying Co-integration, error correction and variance decomposition tests.
Wolde-Rafael (2004)	1952–1999, Shanghai	The study shows that causality runs from energy consumption to economic growth by using modified version of Granger causality test.
Oh and Lee (2004)	1970–1999 Korea	The study refers that causality comes from energy consumption to economic growth by using model of Granger causality along with error correction.
Lee and Chang (2005)	1954–2003 Taiwan	The results proof that causality runs from energy consumption to economic growth by applying Johansen -Juselius, Co-integration and VEC models.
Karanfil (2008)	1970–2005 Turkey	The study revealed that there is no causality from economic development to energy consumption by applying Granger causality test, Co-integration test
Ang (2008)	1971–1999 Malaysia	The findings concluded that causality drives from economic growth to energy consumption by using Executed Johansen co-integration and VEC test.
Erdal et al (2008)	1970–2006 Turkey	The results concluded that there bi- directional causality exist from energy consumption and economic growth by applying Pair-wise Granger causality and Johansen co- integration tests.
Soytaş and Sarı (2009)	1960-2000, Turkey	Findings revealed that no causality exists among energy consumption and economic development by using Toda and Yamamoto causality test.
Zhang and Cheng (2009)	1960-2007, China	The study concluded that causality drives from economic development to energy consumption by employing Granger Causality to test.

Soytaş et al (2001) had conducted a research for Turkey by appointing Co-integration, Granger causality during the period 1960 to 1995 to determine the causality among economic growth and energy consumption. Results exhibited that causality runs from economic growth and energy consumption.

Aqeel and Butt (2001) had conducted a study for Pakistan by considering 1955–1996 as a time period to test relationship among economic growth and energy consumption by executing Granger Causality by Hsiao’s version and Co-Integration method. Findings of this research demonstrated the causality moves from the point of economic growth to energy consumption

Fatai et al (2002) had conducted a research for New Zealand by considering 1960–1999 as a time period. Researchers used various tests such as Granger causality, ARDL, Toda and Yamamoto tests to examine linkages among economic growth and energy consumption. Results revealed that causality doesn’t exists among economic growth and energy consumption.

Gleasure (2002) conducted a study to investigate the relationship among economic growth and energy consumption during 1961–1990 for Korea by executing error correction, Co-integration, and variance decomposition models. Results stressed that bi-directional causality exists that runs from economic development and energy consumption.

Wolde- Rafael (2004) had conducted a research to determine the connection among energy consumption for Shangai during 1952–1999. Researcher assigned upgraded form of Granger causality by applying Toda and Yamamoto methodology. Study stated that causality comes from energy consumption to economic growth.

Oh and Lee (2004) had designed a research to examine association among energy consumption and economic growth for Korea during 1970–1999 by using Granger causality and error correction model. Results concluded that causality comes from energy consumption to economic growth.

Another study conducted by Karanfil (2008) was analyzed the link intervening economic growth and energy consumption in Turkey during 1970–2005. Researcher appointed Co-integration along with Granger causality test. Findings of the research showed that no sign of causality has been found from economic development to energy consumption.

Ang (2008) arranged a research to investigate the linkage intervening economic growth and energy consumption for Malaysia by considering 1971–1999 as a time frame. Scholar appointed Johansen co-integration, VEC model. Results signified that causality occurs from economic growth to energy consumption.

Erdal et al (2008) designed a research to discover the interaction among economic growth and energy consumption for Turkey the period of 1970 to 2006 as a time period. Scholars executed Johansen co- integration and Pair-wise Granger causality, models. Finding of the study reveals that bi-directional causality exists and runs from economic development and energy consumption.

Soytaş and Sarı (2009) conducted a research to investigate the linkage among economic growth and energy consumption in Turkey by considering 1960-2000 as a time frame. Scholars assigned Toda and Yamamoto causality tests in their study. The results of the research suggest that no causality exists among economic development and energy consumption.

Zhang and Cheng (2009) designed a study to investigate linkage between economic growth and energy consumption for China by considering 1960-2007 as a time period. Scholars appointed Granger Causality tests. Study concluded that causality comes from economic development to energy consumption.

Table 4: Summary of Empirical Studies on Energy Consumption and Growth Nexus (Continued)

Scholar (s)	Method	Time Period	Countries	Results
Erol& Yu (1987)	Granger- cause	1952-1982	Japan, Italy, Germany, Canada, France, United Kindom	EC ← → G DP (Japan) GDP→ EC (Italy, Germany) EC → GDP (Canada) GDP - - - EC (France, UK)
Lee (2005)	Panel VECM	1975-2001	18 developing countries	EC→ GDP
Al Irani (2006)	Panel Co-integration,GMM	1970-2002	Bahrain, Kuwait, UAE OMAN,Qatar and Saudi Arabia	EC → GDP
Huang et al (2008)	GMM-SYS Panel Var	1972-2002	82 Nations were examined	a.For low income group: EC --- GDP b. Middle income groups: GDP →EC positively c. For High income GDP → EC negatively related
Lee & Chang (2008)	Panel co-integration causality	1971-2002	16 Asian Countries	EC→ GDP (in Long-run)
Mohammadi and Parvaresh(2014)	Panel Estimation,Pooled Mean Group, Mean Group Estmators	1980-2007	14 Oil Exportng Nations	EC ← → G DP.
Jammazi and Aloui (2015)	Wwcc Method	1980-2013	Saudi Arabia Bahrain, Oman Kuvait, UAE, Quatar.	EC ←→ G DP
Margues et al (2016)	ARDL, Johansen Co-,ntegration, Toda Yamamoto	1965-2013	Global Level	EC ← → G DP
Alper and Oğuz(2016)	ARDL method	1990-2009	selected EU countries	GDP- - - EC (Cyprus, Hungary, Poland, Slovenia),GDP→ EC (Czech Republic),. EC GDP (for Bulgaria).

As seen from table 4, several scholars have conducted studies to examine causality among EC and GDP on a multi-country basis. It could be argued that the conflicting results are still reported.

Erol and Yu (1987) tested causality among Germany, France, Japan, Italy, Canada, and lastly United Kingdom by employing Granger causality Method. Research concluded that in Japan EC and GDP have bi-directional causality (feedback hypothesis) whereas, causality runs from GDP to EC in Italy (conservation hypothesis) and Germany while EC to GDP (growth hypothesis) in Canada. Lastly no causality exists in France and UK (neutrality hypothesis).

Huang et al (2007) also examined causality among EC and GDP by employing GMM-SYS Panel and VAR model. Overall, 82 nations were analyzed and categorized as low, middle and high income respectively. It could be stated that for poor economy nations causality doesn't exists among GDP and EC so feedback hypothesis was supported. For Middle Income Group, causality runs from GDP to EC positively which implicitly indicates that conservation hypothesis was supported. Lastly, for high income group causality runs from GDP to EC negatively.

Al Irani (2006) and recently Jammazi and Aloui (2015) have conducted a study to examine causality among two variables. Saudi Arabia Bahrain, Oman Kuwait, UAE, Qatar were the selected countries. Al Irani (2006) appointed Panel Co-integration, GMM technique and attained 1970-2002 as a time period. Result of the study gave support to growth hypothesis whereas recently Jammazi and Aloui (2015) employed Wavelet Window Cross Correlation (WWCC) method to combine multi scaled decomposition, and lead/lag cross correlations by attaining 1980-2013 as a time period. Their findings were supporting feedback hypothesis.

Alper and Oğuz (2016) conducted a study to test causality among two variables namely EC and GDP with the light of selected EU countries. Researchers employed 1990-2009 as a time period and performed symmetric causality and ARDL method to determine existence and direction of the causality among two variables for the selected nations. Study revealed that neutrality hypothesis was supported for Cyprus, Hungary, Poland, and Slovenia while conservation hypothesis was supported for the case of Czech Republic. Finally, for Bulgaria growth hypothesis was supported.

Several researchers had conducted studies to analyze the linkage among economic growth and pollution variables. Findings of the researches showed in table 5 below.

Table 5: Summary of Empirical Studies Investigating Causality Between Pollution Variables and Economic Growth

Name of Scholar(s)	Method(s)/Findings
Ang (2007)	Had applied co-integration vector correction modelling methods to investigate the dynamic causal relationship between pollution emissions, energy consumption and output in France. Findings revealed that economic growth utilize causal influence on energy growth and pollution growth in the long-run.
Zhang and Cheng (2007)	Had used Granger causality test in China to analyze the causality between economic growth, energy consumption and carbon emissions. According to the results China can use a conservative energy policy and carbon emission reduction in the long- run period without impeding economic growth because both carbon emissions and energy consumption tend to an economic growth
Lean and Smyth (2010)	The study concluded that positive relationship exist among electricity consumption and CO2 emissions in a panel date of five ASEAN countries for the years of 1980-2006.
Fodha and Zaghdoud, (2010)	Findings show that inverted U shape relationship exist between SO2 and GDP Tunisia therefore according to the causality results they can proof the relationship between income and pollution in Tunisia, uni-directional causality exist in income causing environmental changes for both in short run and long run.
Saboori et al (2012)	The study revealed that inverted U shape relationship exist in both long run and short run by using Granger causality test based on vector Error correction model in the relationship between economic growth and CO2 emissions. Therefore Uni- directional causality running from economic growth to CO2 emissions.
Yavuz(2014)	The study had analyzed the relationship between CO2 emissions per capita, energy consumption per capita and income per capita in the long run during the period of 1960-2007. Gregory – Hansen co integration test had been applied to revealed that there is a long run equilibrium relationship among the variables and EKC hypothesis exist in the long run for the case of Turkey.
Apergis and Ozturk (2015)	The study examined that there is a U shaped relationship between Co2 emissions and income per capita for 14 Asian countries over the period between 1990 and 2011.

Ang (2007) analyzed the dynamic causal relationship between energy consumption, pollution emissions, and output in France by employing co-integration vector correction modelling techniques. Results signified that economic growth exerts causal influence on growth of energy use and growth of pollution in long-run.

Zhang and Cheng (2007) designed a research to discover the causality among energy consumption, economic growth and carbon emissions for China by executing Granger causality method. Results highlighted that that carbon emissions and energy consumption does not contribute to the economic growth thus, policy makers in China may perform conservative energy policies and carbon emission reduction in long- run.

Lean and Smyth (2010) aimed to test the correlation among CO_2 emissions, electricity consumption as an energy consumption indicator and economic growth in a panel setting for five ASEAN countries by considering 1980-2006 as a time frame. The findings of this thesis reveals that there is a direct proportion amongelectricity consumption and CO_2 emissions.

Fodha and Zaghdoud, (2010) had conducted a study to test relationship among economic growth and environmental de-gradation for Tunisia. Study concluded that an inverted U shape relationship is occurring among SO_2 and GDP. Results of causality prove the relationship between pollution and income in Tunisia.

Saboori et al (2012) had designed research to analyze effective relationship among economic growth andCO_2 emissions by executing Granger causality test. Scholars obtained an inverted U shape relationship both in long and short run. Moreover, study also stated that uni-directional causation is available from income growth towards emission levels in the long –term period.

Yavuz (2014) had conducted a study which aimed to test long -run equilibrium correlation among energy consumption per capita, CO_2 emissions per capita, and income per capita over the time period of 1960-2007 by employing Gregory – Hansen co integration test. Gregory-Hansen co-integration test findings reveal that the long run equilibrium correlation between the variables conducted in the empirical model of the study. Moreover, validity of EKC is examined and findings revealed the validity of EKC hypothesis in the long- run for Turkey case.

Apergis and Ozturk (2015) had designed a research which aim to analyze the strength of EKC hypothesis by assigning panel data methodology over fourteen Asian countries between 1990 and 2011. Study stressed the U shaped relationship exist among income per capita and Co2 emissions.

As the last step, Table 6 summarizes the studies on usage of non renewable and renewable energy sources on CO2 emissions.

Table 6: Selected Studies on The Effects of Renewable and Non-Renewable Energy Sources on Co2

Name of Scholar(s)	Aim of research	Findings
Jebli et al 2016)	In the econometric sliterature one of the significant research has been carried out by Jebli et al (2016) he has consucted a study to investigate the relationship between Gdp and CO2 emission, consumption of renewable and also non-renewable energy and international trade for a panel of 25 OECD countries over the period 1980–2010.	Results revealed that unidirectional casualty is running from exports to renewable energy, trade to Co2 emissions, and output to renewable energy. Bi-directional causalities were discovered among all variables. Lastly, results signaled that intensively using non- renewable energy sources will increase co2 emissions whereas using renewable energy sources will decline co2 emissions.
Doğan and Şeker (2016)	Had conducted a research to investigate the relationship among renewable energy consumption, trade openness, financial development, carbon emissions.	With the light of employing , FMOLS and the DOLS, study signified that increases in renewable energy consumption, trade openness and financial development decrease carbon emissions while increases in non-renewable energy consumption contribute to the level of emissions, and the EKC hypothesis is supported for the top renewable energy countries

Mert, M. (2015) examines the reduction in impact of GHG emissions by renewable energy sources in Turkey. The study applied Autoregressive Distributed Lag (ARDL) method during the period 1961and 2010.The study test the validity of EKC hypothesis by considering the relationship relationship among GDP, CO2 emissions, and electricity generated using renewables in Turkey. The results show that environmental enhancement will be strengthen by the contribution of renewable electricity production and it also proof the U-shaped EKC correlation among income and per capita GHGs.

Jebli et al (2016) had designed a study to determine the causal relationships among GDP, per capita CO2 emissions, renewable and non-renewable energy consumption, and lastly applying Panel Method for international trade for 25 OECD countries between the periods 1980 to 2010. Study concluded that unidirectional casualty is running from exports to renewable energy, trade to Co2 emissions, and output to renewable energy. Besides of these, bi-directional causalities were discovered among all variables. Lastly results also signaled that intensively using non- renewable energy sources will increase CO2 emissions whereas using renewable energy sources will reduce CO2 emissions.

Doğan and Şeker (2016) had conducted a study to test the linkages between several variables such as trade openness, renewable energy consumption, financial development and lastly carbon emissions (CO2). Scholars employees FMOLS and the DOLS.Results of the study indicated that carbon emissions can be reduced by an increases in renewable energy consumption, financial developments and trade openness. On the other hand when the non-renewable energy consumption increases it contributes to the level of emission. Therefore the EKC hypothesis is confirmed for the top renewable energy countries.

2.3 Environmental Kuznets Curve Theory

2.3.1 Introduction

The systematic correlation among environmental quality and income change is called Environmental Kuznets Curve (Dinda, 2004). Quality of the environment has been effected by the economic growth in three different ways which could be indicated as technological effects, scale effects, and composition effects (Grossman and Krueger, 1991). Environmental Kuznets Curve is (EKC) a model of realistic views of relationships among energy use, environmental and economic development, which introduced by Simon Kuznets (Stern, 2004). Literature suggests that environmental degradation can be increased by a higher level of income. In addition to this, desire for environmental quality increases when the income increases (Dinda, 2004).

This theory emphasized that unfair distribution of the income first rises and then falls based on economic growth of the nation. Stern (2004) also indicated that, Grassman and Krugger’s during the early 1990’s with the accomplishment of the North American Free Trade Agreement (NAFTA) and Shafik and Bandyopadhyay’s studies for the World Development Report 1992, the EKC theory survived. EKC hypothesis used to point out the correlation between environmental degradation and economic growth.

Dinda (2004) stated that such an advancement provides investment opportunities for the people who have money while it pushes rural labors to move to cities with low wages.

Dasgupta et al. (2002) stated that the logic of EKC relationship is naturally appealing. At the beginning of the industrialization, the first priority is to increase the output and this leads to an increase in pollution, and it is also observed that people are becoming more concerned about income than clean water and air. However, economic growth also positively influence the environment through a composition effect: When the income increases, structure of the economy is likely to change and slowly increases environmentally friendly activities that produce no pollution (Dinda, 2004).

According to the Kuznets curve indicate that if a nation goes to an industrialization especially rules by mechanization of agriculture the majority of the nation’s economy will move to the cities. This will also lead to an internal migration as most of the farmers would be searching for better jobs where they can increase their income and this will cause an important inequality gap as the shareholders would be profiting, while income of the employees are decreasing.

Kuznets suggested that unfair distribution of income would bring an inverted “U” shape as it increases and then decreases again with the increase of income per-capita (Kuznets, 1955).

Kuznets (1955) suggests the curve diagrams show an inverted U curve, although variables along the axes are often mixed and matched, with inequality or the Gini coefficient on the Y axis and economic development, time or per-capita incomes on the X axis.

Figure 1: Original Kuznets Curve

Here is original Kuznets Curve assuming that at further levels of income, there will exist inequality.

The EKC which is based on proposed relationship between economic development and environmental quality: other barometers of environmental degradation likely to get worse as modern economic growth continues until average income reaches to certain point over the course of development. With growth to such an extent, it inevitably put pressure on the use of natural resources which eventually leads to emission of pollution. An increase in the output requires an increase in the input which results in the use of more natural resources in the production process. With higher output there will be more waste followed by emission as by-product which also adds to degradation on environmental quality. In addition, this leads to a reduction in stock of natural capital by time.

Even though there is a consensus in the literature about this topic, there are evidences which supports the claim that U-shaped curve is environmental health indicators, for instance water and air pollution. Kuznets (1995) predicts that the changing relationship between per capita income and income inequality is an inverted U-shape curve (Dinda, 2004). It might be stated that this trend can be exist in the level of many different environmental pollutants, such as chemicals which has released to air and water previously, lead, sulfur dioxide, DDT, nitrogen oxide, chlorofluorocarbons, sewage and other directly into the air or water (Kuznets, 1955).

Urban sanitation, municipal solid waste, volume of traffic, access to safe drinking water, energy use and so on are considered as other environmental indicators and they are used to test the EKC (Dinda, 2004). But, there is no strong evidence to prove the relationship for other pollutants, for natural resource use or for bio-diversity conservation. For instance, ecological footprint such as energy, land and resource use do not decrease with an increase in income. In most of the developed countries there is a decreases in the ratio of energy per real GDP and increases in a total use of energy. Furthermore, the emission of many greenhouse gases are much higher in industrialized countries. Besides of this, freshwater provision and regulation, soil fertility, and fisheries as being the key "ecosystem services" have continued to decline in developed countries (Perman, et al., 2003).

In general environmental health concerns, as an example of air pollution have Kuznets curves however it does not exist in other concerns. Some scholars argue that EKC does certainly abrogate the hypothesis – Kuznets curves may show differences in different environmental forces and regions.

On the other hand, countries who have thermodynamically economics reveal that production of degraded issues and energy are an unavoidable results of any use of elements and energy. Degraded productions such as noxious wastes, and how those wastes eliminated depends on the use of technology by the firms and regulatory schemes rather than income or production levels. According to Kuznets, (1955) the EKC reveals that "*the solution to pollution is more economic growth*;" in the other, pollution is accepted as undesired output that should be decreased when the benefits obtain through its production are exceeded by the costs it imposes in externalities like health decrements and loss of ecosystem services.

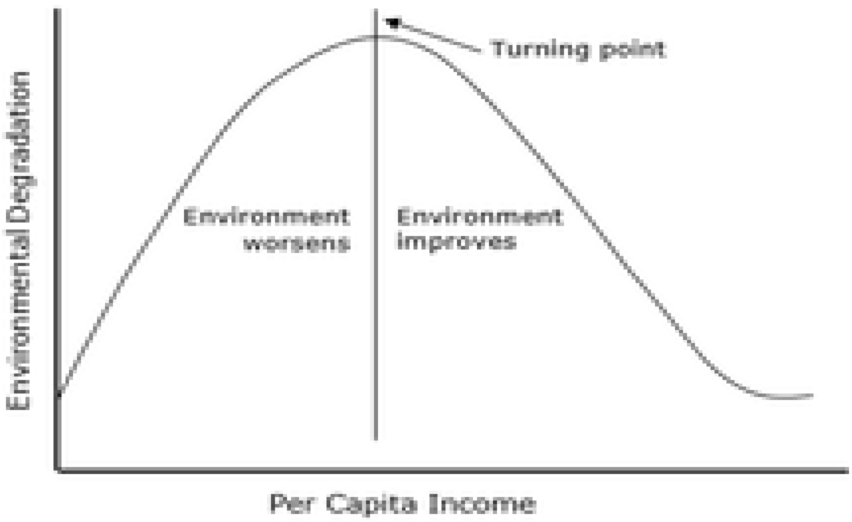

Figure 2: Environmental Kuznets Curve

Figure 2, proves that Environmental Kuznets Curve, which is an inverted U-shaped by theory and argues that at further levels of income, alternative and renewable energy resources are efficiently utilized, and therefore, environmental degradation is likely to decline.

2.3.2 Integration of Environment into Kuznets Curve

No doubt that, achieving economic development, material prosperity and well-being of community are some of the major goals of governments. However, inequality in the distribution of income have increases at the early stages of the growth and it even goes worse when economic growth continues (Kuznets, 1955). Needless to indicate that, industrialization plays a crucial role on economic development which in turn triggers the consumption of natural resources and effects environmental quality (Yang, Yuan,Sun,2012; Arrow, Bolin, Costanza and Dasgubta, 1995).

At first glance, the relationship among economic development and environmental quality could be better explained by composition and technical effects. Composition effect stresses that to level of economic activity considered as one of the significant prerequisites of economic development and if the structure of economic activity mainly based on primary sectors which are likely to drain resources and tend to be more pollution-intensive then economic development would degrade the quality of environment. However, in technical effect it is believed that raises in income would provide grounds for public expenditure for environmental regulations as well as imposing rules for environment friendly regulations (Grossman and Krueger, 1995).

The effects of environment on economic growth pay rising attention on economists in current years (Dinda, 2004). He also argued that EKC theory hypothesizes the relationship between environmental degradation and economic growth with the lead of inverted U-shaped Kuznets curve and argued that income per capita rises as environmental degradation goes down at a certain level and decreases as environmental pressure falls.

The Environmental Kuznets Curve (EKC) proves that environmental improvement could be achieved with the pre-condition of economic growth. People pay more attention to the environmental facilities as standards of living, income per capita increases (Pezzey, 1989; Selden and Song, 1994). Market oriented philosophy has been widely accepted by many developing countries thus countries are getting away from command-and-control policies (Panayotou, 1999; Vukina et al., 1999). Although there is an increase of population and urbanization, and with huge awareness of environmental degrading, several communities have stressed on their local councils to implement regulations that will lead to a decrease in pollution over a period of time by adopting best practices regardless of the increase in the production.

Air pollution can be prevented by strong environmental regulations (Hettige et al., 2000a). Several communities insist on a cleaner tomorrow and healthier future for their children and environmental degradation can reduce by invested in latest technologies, strong policy reforms and public environmental education. Environmental standards can be strength and significantly improved by information about polluters, damages, local environmental quality and abatement (Dinda, 2004).

The EKC hypothesis proves that rich, high income people have higher demand for environmental quality than poor, low income people. Beckerman (1992) examine and emphasize the quote that ‘economic growth first after than clean environment’. Undeveloped economies can improve their environmental quality by an increase in investment and proving opportunity for employment (Dinda, 2004).

CHAPTER 3
ENERGY, DEBT HISTORY AND TURKISH ECONOMY IN RETROSPECT

3.1 Economic Growth and Energy

Turkey is a rapidly developing country that is the 18th biggest middle income partner in the world. Gross Domestic Product has shown a rapid increases in each year and it reached to $857 billion (https://tradingeconomics.com). This increases as a cause of higher government spending, investment and exports. Turkey's per capita emissions and per capita GDP is one of the lowest country in Annex 1 of the Kyoto Protocol but Turkey still has the fastest growing emissions in the world (UNFCCC, 2006). Turkish economy has shown a rapid expansion in household consumption, fixed investment, export and government spending since 2011. On the other hand output growth is supported by production side as well that includes industrial production of which manufacturing, construction, public administration, education, human health and social activities, information and communication, professional, administrative and support service activities and real estate activities. By the introduction of the free market economy started in 1980s all industries in Turkey have been influenced by several factors and growth of these industries caused an increase in energy consumption (SIS, 2003).

Since 1963 Development plans of Turkey, which these plans are the guiding procedures for the private investments and also compulsory rules for the governmental organizations have been prepared every 5 years in Turkey. In the early periods development plans were prepared as similar as in other developing countries to boost the short-term economic gains without considering the environmental challenges in Turkey (Say, and Yucel, 2005).

Turkey which is a middle income country with weak investor rights, high ownership concentration and their financial system is controlled by banks can be considered as different as other advanced economics because of its economic and financial development.

Günçavdı and Kayam (2017) indicate that one of the most important reason for Turkish economy to depend highly on imports and has poor performance on export is, it is lunched on a type of macroeconomic governance which produced high growth rates and high currency deficit. Developing countries depend on service economies to generate economic growth. Since the globalization concept started in emerging economies in the early year 1980s, low interest rates and high level of international liquidity leads to expand their economic activities into sectors producing non-tradable goods. Turkey which is the one emerging market economies has done changes on the relative prices of non-tradable goods compared to tradable goods and this leads to increase the dependency on capital flows to finance domestic demand as well as imports.

Turkey is considered as one of the prosperous countries in renewable energy resources. Wind energy capacity have increased over the years and increased from 20MW to 4503MW over ten years (Dawood, 2016). Table 7 presents wind energy figures in Turkey. According to Karagol&Kavaz (2017), the overall installed renewable energy capacity of Turkey is 35 GW as of the end of 2016 and of the overall energy demand (consumption) in Turkey, a total of 35 percent is provided by renewable energy resources.

Table 7: Wind Energy Capacity in Turkey

Intalled Capacity, Turkish Wind Energy Association

Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
MW	146	364	792	1,329	1,806	2,312	2,958	3,762	4,718	6,108

Source: Statistical Report (2017), Turkish Wind Energy Association.

On the other hand, it is reported that solar energy capacity of Turkey is 300 MW as of 2015, which increased to 1,800 MW in 2017 and projected to be 3,000 MW in 2019 and 5,000 MW in 2023 (Turkish Wind Energy Association, 2017). Dawood (2016) reported that bioenergy usage in Turkey is about 8.6 mtoe per year and Turkey’s hydroelectricity capacity is 23 GW to be generated by its hydroelectric plants. There are considerable number of ongoing projects currently in progress in Turkey, i.e., the Southeastern Anatolia Project, which is expected generate a 15GW hydroelectric energy (Turkish Wind Energy Association, 2017). According to Dawood (2016), In Turkey hydraulic energy’s potential is 216 TWh/year and 127.4 TWh/year is the economical potential. According to Yilmaz (2012), of the overall primary energy consumption in the world as of the year 2035, 27 percent will belong to fuel oil/petroleum, 30 percent to coal, 23 percent to natural gas, 5 percent to nuclear energy, 2 percent hydroelectric energy, 9 percent to biomass energy, and 3 percent to the other renewable energies.

Energy consumption that includes natural gas, oil and coal has shown a corresponding increases to its GDP as well as energy generation has been doubled at the same period. Limited energy resources, economic growth, and increases in population are induce a deficit between the production and the consumption of energy and this is being considered as a constant problem faced by Turkish economy. Struggle of energy deficit is being solved by importing energy resources and electricity. Economic problems both regional and national can result a decrease in production of industries and this causes a reduction in the energy consumption (Say, N.P and Yucel, M. 2005).

Turkey is considered as expensive imported energy resources which leads to a significant effect on energy supply security and balance of payments. With its 70% dependency level it is accepts as the most intensive energy importing countries. Therefore since 2005 Turkey has adapted by the Law on Utilization of Renewable Energy Resources to expand power generation and diversify the energy supply with environmental sustainable way (Bresellioglo, M.E, at all. 2017). Literature suggest that there is a significant relationship between energy use, GNP, CO_2 emission in Turkey between the years 1970 and 2003

(SIS, 2004). In order to become compatible with EU standards Turkey should accommodate its economy, infrastructure and government policies such as growth, energy, and environmental policies (UNFCCC, 2006).

Table 8 presents comparative statistics of energy and renewable energy uses in Turkey, European Union, and United States of America. It is shown that of the total final energy consumption in Turkey, 13.37 percent is provided by renewable energies while this ratio is 16.56 percent in European Union, and 8.72 percent in the United States.

Table 8: Comparative Energy & Renewable Energy Statistics among Turkey, European Union and United States

Turkey				
Years	Energy imports, net (% of energy use)	Energy use (kg of oil equivalent per capita)	Renewable energy consumption (% of total final energy consumption)	Population, total
2010	69.62	1,474.67	14.33	72,326,914.00
2011	71.61	1,546.20	12.78	73,409,455.00
2012	74.02	1,585.40	12.83	74,569,867.00
2013	73.07	1,542.97	13.85	75,787,333.00
2014	74.21	1,577.83	11.61	77,030,628.00
2015	75.21	1,656.80	13.37	78,271,472.00
European Union				
	Energy imports, net (% of energy use)	Energy use (kg of oil equivalent per capita)	Renewable energy consumption (% of total final energy consumption)	Population, total
2010	51.29	3,420.13	12.96	504,421,126.00
2011	51.35	3,289.94	13.34	504,012,081.00
2012	51.38	3,257.25	14.49	505,104,333.00
2013	51.17	3,210.40	15.31	506,592,460.00
2014	50.48	3,079.71	16.22	508,157,248.50
2015	..	3,207.30	16.56	509,670,169.00
United States				
	Energy imports, net (% of energy use)	Energy use (kg of oil equivalent per capita)	Renewable energy consumption (% of total final energy consumption)	Population, total
2010	22.21	7,160.94	7.51	309,348,193.00
2011	18.55	7,028.15	8.16	311,663,358.00
2012	15.69	6,869.39	8.48	313,998,379.00
2013	13.94	6,902.43	8.71	316,204,908.00
2014	9.21	6,956.81	8.75	318,563,456.00
2015	7.31	6,800.65	8.72	320,896,618.00

Source: World Development Indicators (2018).

Economic growth, inflation, foreign direct investments, and foreign trade are considered to be most significant macroeconomics indicators in order to measure economic indicator, foreign trade has increased effectively in the emerging countries thus Turkey’s export has increased from $143 billion to

$157 billion and its import has increased from $199 billion to $234 billion between the period 2016 - 2017 (TUIK, 2017).

3.2 Turkey's Energy Policies

3.2.1 Introduction

One of the most fundamental requirements and the driving force of economic and social development of countries is energy. For this reason, those, who undertake country management, have to find energy through uninterrupted, reliable, clean and cheap ways and absolutely diversify these resources. The concept of "sustainable development" has come to the agenda in order to prevent irreversible destruction of environment by the use of backward technology and traditional energy sources. In parallel to this, energy security models that take into account resource diversity and geopolitical realities, with a planning approach that carefully considers the energy-economy balance has begun to replace the merely energy-source-supply and energy production based planning in the developed societies. Another essential element that must be applied and is indispensable for the optimum use of resources, due to the inability to store electricity energy obtained from primary energy sources, is the planning.

Energy is an indispensable input for economic and social development of countries. Those who direct energy and the management of the country have to supply this most basic requirement of the people in an uninterrupted, reliable, timely, cheap and clean way. This necessity is valid to the same extent for our industrialists and trades people as for the household consumers. In a globalizing world, the supply of energy, which is the most basic and predominant input in the cost of end products in the country's industry, from uninterrupted and reliable resources in a cheap way is an indispensable prerequisite. However, the facts that are happening in the energy field of our country, are totally dissimilar with these basic requirements let alone being in harmony with them. Today, 87% of the world's total energy production is covered by fossil fuels, 6% by renewable sources and 7% by nuclear energy.

About 64.5% of world electricity energy production are accounted for by fossil resources (38.7% coal, 18.3% natural gas, 7.5% petroleum).

3.2.2 Turkey's Current Energy Policies

Today, the energy policies applied in Turkey, which imports half of the energy resources it consumes, are highly affected by the general structure of the world energy sector. In Turkey, while there are almost any kind of energy resources depending on the geological and natural structure, the reserves of fossil fuels except for the brown coal are in limited amounts and their productions are at rather low levels. Of the primary energy produced in Turkey, 39% is derived from oil, 27% from natural gas, 27% from coal and 13% from renewable energy sources. The share of imports in energy consumption is about 70%. In addition to high levels of external dependence in terms of energy, 65% of the natural gas import is made from the Russian Federation and this situation causes significant problems in terms of energy security (Ulutaş, 2008, 11). Importing more than 70 percent of its energy needs, Turkey should closely follow any development to make an impact on petrol prices. Considering the fact that Turkey imports approximately 170 million barrels of oil every year, every 1 dollar rise in the oil prices increases the import costs by 170 million dollars and consequently makes a negative impact on the current account deficit. In 2007 in Turkey, oil consumption was 31.1 million tons (0.8% of the world oil consumption) and natural gas consumption was 35.1 billion cubic meters (1.2% of world natural gas consumption) (http://www.enerjiajansi.com, 17.7.2008). It is estimated that Turkey's annual energy consumption will reach to 171.3 million tons equivalent petroleum (TEP) in 2010, and 298.4 million TEP in 2020 with a growth rate of 6.8% (IEA, 2006). Being a strategic transit country, Turkey is also a candidate to be the energy market. For this reason, developing large-scale energy transportation projects plays crucial importance for Turkey to ensure resource diversity, supply security and sustainability, source Eskişehir Osmangazi University Journal of Social Sciences , 10(1) 135 H. Naci BAYRAÇ (Ültanır, 1998, 169-177). Almost all sea and territorial routes combining the Middle East and the Caspian region to the Mediterranean and Europe passes through Turkey. In Turkey's National Program for the Adoption of the Community acquis, it is mentioned that Turkey's energy policy objectives are compatible with the EU objectives to a large extent and that the security of energy supply, diversification, market principles and environmental rules and efficiency should be enhanced. In addition to the existing pipelines, Turkey has been included in many of the projects below. The Kirkuk-Yumurtalık Crude Oil Pipeline, The Baku-Tbilisi-Ceyhan (BTC) Crude Oil Pipeline, The Samsun-Ceyhan Crude Oil Pipeline (in the project phase), The Russia-Turkey Western Natural Gas Pipeline, The Blue Stream Natural Gas Pipeline, The Azerbaijan-Turkey Natural Gas Pipeline The Iran-Turkey Natural Gas Pipeline, The NABUCCO Natural Gas Pipeline (in the project phase), The Iraq-Turkey Natural Gas Pipeline (in the project phase), The Egypt-Turkey Natural Gas Pipeline (in the project phase), The Israel Extension of the Blue Stream (in the project phase), The Turkmenistan-Turkey Natural Gas pipeline (in the project phase), The Turkey-Greece-Italy Natural Gas pipeline (the pipeline between Turkey and Greece are being installed). With the completion of these projects, in the near future, Turkey will get the key position to save the EU countries from energy crises by being a candidate to become a North-South energy corridor, in addition to being the East-West energy corridor. Thus, an energy cooperation to be established with the EU will enhance the importance of Turkey in the process of full membership.

3.2.3 Environmental Pollution And Energy Policies

Environment is the physical, biological, social and cultural medium, where people and other living creatures pursue their relationships and be in mutual interaction. It is estimated that the world population will double in the mid-21st century, durability in economic developments will be ensured and global demand for energy services will significantly increase by 2050. Concurrently, environmental struggles such as rain, ozone depletion, acid, and global warming (greenhouse effect) are expected to skyrocket in parallel to the increase in energy use (International Energy Agency, 2018). The most important factors in the formation of global and local environmental problems that arise in the phases of energy production and use are fuel and the systems used for converting fuel into energy (International Energy Agency, 2018).

Factors affecting the environment: today, the primary factors affecting environmental issues are energy use, type and efficiency. Other factors include Industrial raw material varieties used in the industrial production, population growth and urbanization, excessive consumption and recycling of solid wastes, deforestation and air, water and soil pollution, the use of pesticides, natural changes (drought, flood, fire, volcanic eruption, earthquake, tornado, disease, etc.) and climate change, ozone depletion, acid rain, migration of species and evolution that are known as gradual changes.

Air Pollution and its Effects, Air Pollution: It is the air polluted up to the extent that will damage human health and comfort and give harm to animals, plants and goods as a result of the change in the percentage amount of main ingredients in the natural structure of air or entrance of impurities in its structure (International Energy Agency, 2018). The most significant global problems that arise as a result of air pollution are Acid rain, Ozone depletion and the Greenhouse effect (International Energy Agency, 2018).

Acid Rains: Sulfur dioxide and nitrogen oxide emissions from stationary sources form the pollutants involving sulfuric acid and sulphate and nitrate salts containing nitrogen oxide, nitric acid fumes and droplets as they are carried away to long distances by the winds. These chemicals return to the earth in aqueous form, as acid rain, or in dry form as gas, fog, dew or solid particles. The composition of the dry and aqueous mixtures of acids and acid-forming compounds on the earth is called acid accumulation or acid rain. Nitrogen oxide emissions from large number of motor vehicles in large cities also contribute to acid accumulation. Acid accumulation constitutes a regional rather than a global problem because large amounts of water droplets and solid particles are removed from the atmosphere. The best known effects of acid rains are as follows: destruction of fish and living life as a result of the acidification of lakes and underground waters, destruction of forests and agricultural products, buildings, metal structures etc. Transportation is the most important source of NOx emission. OECD countries account for 48% of total emissions. The United States, China and the Russian Federation are the countries that contribute the most in the World (International Energy Agency, 2018).

Stratospheric Ozone Depletion: The atmosphere has a basic role of absorbing the ultraviolet (UV) and infrared radiations that occur in the Stratosphere between its 12th and 25th km. Regional depletion and degradation of Stratospheric Ozone by Chlorofluorocarbons (CFCs), Halogens and N_2O emissions is a global environmental problem. The increasingly reach of destructive ultraviolet radiation to the earth as a result of ozone depletion causes damages for human health and biological species. The sources depleting ozone are human and nature-originated. Emissions that result from energy consumption comes in the first place. Despite the 65-70% N_2O resulting from the burning of fossil fuels and biomass, main effect on ozone layer is made by the CFCs used in the ACs, fridges and also in the foams used as insulation material. Developing countries concentrate on investments involving CFC technologies, due to economic difficulties.

Greenhouse Effect: While the sun continuously sends energy to the world, the world constantly emits infrared radiation. A situation arises, where the amount of solar radiation absorbed, must be equal to the infrared radiation that the earth emits. This is called the radioactive balance. While the atmosphere absorbs the radiation at certain wavelengths, it remains totally permeable to others. The atmosphere is selective absorber with this feature. In other words, the atmosphere has a natural greenhouse feature. In addition to being selective absorbers, water vapor and CO_2 are selective emitters in the infrared wavelengths. The radiation emits in all directions outward from these gases. A portion of this energy is absorbed by the Earth and heats the ground. The ground, then, re-emits the energy it received upward where it is absorbed again. Eventually, this process allows the lower atmosphere to be heated. Thus, water vapor and CO_2 act as a layer that creates an insulation effect over the earth, preventing the infrared radiation from escaping easily to the space and eventually the temperature of the atmosphere raises. Even if the production of existing greenhouse gases is terminated, the greenhouse effect caused by these gases will continue for many years due to their atmospheric lifetimes. Atmospheric lifetimes of greenhouse gases are: CO_2 50-200 years, CH_4 12 years, N_2O 120 years and CFC 11-50 years. On the other hand, the contribution of water vapor to the atmospheric effect of greenhouse effect is 60%, carbon dioxide is 26%, and the contribution of other greenhouse gases is 14% (International Energy Agency, 2018). Gases such as CO_2, CH_4, CFCs, Halogens, N_2O, Nitrogene and Peroxyacetnitrate, which increase the greenhouse effect, also increase the surface temperature of the earth. Surface temperature of the Earth has increased by approximately 0.6 ºC in the last century. A 20 cm of rise in the sea level occurred due to this. In general, it is calculated that human-sourced greenhouse effect is caused by CO_2 by a rate of 50%. The increase of various greenhouse gases in the atmosphere is caused by changes in the economic and lifestyle of mankind. For example; All of the factors such as methane emissions, the burning of fossil fuels, the freely use of CFCs, and the destruction of forests contribute to the greenhouse effect. Energy and energy related activities are influential in the direct and indirect formation of derivatives of CO_2 and other potential greenhouse gases. It is possible to reduce the amount of these gases that cause the formation of greenhouse gases. The use of these gases can be reduced by making some changes in energy production and use (International Energy Agency, 2018). There is a close connection between energy, environment and sustainable development. A community asking for sustainable development should take advantage of the useful energy sources that do not produce environmentally hazardous emissions. However, since all energy sources create environmental impacts, the harmful effects they make on the environment can be reduced by increasing energy efficiency. Therefore, there is a significant relationship between environmental impacts and energy efficiency. Less resource consumption to produce the same amount of energy is associated with pollution and energy efficiency.

3.3 External Debt History of Turkey

On the other hand, which has also significant influence on economy is external debt. External debt in Turkey is a part of the total debt that covers all payable to creditors outside the country. Since Ottoman Empire time Turkey has strived with considerable amount of external debt. Moreover, modernization attempts and nationalization movements of Turkey has increased the external debt dramatically due to heavy weapon purchases for the Turkish Army Forces.

Above all, Great Depression and World War II was the main cause of external debt until 1950s (Donek, 1995). Although liberal economy as well as free trade between the countries gear up the trade activities more actively Turkey’s main concerns were on agricultural improvements and modernization where country has to lend financial aid. International Monetary Fund (IMF) and the World Bank were the primary sponsor for Turkey’s financial aid (Donek, 1995). In other words, free import model of the Democrat Party was the primary reason of high external debt of the country (Yavuz, 2009).

Countries like France, Austria, USA, Germany, Belgium, Denmark, Canada, Netherlands, UK, Luxemburg, Sweden, Norway and Italy were the member countries of Trade Association was established in 1962. The Trade Association was supporting countries by providing long term loans where Turkey also lend loans from the Trade Association along with OECD countries, IMF, the European Investment Bank, and the IDA between 1960 and 1970.

Turkey was struggling with economic problems in 1970s likewise failing to carry out a needed corrective policy tasks. The main reason of the economic problem was the increase in oil prices and the devaluation on Turkish economy. Therefore, Turkey had to pause its instalments on external debts during this period. In addition, Turkey had to stop lending from IMF between the years 1970 – 1978 (Karagöl, 2010).

On 24 January, 1980 government of Turkey suggested a modified economic model. Based on this new model, import would take place instead of export model for the sake of economic liberalization and boost tourism industry to raise foreign exchange rate in Turkish economic system. Yet the country was encountring challenge on external debt due to political instability and devaluations belong to previous periods (Candemir 1994; Yavuz 2009; Karagöl 2010).

Furthermore, Turkey’s external debts was also high in 1990s due to lack of sufficient local reserves. On the other hand credit grade of Turkey was reduced by ICA in 1994, which ended contributing to economic crises as Turkey had difficulties to obtain financial sources from other countries in order to aid its deficits. However, Turkey then had an agreement with the IMF to re-design its external debt policies in 1994 (Yavuz, 2009).

Economical regression in February 2001 caused an increase in capital outflow, therefore external debt of Turkey has raised in this period. Turkey later obtained a support from IMF to avoid instability (Erkan, et al. 2012). In addition, Turkey has struggled with several more economic troubles in 2001, thus it made it more difficult for Turkey to apply its debt management along with completing several laws re-shaping country’s financial affairs. Although Turkey’s external debt was still high, the country was more adaptable and in balance.

CHAPTER 4
DATA, MODEL AND METHODOLOGY

The primary aim of this chapter is to present information about data, model and the methodology used for the current study.

4.1 Data

It could be mentioned that the annual data is used for this study from the year 1960 until 2013 (World Bank, 2017). Moreover, variables which are used for the current study can be stated as energy use (E) (kt of oil equivalent), (CO2) emission (kt), GDP constant in USD (2005 = 100), GDP constant squared in USD (2005 = 100) (GDP2), and Turkey’s external debt (D) stock as ratio to GDP. Apart from these, in this thesis external debt of Turkey which was reflected out of the gross domestic product was designated as a proxy of external debt.

4.2 Model

The present study assumed that debt is a major contributor for CO2 emissions. Therefore, it could be stated that a foreign debt stock is added to traditional Environmental Kuznet Curve setting. Besides of this, use of energy and external debt and were also added to our model with the light of the recommendations of the previous studies on related field (Anastasia, 2015; Katircioğlu, 2014; Kapusuzoğlu, 2014).

Moreover, it could be stressed that external debt is one of the major denominators to effect a nation’s economic growth (GDP) and level of energy consumption. Furthermore, external debt could indirectly influence carbon-dioxide emissions (CO2) through energy consumption. Thus, the present study proposes the extended EKC model with the following formula.

$$CO_{2t} = f\,(y^{\beta_1}, y^{2^{\beta_2}}, E_t^{\beta_3}, ED_t^{\beta_4}) \qquad (1)$$

Where y stands for real income, CO2 represents carbon dioxide emissions as represented as (kt), y2 denotes real income square, E (oil equivalent in kt) represents energy consumption and ED is stock of foreign (external) debt. The first equation is shown in the version of logarithm for obtaining growth in the long run (Katircioglu, 2009a):

$$\ln CO2_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln y_t^2 + \beta_3 \ln E_t + \beta_4 \ln ED_t + \varepsilon_t \qquad (2)$$

Where ε could be denoted as white noice error disturbance. The anticipated direction of β1 is positive, where as that of β2 is negative, as Environmental Kuznet Curve illustrates the environmental degradation should decrease at further output levels (de Vita et al., 2015). Moreover, it can be stated that the coefficients of β3 and β4 are closely associated with success of the implementation of environmentally friendly energy policies of the nation.

Moreover, it is notable that in theory in econometrics field the dependent variable in condition (2) may not immediately adjust to its long-term equilibrium level. Therefore, to anticipate the adjustment speed among both in short and long -run equilibrium level the following Error Correction Model should estimated. The formula could be portrayed as follows:

$$\Delta \ln CO2_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln CO2_{t-j} + \sum_{i=0}^{n} \beta_2 \Delta \ln y_{t-j}$$

$$+ \sum_{i=0}^{n} \beta_3 \Delta \ln y^2_{t-j} + \sum_{i=0}^{n} \beta_4 \Delta \ln E_{t-j} + \sum_{i=0}^{n} \beta_5 \Delta \ln ED_{t-j} + \beta_6 \varepsilon_{t-1} + u_t \qquad (3)$$

Where Δ could be signified as changes which takes place in CO2, E, y,y2 and ED while ε_{t-1} s stands for one period lagged error correction term (ECT) estimated from equation (2). The ECT shows how quick the disequilibrium is neglected among the values of dependent variables (CO2) both in short and long term (Katircioğlu, 2017; Katircıoğlu, 2010).

Changes in CO2, E, y, y2, and ED are represented as Δ while $\varepsilon_{t-1}$is the particular extended of time lagged error correction term (ECT) estimated from equation (2). The ECT shows the elimination of the disequilibrium among dependent variable's (CO2) values at the short and long-run. The anticipated indicator of the Error Coefficient Term is found to be negative.

4.3 Methodology

The time series analysis technique has been employed by various scholars to assess the role of external debt in Turkey. Due to the deterioration of environmental quality, public concern has sparked a debate to create better understanding about the main reasons which causes environmental degradation and its relationship with econometric.

It could be mentioned that GAUSS codes has been appointed to fulfill unit root tests then the impact of econometric on environment has been tested. Moreover, GAUSS codes is executed to assimilate GLS, unit root tests which are presented by Carrion-i-Silvestre et al. (2009) that allows until five break points for variables under consideration.

Time series generates an opportunity to locate multiple breaks over the years to analyze and create better understanding about the data which will be illustrated in figure 3. Then, Maki co-integrations tests (2012) will be conducted up to 5 structural breaks to prove the presence of equation (2)'s co-integration vector. Thirdly, equations (2) and (3) were estimated coefficients at the long and short-run, on top of the ECT term in equation (3). The approximations were carried out by practicing Johansen's methodology which is accepted as one of the well-known and reliable approach in the related literature (Katırcıoğlu, 2009b;Enders, 1995).

Last but not least, the current study employed Causality approach of block exogenity technique, impulse responses and decomposition analyses to prove the previous findings of this study. The standard econometric approaches were not stated in a detailed manner as these standards are mostly terms and discussed in forms of theories in econometric fields at relevant textbooks.

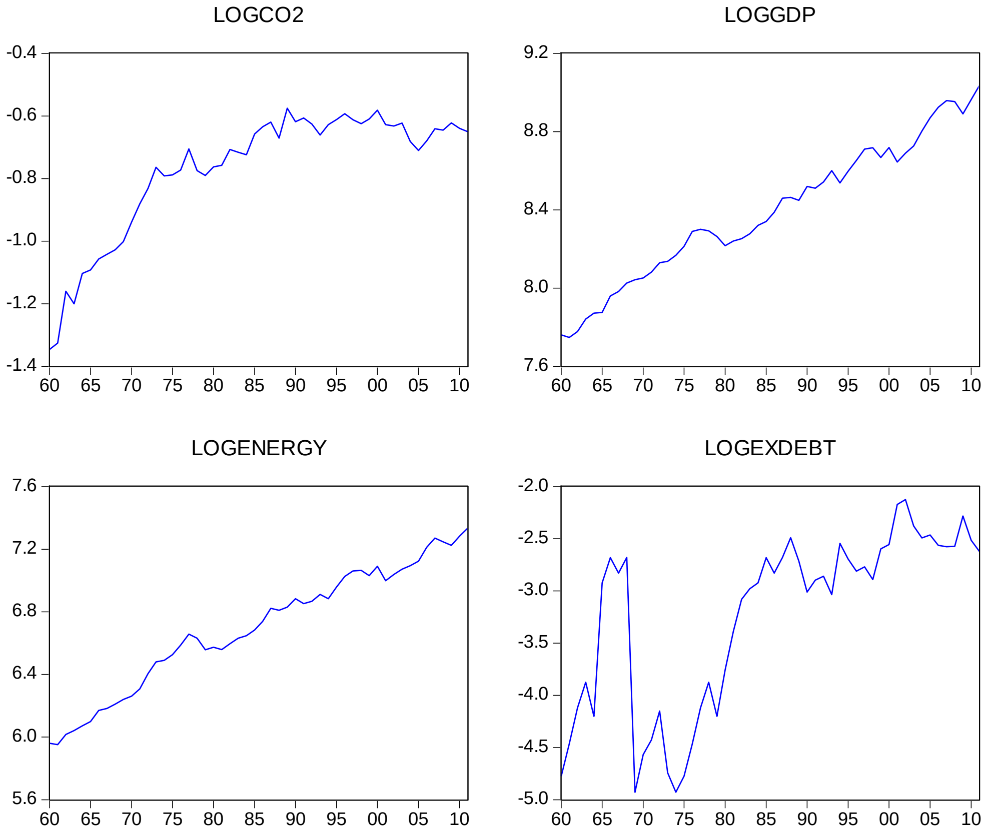

Figure 3: Graphical Presentation of Variables

4.3.1 The Quasi-GLS Unit Root Tests

It could be mentioned that Perron (1989), Zivot-Andrews (1992), Lumsdaine-Papell (1997), Perron (1997), and Ng-Perron (2001) are all accepted as pioneers of structural breaks approaches that all of them allow one break whereas Lee-Strazicich (2003) allow two breaks in the unit root tests. Apart from these methods, Carrion-i-Silvestre et al. (2009) method allow almost five breaks for unit root tests.

Furthermore, the quasi-Generalized Least Squares which proposed by Carrion-i-Silvestre et al. (2009) and permits (1) tolerating an arbitrary number of variations in both the level and slope of the trend function, (2) covering detrending method provided by Elliott et al. (1996) and (3) in view of a diversity of tests, specifically the class of M-tests which were make known to in Stock (1999) and tested in Ng and Perron (2001). Thus, in this thesis the quasi-GLS will be adopted (Generalized Least Squares) as a unit root tests by Carrion-i-Silvestre et al. (2009) for the conducted model.

Bai and Perron (2003) had introduced an algorithm through quasi-GLS (Generalized Least Squares) approach which diminishes residual sum of squares that is performed to obtain the structural breaks by Carrion-i-Silvestre et al. (2009). The procedure of stochastic data which created in the GLS unit root tests exhibited by the following formulas.

$$y_t = d_t + \mu_t \qquad (4)$$

$$\mu_t = \alpha\mu_{t-1} + \upsilon_t \qquad t = 0, 1, ..., T \qquad (5)$$

Under multiple structural breaks, Carrion-i-Silvestre et al. (2009) then assessed five different statistical tests to analyze null hypothesis of a unit root include:

$$P_T\left(\lambda^0\right) = \frac{\left[S\left(\overline{\alpha}, \lambda^0\right) - \overline{\alpha} S\left(1, \lambda^0\right)\right]}{S^2\left(\lambda^0\right)} \qquad (6)$$

PT laments Gaussian point optimal statistic and spectral density function is represented as S.

$$MP_T\left(\lambda^0\right) = \frac{\left[c^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2 + \left(1-\bar{c}\right)T^{-1}\tilde{y}_T^2\right]}{s\left(\lambda^0\right)^2} \qquad (7)$$

Modified feasible point optimal statistic represented as MPT proposed by Ng &Perron (2001).

$$MZ_\alpha\left(\lambda^0\right) = \left(T^{-1}\tilde{y}_T^2\right.$$

$$\left. - s\left(\lambda^0\right)^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \qquad (8)$$

$$MSB\left(\lambda^0\right) = \left(s\left(\lambda^0\right)^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2} \qquad (9)$$

$$MZ_t\left(\lambda^0\right) = \left(T^{-1}\tilde{y}_T^2\right.$$

$$\left. - s\left(\lambda^0\right)^2\right)\left(4s\left(\lambda^0\right)^2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2} \qquad (10)$$

GLS-detrending approaches have been employed to compute MZα, MSB, and MZt are M-type test statistics.

The bootstrap approach was appointed to anticipate the asymptotic critical values. Consequently, the nonexistence of a unit root in the sequences suggested by the rejection of the null hypothesis in the GLS unit root tests.

4.3.2 Maki's (2012) Cointegration Test

According to Westerlund and Edgerton (2006), cointegration tests for variables which are non-stationary series, integrated of order one and that do not reflect the existence of structural breaks are likely to deliver biased outcomes while testing for long time horizon relationships. Nowadays, the relevant literature contemplates the actuality of structural breaks in the time series by the superior approaches. For instance, the single structural break series in the co-integration tests provided by Gregory and Hansen (1996), Carrion-i-Silvestre and Sanso (2006), Westerlund and Edgerton (2006), and Hatemi-J (2008). In the meanwhile, cointegration test of Maki (2012) advanced a new method that provides up to five structural breaks and completed the gap in the literature with this evolution.

The final minimum t-ratios are achieved as structural breaking points with the calculation of cointegration time series tests and t-statistics by the algorithm of Maki (2012). The algorithm of Maki (2012), estimates the series of long time horizon equilibrium relationships under the existence of integration that should be stationary at first differences as shown by I (1).

Model 1: Existence of Break in Intercept and non-existence of Trend

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \beta x_t + \upsilon_t \tag{11}$$

Model 2: Existence of Break in Intercept and Coefficients, and non-existence of Trend

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t \tag{12}$$

Model 3: Existence of Break in Intercept and Coefficients, and existence of Trend

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \gamma x + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t \tag{13}$$

Model 4: Existence of Break in Intercept, Coefficients, and Trend

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t K_{i,t} + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t \tag{14}$$

Maki (2012) proposed dummy variables which is represented as Ki as shown as follows:

$$K_i = \begin{cases} 1 & when \ \mathrm{t} > \mathrm{T_B} \\ 0 & otherwise \end{cases}$$

Break point is represented as T_B.

In the above critical values which is used to measure the Null hypothesis of no cointegration under structural breaks are calculated. In order to estimate the existence of multiple coinetgration breaks as in the criticism of Maki (2012) Monte-Carlo simulations test is applied.

4.3.3 Assessment of Long term horizon and Short term horizon Coefficients

The assessment of long and short term horizon coefficients equation obtained through DOLS approach are the step after exposing the relationship of cointegration. The elimination of any unconventionality and internality complications in the ordinary least square estimators can be achieved by recommendation of Stock and Watson (1993) which suggest to comprise lagged and differenced forms of independent coefficients.

DOLS methods can be revealed as dependent variable have to be I(1) , but nevertheless of the order of combination of the variables whether regressors are purely I (0), purely I (1) or mutually co-integrated. The DOLS method offers powerful and consistent estimations in the existence of internality and autocorrelation. The robust and reliable estimations even in the place of internality and autocorrelation complications can be obtained by the DOLS method (Esteve and Requena, 2006). The DOLS estimation will be employed to assess equation (2) of the thesis which can be indicated as the following:

$$\ln CO2_t = \alpha_1 + \alpha_2 \ln E_t + \alpha_3 \ln y_t + \alpha_4 \ln y_t^2 + \alpha_5 \ln ED$$

$$+ \sum_{i=-q}^{q} \beta_i \Delta \ln E_{t-i} + \sum_{i=-q}^{q} \gamma_i \Delta \ln y_{t-i} + \sum_{i=-q}^{q} \delta_i \Delta \ln y_{t-i}^2 + \sum_{i=-q}^{q} \mu_i \Delta \ln ED_{t-i} + \varpi D_i + \varepsilon_t$$

(15)

Lag structure (level) is represented as q to be determined by Akaike Information Criterion (AIC) and time trend as represented as t, and Di is for dummy variables of structural breaks with allowance not more than five from Maki (2012). As a conclusion, the statistically significance of long term effect on breaking years can be possible to detect now.

Furthermore, the short term coefficients with error correction term will be also evaluated through DOLS approach as well. However, In order to observe the effects of statistically significance on the coefficients in addition to equation (3) as presented in this thesis cointegration test of Maki (2012) is applied . Finally, the error correction model can be calculated as:

$$\Delta \ln CO2_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln CO2_{t-j} + \sum_{i=0}^{n} \beta_2 \Delta \ln E_{t-j}$$

$$+ \sum_{i=0}^{n} \beta_3 \Delta \ln y_{t-j} + \sum_{i=0}^{n} \beta_4 \Delta \ln y^2_{t-j} + \sum_{i=0}^{n} \beta_5 \Delta \ln ED_{t-j} + \sum_{i=1}^{5} \beta_6 D_i + \beta_7 \varepsilon_{t-1} + u_t$$

(16)

Where D_i is included to the model and stands for dummy variables of breaking periods based on five breaks by Maki (2012).

4.3.4 Granger Causality Test, Variance Decompositions, and Impulse Responses

In the existence of long time horizon relationship that put forward in equation (2) of the thesis, Granger causality tests employed with the block exogeneity Wald tests within the ECM structure. For that reason, the present study covers the framework for Granger causality tests which indicated as follows:

$$\begin{bmatrix} \Delta \ln CO2_t \\ \Delta \ln E_t \\ \Delta \ln y_t \\ \Delta y_t^2 \\ \Delta T_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \end{bmatrix} + \begin{bmatrix} \partial_{11,1} & \partial_{12,1} & \partial_{13,1} & \partial_{14,1} & \partial_{15,1} \\ \partial_{21,1} & \partial_{22,1} & \partial_{23,1} & \partial_{24,1} & \partial_{25,1} \\ \partial_{31,1} & \partial_{32,1} & \partial_{33,1} & \partial_{34,1} & \partial_{35,1} \\ \partial_{41,1} & \partial_{42,1} & \partial_{43,1} & \partial_{44,1} & \partial_{45,1} \\ \partial_{51,1} & \partial_{52,1} & \partial_{53,1} & \partial_{54,1} & \partial_{55,1} \end{bmatrix} \begin{bmatrix} \Delta \ln CO2_{t-1} \\ \Delta \ln E_{t-1} \\ \Delta \ln y_{t-1} \\ \Delta y^2_{t-1} \\ \Delta ED_{t-1} \end{bmatrix}$$

$$+ \ldots + \begin{bmatrix} \partial_{11,i} & \partial_{12,i} & \partial_{13,i} & \partial_{14,i} & \partial_{15,i} \\ \partial_{21,i} & \partial_{22,i} & \partial_{23,i} & \partial_{24,i} & \partial_{25,i} \\ \partial_{31,i} & \partial_{32,i} & \partial_{33,i} & \partial_{34,i} & \partial_{35,i} \\ \partial_{41,i} & \partial_{42,i} & \partial_{43,i} & \partial_{44,i} & \partial_{45,i} \\ \partial_{51,i} & \partial_{52,i} & \partial_{53,i} & \partial_{54,i} & \partial_{55,i} \end{bmatrix} \begin{bmatrix} \Delta \ln CO2_{t-i} \\ \Delta \ln E_{t-i} \\ \Delta \ln y_{t-i} \\ \Delta y^2_{t-i} \\ \Delta ED_{t-i} \end{bmatrix} + \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \varphi_3 \\ \varphi_4 \\ \varphi_5 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \\ \varepsilon_{5,t} \end{bmatrix} \tag{17}$$

In equation (17), Δ stands for the difference operator. The ECTt-1 is the lagged error correction term originated from the long time horizon equilibrium model. As a final point, $\varepsilon_{1,t}$, $\varepsilon_{2,t}$, $\varepsilon_{3,t}$, $\varepsilon_{4,t}$,, and $\varepsilon_{5,t}$are serially independent random errors with a finite covariance matrix and a mean of zero. The circumstance of having long-run and short-run relation of causation(s), having statistically significant χ^2 - (chi-square) statistic(s) for ECTt-1 in equation (17) estimated through the ECMs for causality tests.

As a conclusion, exogenous shocks to independent variables have used to estimate variance decompositions for CO2 emissions and debt, those variables show the percentage of the forecast error variance of the dependent variable. The impulse responses will be assessed in order to examine how the identified variable under consideration responds to the exogenous shocks in the others after variance decompositions.

CHAPTER 5

TESTING THE ROLE OF EXTERNAL DEBT IN AUGMENTED ENVIRONMENTAL KUZNETS CURVE: EVIDINCE FROM MAKI CO-INTEGRATION & VECM APPROACHES

This chapter could be considered as a first empirical chapter which estimates the role of external debt in the EKC behavior of Turkey by performing the quasi-GLS based unit root tests, Maki (2012) cointegration tests and vector error correction model for long run / short run coefficients. In addition to this, Granger causalities, variance decompositions, and impulse responses among the series are also evaluated. As a first step, stationary nature of series will be investigated by the GLS method provided below:

Table 9: The Quasi-GLS Based Unit Root Tests Under Multiple Structural Breaks

	Levels					Break Years
	P_T	MP_T	MZ_α	MSB	MZ_t	
$lnCO_2$	16.09 [8.22]	14.75 [8.22]	-24.30 [- 43.91]	0.14 [0.10]	-3.48 [-4.67]	1966; 1971; 1977; 1982; 1988
Lny	17.90 [8.54]	17.09 [8.54]	-23.10 [-43.72]	0.14 [0.10]	-3.28 [-4.67]	1975; 1980; 1994; 1999; 2004
lny^2	17.90 [8.54]	17.01 [8.54]	-23.10 [-43.72]	0.14 [0.10]	-3.28 [-4.67]	1975; 1980; 1994; 1999; 2004
LnE	19.42 [8.05]	17.51 [8.05]	-20.18 [-42.77]	0.15 [0.10]	-3.14 [-4.62]	1978; 1986; 1995; 2000; 2005
lnED	19.04 [9.21]	18.37 [9.21]	-23.87 [-46.82]	0.14 [0.10]	-3.44 [-4.82]	1969; 1974; 1979; 1989; 1999
	First Differences					
$\Delta lnCO_2$	4.11* [5.54]	4.21* [5.54]	-21.71* [-17.32]	0.15* [0.17]	-3.29* [-2.89]	-
Δlny	4.79* [5.54]	4.61* [5.54]	-23.61* [-17.32]	0.14* [0.16]	-3.30* [-2.89]	-
Δlny^2	4.79* [5.54]	4.61* [5.54]	-23.61* [-17.32]	0.14* [0.16]	-3.30* [-2.89]	-
ΔlnE	4.23* [5.54]	4.05* [5.54]	-23.67* [-17.32]	0.14* [0.16]	-3.40* [-2.89]	-
$\Delta lnED$	4.11* [5.54]	4.21* [5.54]	-21.71* [-17.32]	0.15* [0.17]	-3.29* [-2.89]	-

Notes: The quasi GLS-based unit root tests of Carrion-i-Silvestre et al. (2009)is used to obtain iBreaks years. ii* denotes the 0.05 significance level that is a rejection of the null hypothesis of a unit root . iiiNumbers in brackets are critical values and from the bootsrap approach by Carrion-i-Silvestre et al. (2009).

Table 9 demonstrates CO2, GDP, GDP squared, energy, use of energy and external debt's GLS-based unit root test outcomes. To create better understanding it could be stressed that these series generated successful break points. When these points were outlined, it implies that all of these series were on stationary at their levels, so the unit root null hypothesis could be accepted. However, when these series of variables were segregated they became stationary hence unit root null hypothesis could be rejected. Hence, it could be stated that the findings which are obtained from the unit root tests proved that, ln CO2, ln y, ln E, and ln ED were integrated with order one I (1); thus equation (1) is likelihood co-integration model for the present thesis.

Table 10: Maki's (2012) Co-Integration Tests Under Multiple Structural Breaks

Number of Break Points		Test Statistics [Critical Values]	Break Points
$T_B \leq 1$			
	Model 0	-6.13 [-5.65]*	1963
	Model 1	-6.67 [-5.91]*	1968
	Model 2	-5.23 [-6.52]*	1985
	Model 3	-6.13 [-6.91]*	1985
$T_B \leq 2$			
	Model 0	-6.64 [-5.83]*	1963; 1968
	Model 1	-7.47 [-6.05]*	1968; 1975
	Model 2	-5.23 [-7.24]	1985; 2001
	Model 3	-6.12 [-7.63]	1985; 1998
$T_B \leq 3$			
	Model 0	-7.05 [-5.99]*	1963; 1968; 1984
	Model 1	-7.62[-6.21]*	1968; 1975; 1996
	Model 2	-5.23 [-7.80]	1974; 1985; 2001
	Model 3	-6.12[-8.25]	1985; 1998; 2004
$T_B \leq 4$			
	Model 0	-7.38 [-6.13]*	1963; 1968; 1984; 1998
	Model 1	-7.70 [-6.37]*	1968; 1975; 1996; 2003
	Model 2	-14.42 [-8.29]*	1974; 1985; 1993; 2001
	Model 3	-13.11 [-8.87]*	1985; 1991; 1998; 2004
$T_B \leq 5$			
	Model 0	-7.38 [-6.30]*	1963; 1968; 1979; 1984; 1988
	Model 1	-8.10 [-6.49]*	1968; 1975; 1992; 1996; 2003
	Model 2	-17.13 [-8.86]*	1974; 1985; 1993; 1998; 2001
	Model 3	-17.87 [-9.48]*	1966; 1985; 1991; 1998; 2004

Notes: Numbers brackets could be expressed as critical values at the 0.05 level. Table 8 of Maki (2012). * represents a statistical significance at the 0.01 level.

For the current study, the variables were integrated by (1) I; therefore, the co-Maki's (2012) co-integration technique was employed for equation (2) will be acceptable. Furthermore, GAUSS software was appointed co-integration tests of Maki' (2012) to equation (2). The findings of the test with 5 structural breaks are portrayed in above Table 10.

Table 11: Estimation of Long-/short-term and ECT Coefficients

Panel (a). Long-Term Model

Co-integrating Eq:	CointEq1		
$lnCO_2(-1)$	1.000000		
lny(-1)	1.408834		
	(0.26381)		
	[5.34024]		
$lny^2(-1)$	-0.186		
	(0.056)		
	[3.321]		
lnE(-1)	-1.501206		
	(0.23507)		
	[-6.38627]		
lnED(-1)	-0.016868		
	(0.01789)		
	[-0.94299]		
Constant	-1.058558		
Error Correction:	**$D(LOGCO_2)$**		
ECT(-1)	-0.240154		
	(0.07252)		
	[-3.31149]		
$D(lnCO_2(-1))$	-0.207846		
	(0.19133)		
	[-1.08631]		
D(lny(-1))	0.115477		
	(0.29090)		
	[0.39696]		
$dlny^2(-1)$	0.107		
	(0.321)		
	[0.333]		
		R-squared	0.244537
D(lnE(-1))	-0.176714	Adj. R-squared	0.158689
	(0.30265)	Sum sq. resids	0.070768
	[-0.58389]	S.E. equation	0.040104
		F-statistic	2.848483
D(lnED(-1))	-0.005140	Log likelihood	93.06244
	(0.01353)	Akaike AIC	-3.482498
	[-0.37995]	Schwarz SC	-3.253055
		Mean dependent	0.013514
Constant	0.018576	S.D. dependent	0.043723
	(0.00719)		
	[2.58365]		

It can be mentioned that null of no co-integration can not be accepted, even though allowing the presence of different structural break years, as can be illustrated in Table 11. Moreover, it can be signaled that Maki’s (2012) model choices could not be accepted the null of no co-integration in equation (2). Thus tests of Maki (2012) affirmed the co-integration vector which takes place in equation (2), and subsequently a long-run linkage among Turkey’s CO_2 emissions and its factors, including foreign debt stock (see Katircioglu & Taspinar, 2017).

Following stage, the coefficients of long-run which located in equation (2) should have been assessed. Table 11 introduces both long and short run coefficients, as demonstrated in equation (3) by performing approach of Johansen.

The long-run coefficients of income (β= 1.408, $p < 0.01$) and y2 (β = - 0.186, $p < 0.01$) were significant as well as positive and negative respectively. This was as anticipated can be viewed in Table 11. This approves the conventional Environmental Kuznet Curve assumption for Turkey. Moreover, the long run coefficient of energy consumption was found to be elastic as well as negative and significant (β = - 1.501, $p < 0.01$), expressing an influential energy strategy with respect to environmental concerns. On the other hand, it could be signified that the long-run coefficient of Turkey's external debt was positive, as anticipated, however it was not statistically significant (β = - 0.016, $p < 0.10$).This stresses that, despite the fact that the conventional Environmental Kuznet Curve was approved, Turkey's external debt stock did not significantly influence the Turkish economy's Environmental Kuznet Curve conduct.

Furthermore, the ECT and coefficients of short-run were assessed in the following stage, and coefficients are presented in Table 11. Error-Correction Term of equation (3) was negative (β = - 0.240, $p < 0.01$), which mentioned that CO_2 emissions of Turkey respond to its long-run equilibrium path by a 24.0% speed of adjustment per year through the channels of variables. Although, the Error Correction Term is found moderately low it is statistically significant. The main reason behind of this could be considered as external debt series are extremely unstable as it is demonstrated in Figure 5. Moreover, it may be indicated that it failed to stress movements in CO_2 emissions at high levels. On the other hand, the volatility of the external debt influences the rationality of the Error Correction Model estimation findings of regressors since it could be exhibited in Table 11. Thus, unlike the long –run coefficients the short- run could be indicated as coefficients of Gross Domestic Product, energy and external debt were not significant.

Table 12: Granger Causality Tests Under The Block Exogeneity Approach

Dependent variable: $lnCO_2$

Excluded	Chi-sq	Df	Prob.
lny	1.727903	2	0.4215
lnE	1.420520	2	0.4915
lnED	0.871140	2	0.6469
All	2.707275	6	0.8446

Dependent variable: lny

Excluded	Chi-sq	Df	Prob.
$lnCO_2$	0.319032	2	0.8526
lnE	0.209361	2	0.9006
lnED	2.528111	2	0.2825
All	4.165204	6	0.6543

Dependent variable: lnE

Excluded	Chi-sq	Df	Prob.
$lnCO_2$	3.542140	2	0.1702
lny	5.279895	2	0.0714
lnED	2.143314	2	0.3424
All	7.444173	6	0.2817

Dependent variable:lnED

Excluded	Chi-sq	Df	Prob.
$lnCO_2$	4.894542	2	0.0865
lny	3.741076	2	0.1540
lnE	5.176590	2	0.0751
All	7.679901	6	0.2625

In the following stage, Granger causality tests under block exogeneity method would be indicated, as exhibited by Table 12. In spite of the fact that the results of chi square test failed to provide causality in long-run in equation (2), the results of F-test stressed short-term results. For instance, the findings which portrayed by Table 12 recommend a short-run correlation is running from Gross Domestic Product to energy consumption, that is profoundly logical and expected. Besides of these it may be indicated that demand towards to energy changes as a result of the developments/shrinkages in Turkish Economy. The reason behind of this could be lamented as F-measurement, the relationship among Gross Domestic Product and energy consumption was significant. ($F = 5.279$, $p < 0.10$).

Furthermore, causality among carbon dioxide emissions and external debt was found statistically significant. This implies that changes in levels of carbon emissions leads changes in external debt volume ($F = 4.894$, $p < 0.10$). It could be justified by the reality that Turkish policy makers' at environmental concerns yield them to borrow for financing purposes.

Table 13: Variance Decomposition Results

Model: lnCO2= f (lny, lny2, lnE, lnED)

Period	S.E.	$lnCO_2$	Lny	lnE	lnED
1	0.036906	100.0000	0.000000	0.000000	0.000000
2	0.040763	99.24089	0.397150	0.355333	0.006627
3	0.045107	97.59887	0.407285	1.039418	0.954430
4	0.047361	96.33346	0.473113	1.578204	1.615223
5	0.049296	94.75656	0.687596	2.403864	2.151980
6	0.050566	93.38176	0.916690	3.193668	2.507882
7	0.051559	92.20732	1.160226	3.949817	2.682637
8	0.052275	91.29582	1.369000	4.600456	2.734720
9	0.052818	90.60121	1.545115	5.130669	2.723004
10	0.053224	90.09113	1.685104	5.534085	2.689686

In the following stage, findings of variance decomposition would be explained and the results will be exhibited in Table 13. The findings showed that at previous stage, lower levels of the forecasted error variance levels of carbon-dioxide emissions could be explained with the help of exogenous shocks to Gross Domestic Product, external debt and consumption of energy. However, same ratios could be higher in the coming periods. For instance, the finding in period 10 demonstrated that the forecast error variance of CO2 emissions due to the effect of GDP was 1.685%, in the meanwhile external debt and energy consumption ratios were 5.534% and 1.685% respectively. Thus the findings reveals that changes in CO2 emissions are explained mainly by external debt and energy consumption are accepted as a major reasons to change in CO2 emissions. Therefore, It implied that external debt is the most influential factor for CO2 emission deviations.

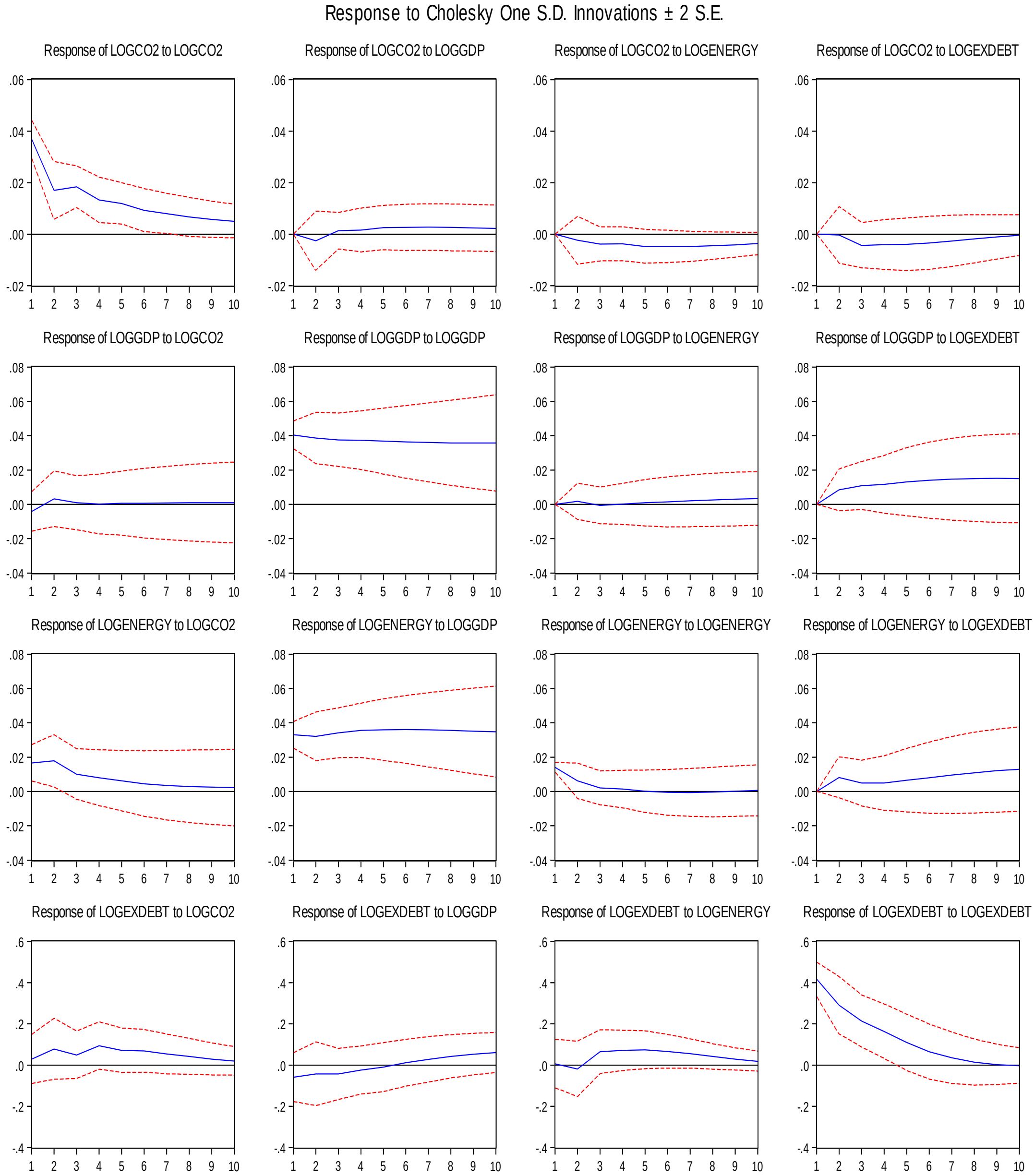

Figure 4: Impulse Response Functions

At last, figure 4 presents line plots of the impulse reactions among CO2 emissions and its domains, such as external debt. It portrayed from the above-mentioned figure, the reaction emissions of CO2 to external debt shock constantly negative, and impressively not significant. This outcome was almost compatible with the Error Correction Model findings which postulated by Table 13. The highest reaction of CO2 emissions was gathered for the time period of 3, however then it turned out to be significantly irresponsive to the external debt stocks. It might be figured that CO2 emission reactions to Gross Domestic Product shocks was again negative, not responsive and not significant by the time. Results could be stressed alike with the consumption of energy.

CHAPTER 6
TESTING THE ROLE OF EXTERNAL DEBT IN AUGMENTED ENVIRONMENTAL KUZNETS CURVE: EVIDENCE FROM THE GMM METHOD

This chapter is the second empirical chapter to analyzed role of external debt for Turkey's case in terms of Environmental Kuznet Curve behavior. The Generalized Method of Moments (GMM) is adopted in the series under consideration with this respect. Studying the effects of external debt on the EKC with different approaches is essential in order to provide robust results in estimation and forecasting. Although the GMM methodolology has been proposed for panel settings in the econometric literature, it has been also adapted for time series setting in theoretical papers such as Hansen (2001). Thenafter, this methodology has started to appear in important econometric softwares such as EVIEWS 10. To the best of our knowledge, there isn't any empirical study adapting the GMM methodology to time series data sets; thus, this will be another important contribution of this thesis to the relevant literature.

6.1 Methodology& Data

The approach of the GMM have proposed by Holtz-Eakin et al. (1988), Arellano & Bond (1991), Arellano &Bover (1995) and Bundell & Bond (1998) and has been popular in the econometrics methodology in the last decade as it provides strong estimations. It is proposed that the GMM is an effective method when the problems of heterogeneity and endogeneity exist in the models (Hoeffler, 2002).

The following model will be then estimated via the GMM mechnanism as suggested in the relevant theoretical literature:

$$\Delta \log CO2_{it} = \beta_1 \Delta \log GDP_{it-1} + \beta_2 \Delta \log GDP2_{it} + \beta_3 \Delta \log ENERGY_{it} + \beta_4 \Delta \log EXDEBT_{it}$$

$$+ \sum_{k=1}^{K} \delta_k \Delta X_{kit} + \Delta u_{it}$$

(18)

$$E(\Delta \log CO2_{i,t-1} \Delta u_{it}) \neq 0 \qquad (19)$$

Where Xit stands for control variables to be considered as instrument variables exogeneously added to the system (see Holtz-Eakin et al. 1988; Arellano & Bond, 1991; Arellano &Bover, 1995; and Bundell& Bond, 1998).

In order to estimate the GMM coefficients in equation (18), the same data set used in the previous chapter will be used for the same annual data period that ranges between 1960 and 2011. However, it is important to mention that as per requirement of the GMM method, additional variables would be needed to add to the system as instrumental variables. Therefore, due to this restriction by the GMM, the overall private consumption in USD (2005 = 100) and the overall private investment in USD (2005 = 100) in the Turkish economy have been added as instrumental variables to equation (18) of this study.

Carbon emissions are the determinants of energy consumption (Heidari et al., 2015) through real income generation (GDP), private consumption and private investment are also drivers not only for real income (GDP) but also for energy consumption which in return will cause changes in the level of carbon dioxide emissions (Katircioglu, 2017). Therefore, adding consumption and investment series to the debt-EKC nexus as instrumental variables would be quite reasonable.

The next section will present the GMM results for equation (18) of this study.

6.2 The GMM Results& Discussion

In this section, the GMM results for equation (18) will be presented under the four different model options. Results are provided in Table 12.

Table 14: The GMM Estimation Results

Dep.var.: logCO2	(1)	(2)	(3)	(4)
logGDP	1.106*	1.215**	1.134**	1.116**
$\log GDP^2$	-	-0.182**	-0.316**	-0.517**
logENERGY	-	-	0.380**	0.327**
logEXDEBT	-	-	-	0.418
AR(1)	0.916*	0.904*	0.924*	0.915*
Wald Chi test (p-level)	0.000	0.000	0.000	0.000
Number of instruments	2	2	2	2
SarganJ test (p-level)	0.135	0.112	0.213	0.223
Durbin Watson Statistic	2.105	2.081	2.094	2.057

Notes: * and ** indicate rejection of null hypothesis at 1% and 5% significance levels respectively. AR (1) is the first order of autoregressive coefficient to eliminate serial and autocorrelation in estimations (See Enders, 1995).

In the first model (1) of Table 14, equation (18) has been estimated for only GDP variable as a single regressor. In the second model (2), the conventional EKC model with GDP and GDP^2 has been estimated through the GMM approach. In the third model (3), the energy consumption variable has been added to the conventional EKC setting and finally in the fourth model option (4), the variable of external debt has been added to the conventional EKC setting together with the energy consumption variable. Such comparisons throughout four model options would provide us better insights about the EKC behavior of the Turkish economy.

Table 14 show the results of coefficients of GDP are positively significant and the coefficients of squared GDP (GDP^2) are negatively significant throughout all four model options. This shows that the behavior of the EKC in Turkey does not change no matter what exogeneous factors (variables) are added to the models; thus, the inverted U-shaped EKC for Turkey has been confirmed using the GMM approach. In the model options 3 & 4, the coefficients of energy consumption are positively significant proving that energy consumption in

Turkey utilize positively significant impact on the level of carbon dioxide emissions; this suggests that increases in energy consumption leads to deterioration in the air quality thus cause pollution.

Finally, Table 14 shows that external debt in Turkey still do not exert significant effect on the level of carbon dioxide emissions in parallel to that finding in the previous chapter. The level of external debt in Turkey is positively related to carbon dioxide emissions but this link is not statistically significant. Diagnostic test results in Table 14 reveals the estimated models do not suffer from autocorrelation problem. Thus, the GMM results of this study are accepted to be robust through different model options.

It is evident that an increase in the levels of debt stock in the countries would deteriorate macroeconomic conditions especially if they are current expenditures oriented. Thus, deteriorating effect of external debt on the environmental quality of the countries should not be surprising due to the fact that macroeconomic conditions deteriorate because of debt stock and countries could not initiate investments towards green energy alternatives to increase environmental quality levels. However, results of this study showed that external debt stock in Turkey does not matter for the energy sector and environmental pollution. In reality, this finding is not again surprising because the Turkish economy is heavily rely on the consumption of imported energy; therefore, no matter what the level of debt stock is, energy need and its consumption in Turkey can never be avoidable. Foreign energy dependency of Turkey is the major reason behind persistent current account deficits and macroeconomic instability over many years. Thus, to achieve macroeconomic stability, the Turkish government firstly is expected to reduce foreign energy dependency.

CHAPTER 7
CONCLUSION & POLICY IMPLICATION

7.1 Summary of Major Findings

The current study aimed to test debt-originated EKC assumptions by appointing Turkey's external debt to the conventional Environmental Kuznet Curve. The time period which selected for the present study could be mentioned as 1960-2013. The findings of the study approved the existence of inverted U shape EKC for the Turkeys economy however external debt was not statistically significant both in long and short time periods which means that economic approaches which employed for the current study advised that external debt does not have any impact on EKC in short and long terms.

Aside of these, the execution of both GMM approaches and Error Correction Modelling revealed that the role of debt stock on the EKC is not significant for the case of Turkey. Variance Decomposition and Impulse Response Analysis under the VAR System had shown that there was a significant relationship among Real Income, External Debt, Energy Consumption and CO2 emissions. To advance our understanding it could be signified that for the short term periods changes which takes place in external debt stock of Turkey will also cause a changes in volume of energy consumption which in turn changes CO2 emissions for the nation.

The results of the study also present a critical implications for the policy makers. It is advised to policy makers to formulate policies which will enable to use resources and monetary mechanisms more effectively. To be more accurate the composition of the borrowing should include expenditures more on environment friendly energy sources to mention a few renewable energy sources and solar systems as well as refrain policies which are favoring non-renewable energy sources.

7.2 Policy Implications

This study has founded and concluded that although conventional Environmental Kuznet's Curve is confirmed for Turkey; but, the level of external debt does not significantly affect this behavior. This finding can be linked to the possibility that debt level does not significantly impact on the movements of energy consumption and energy sector, therefore, the level of carbon emissions. We find and propose that the effect or type of energy consumption in Turkey is independent of debt level in the country. But, this finding should not mean to policy makers that debt level in Turkey might be expected to be high. This is because high debt level will constrain macroeconomic activity and therefore GDP and will exert indirect effects on the energy sector. However, if debt is related with energy sector like stimulating alternative energy systems, then, this would have positive effects on not only in the economy but also in creating clean and quality environment. Thus, finding insignificant effect of debt in this study would signal towards motivating authorities to finance and initiate alternative energy projects towards the uses of solar and renewable energies. Although the use of renewable energies in Turkey is about 13.37 percent (World Development Indicators, 2018) of the overall energy consumption and is higher than the United States and close to that of the European Union, its use and its investments should be encouraged by governments and the related bodies in Turkey. Switching towards clean energy and alternative energy systems in Turkey will not only have positive outcome on environmental concerns but also on its economy due to the fact that Turkey suffers from persistent and unsustainable current account deficits mainly because of foreign energy dependency of the country over many years. Thus, based on the main result of this study, hereby we propose that Turkey might consider borrowing for alternative and clean energy investments with this respect to contribute both to clean environment and reducing current account deficits via reducing foreign energy dependency.

7.3 Limitations of the Study

Data availability is the main constraint and limitation in this study. Although at the beginning the overall debt level of Turkey was targeted for this research study, the selection of “external debt” has been made owing to its data availability and unavailability of the overall debt in some periods. The second constraint in this study is that although there have been tremendous number of the EKC studies, no study has been found on the role of debt on the EKC and literature review on this nexus couldn’t be made available in this study; however, this was actually an original contribution of this study to the relevant literature.

7.4 Directions for Further Research

This present study has advised future–related researchers to form a new research hypothesis by concentrating particularly for Turkish economy, which could be considered as fragile, volatile, conjecture. Moreover, future related studies could be designed as comparative study to examine nations which are experiencing high levels of debt. Lastly, it is also recommended to employ panel data as well as other alternative approaches which are supported with alternative debt proxies.

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APPENDIX

VECM Results In Different Lag Structures

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:03
Sample (adjusted): 1962 2011
Included observations: 50 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	1.408834 (0.26381) [5.34024]
LOGENERGY(-1)	-1.501206 (0.23507) [-6.38627]
LOGEXDEBT(-1)	-0.016868 (0.01789) [-0.94299]
C	-1.058558

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	-0.240154 (0.07252) [-3.31149]	-0.016444 (0.07213) [-0.22799]	0.026150 (0.07327) [0.35690]	-0.166721 (0.81660) [-0.20416]
D(LOGCO2(-1))	-0.207846 (0.19133) [-1.08631]	0.138697 (0.19029) [0.72888]	0.305965 (0.19331) [1.58280]	2.627764 (2.15443) [1.21970]
D(LOGGDP(-1))	0.115477 (0.29090) [0.39696]	-0.045804 (0.28932) [-0.15832]	0.241950 (0.29390) [0.82323]	1.816358 (3.27561) [0.55451]
D(LOGENERGY(-1))	-0.176714 (0.30265) [-0.58389]	0.078945 (0.30100) [0.26228]	-0.272621 (0.30577) [-0.89159]	-3.251812 (3.40787) [-0.95421]
D(LOGEXDEBT(-1))	-0.005140 (0.01353) [-0.37995]	0.013810 (0.01345) [1.02642]	0.014738 (0.01367) [1.07823]	-0.138590 (0.15233) [-0.90977]
C	0.018576 (0.00719) [2.58365]	0.022193 (0.00715) [3.10355]	0.024067 (0.00726) [3.31316]	0.048312 (0.08096) [0.59675]
R-squared	0.244537	0.069256	0.077023	0.060775
Adj. R-squared	0.158689	-0.036510	-0.027861	-0.045955

Sum sq. resids	0.070768	0.069998	0.072236	8.972734
S.E. equation	0.040104	0.039886	0.040518	0.451581
F-statistic	2.848483	0.654805	0.734368	0.569426
Log likelihood	93.06244	93.33569	92.54917	-28.00111
Akaike AIC	-3.482498	-3.493428	-3.461967	1.360044
Schwarz SC	-3.253055	-3.263985	-3.232524	1.589487
Mean dependent	0.013514	0.025762	0.027668	0.036873
S.D. dependent	0.043723	0.039177	0.039965	0.441550

Determinant resid covariance (dof adj.)	9.66E-11
Determinant resid covariance	5.79E-11
Log likelihood	305.5031
Akaike information criterion	-11.10012
Schwarz criterion	-10.02939

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:04
Sample (adjusted): 1963 2011
Included observations: 49 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	1.915768 (0.18806) [10.1869]
LOGENERGY(-1)	-1.999865 (0.17215) [-11.6173]
LOGEXDEBT(-1)	-0.044386 (0.01284) [-3.45592]
C	-2.066380

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	0.129291 (0.12451) [1.03838]	-0.086254 (0.13337) [-0.64672]	0.257433 (0.12795) [2.01203]	0.196123 (1.53182) [0.12803]
D(LOGCO2(-1))	0.061177 (0.19029) [0.32150]	0.140313 (0.20383) [0.68840]	0.355444 (0.19554) [1.81779]	2.528248 (2.34102) [1.07998]
D(LOGCO2(-2))	0.412668 (0.20920) [1.97262]	0.102557 (0.22408) [0.45767]	0.295276 (0.21497) [1.37357]	-0.224594 (2.57368) [-0.08727]
D(LOGGDP(-1))	0.378479 (0.28188) [1.34270]	0.011899 (0.30194) [0.03941]	0.301129 (0.28966) [1.03961]	1.990362 (3.46785) [0.57395]
D(LOGGDP(-2))	0.374205 (0.28588)	0.152116 (0.30623)	0.421648 (0.29377)	0.905788 (3.51713)

	[1.30894]	[0.49674]	[1.43529]	[0.25754]
D(LOGENERGY(-1))	-0.472976	0.033209	-0.366139	-3.075353
	(0.30452)	(0.32618)	(0.31292)	(3.74634)
	[-1.55321]	[0.10181]	[-1.17008]	[-0.82089]
D(LOGENERGY(-2))	-0.377461	-0.253562	-0.498471	-0.693295
	(0.30267)	(0.32421)	(0.31103)	(3.72371)
	[-1.24709]	[-0.78208]	[-1.60266]	[-0.18618]
D(LOGEXDEBT(-1))	0.001958	0.007093	0.022257	-0.122014
	(0.01431)	(0.01533)	(0.01471)	(0.17605)
	[0.13683]	[0.46271]	[1.51359]	[-0.69305]
D(LOGEXDEBT(-2))	-0.000166	-0.013063	0.007216	-0.005918
	(0.01459)	(0.01563)	(0.01499)	(0.17950)
	[-0.01138]	[-0.83588]	[0.48130]	[-0.03297]
C	0.007949	0.024400	0.021924	0.034835
	(0.00815)	(0.00873)	(0.00837)	(0.10022)
	[0.97578]	[2.79642]	[2.61916]	[0.34760]

R-squared	0.166001	0.108091	0.197127	0.064582
Adj. R-squared	-0.026461	-0.097734	0.011848	-0.151284
Sum sq. resids	0.058445	0.067058	0.061714	8.845903
S.E. equation	0.038711	0.041466	0.039780	0.476254
F-statistic	0.862515	0.525162	1.063948	0.299175
Log likelihood	95.39368	92.02533	94.05992	-27.58727
Akaike AIC	-3.485456	-3.347973	-3.431017	1.534174
Schwarz SC	-3.099370	-2.961887	-3.044931	1.920260
Mean dependent	0.010410	0.025667	0.026913	0.030590
S.D. dependent	0.038209	0.039577	0.040017	0.443862

Determinant resid covariance (dof adj.)	8.06E-11
Determinant resid covariance	3.23E-11
Log likelihood	313.6805
Akaike information criterion	-11.00737
Schwarz criterion	-9.308589

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:05
Sample (adjusted): 1964 2011
Included observations: 48 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	1.832401
	(0.14243)
	[12.8656]
LOGENERGY(-1)	-1.896663
	(0.13313)
	[-14.2468]
LOGEXDEBT(-1)	-0.042569
	(0.01015)

	[-4.19407]			
C	-2.056825			

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	-0.103055	-0.224380	0.105175	-0.478888
	(0.17889)	(0.19615)	(0.19296)	(2.21979)
	[-0.57609]	[-1.14391]	[0.54506]	[-0.21574]
D(LOGCO2(-1))	0.068411	0.202876	0.432289	1.852271
	(0.25808)	(0.28299)	(0.27838)	(3.20246)
	[0.26508]	[0.71692]	[1.55287]	[0.57839]
D(LOGCO2(-2))	0.313355	-0.068711	0.237052	-0.976237
	(0.24935)	(0.27341)	(0.26896)	(3.09411)
	[1.25669]	[-0.25131]	[0.88136]	[-0.31551]
D(LOGCO2(-3))	0.149170	-0.271883	-0.039601	-0.212295
	(0.23413)	(0.25672)	(0.25255)	(2.90527)
	[0.63712]	[-1.05905]	[-0.15681]	[-0.07307]
D(LOGGDP(-1))	0.373324	0.084618	0.378911	1.062567
	(0.33014)	(0.36200)	(0.35611)	(4.09665)
	[1.13080]	[0.23375]	[1.06403]	[0.25937]
D(LOGGDP(-2))	0.369498	0.044838	0.411790	0.562793
	(0.30720)	(0.33684)	(0.33136)	(3.81197)
	[1.20279]	[0.13311]	[1.24271]	[0.14764]
D(LOGGDP(-3))	0.315660	-0.280586	-0.013958	-3.726449
	(0.32399)	(0.35525)	(0.34947)	(4.02026)
	[0.97430]	[-0.78983]	[-0.03994]	[-0.92692]
D(LOGENERGY(-1))	-0.474374	-0.012029	-0.436312	-1.787561
	(0.35843)	(0.39302)	(0.38662)	(4.44767)
	[-1.32348]	[-0.03061]	[-1.12852]	[-0.40191]
D(LOGENERGY(-2))	-0.354791	-0.036174	-0.443589	0.013216
	(0.34644)	(0.37987)	(0.37369)	(4.29891)
	[-1.02410]	[-0.09523]	[-1.18704]	[0.00307]
D(LOGENERGY(-3))	-0.296732	0.179845	-0.020023	0.432874
	(0.33091)	(0.36284)	(0.35694)	(4.10620)
	[-0.89671]	[0.49565]	[-0.05610]	[0.10542]
D(LOGEXDEBT(-1))	-0.008170	0.001660	0.015399	-0.143289
	(0.01526)	(0.01673)	(0.01646)	(0.18934)
	[-0.53542]	[0.09923]	[0.93557]	[-0.75677]
D(LOGEXDEBT(-2))	-0.013989	-0.018279	-0.000928	-0.075996
	(0.01620)	(0.01776)	(0.01747)	(0.20099)
	[-0.86364]	[-1.02917]	[-0.05313]	[-0.37811]
D(LOGEXDEBT(-3))	-0.022159	-0.017670	-0.014320	-0.156981
	(0.01739)	(0.01907)	(0.01876)	(0.21585)
	[-1.27386]	[-0.92640]	[-0.76320]	[-0.72727]
C	0.009883	0.029520	0.024538	0.127121
	(0.00951)	(0.01043)	(0.01026)	(0.11800)
	[1.03923]	[2.83104]	[2.39213]	[1.07727]

R-squared	0.219822	0.141470	0.202961	0.138411
Adj. R-squared	-0.078482	-0.186791	-0.101789	-0.191020
Sum sq. resids	0.052655	0.063308	0.061264	8.107663
S.E. equation	0.039353	0.043151	0.042449	0.488324
F-statistic	0.736906	0.430967	0.665991	0.420152
Log likelihood	95.45566	91.03376	91.82111	-25.42766
Akaike AIC	-3.393986	-3.209740	-3.242546	1.642819
Schwarz SC	-2.848219	-2.663973	-2.696779	2.188586
Mean dependent	0.011459	0.024883	0.026942	0.026144
S.D. dependent	0.037894	0.039610	0.040440	0.447455

Determinant resid covariance (dof adj.)	7.79E-11
Determinant resid covariance	1.96E-11
Log likelihood	319.2942
Akaike information criterion	-10.80392
Schwarz criterion	-8.464923

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:05
Sample (adjusted): 1965 2011
Included observations: 47 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	2.476527
	(0.19113)
	[12.9571]
LOGENERGY(-1)	-2.805707
	(0.18196)
	[-15.4198]
LOGEXDEBT(-1)	0.058325
	(0.01474)
	[3.95636]
C	-1.041771

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	0.248466	0.194141	0.317471	-7.389175
	(0.12567)	(0.14470)	(0.12993)	(1.14971)
	[1.97713]	[1.34171]	[2.44344]	[-6.42696]
D(LOGCO2(-1))	-0.231558	0.023004	0.101916	9.854278
	(0.28402)	(0.32702)	(0.29365)	(2.59842)
	[-0.81528]	[0.07034]	[0.34707]	[3.79241]
D(LOGCO2(-2))	-0.286842	-0.357366	-0.512391	9.096730
	(0.30062)	(0.34613)	(0.31080)	(2.75023)
	[-0.95418]	[-1.03247]	[-1.64862]	[3.30762]
D(LOGCO2(-3))	0.042209	-0.325122	-0.320759	7.266646
	(0.23130)	(0.26632)	(0.23914)	(2.11611)
	[0.18248]	[-1.22079]	[-1.34130]	[3.43396]

D(LOGCO2(-4))	0.180968	0.147580	0.140988	6.998661
	(0.21868)	(0.25178)	(0.22609)	(2.00061)
	[0.82755]	[0.58613]	[0.62360]	[3.49826]
D(LOGGDP(-1))	-0.122522	-0.388328	-0.210241	18.34988
	(0.42422)	(0.48845)	(0.43859)	(3.88106)
	[-0.28882]	[-0.79503]	[-0.47935]	[4.72806]
D(LOGGDP(-2))	-0.406700	-0.497960	-0.581360	15.28874
	(0.39713)	(0.45725)	(0.41059)	(3.63322)
	[-1.02409]	[-1.08902]	[-1.41592]	[4.20804]
D(LOGGDP(-3))	0.131262	-0.533893	-0.487224	9.208726
	(0.35118)	(0.40435)	(0.36308)	(3.21285)
	[0.37377]	[-1.32038]	[-1.34192]	[2.86622]
D(LOGGDP(-4))	-0.006090	-0.594690	-0.618578	12.00401
	(0.32929)	(0.37914)	(0.34044)	(3.01251)
	[-0.01849]	[-1.56854]	[-1.81699]	[3.98471]
D(LOGENERGY(-1))	0.048547	0.465228	0.190554	-20.37586
	(0.46278)	(0.53285)	(0.47846)	(4.23385)
	[0.10490]	[0.87310]	[0.39826]	[-4.81261]
D(LOGENERGY(-2))	0.426420	0.566512	0.674961	-16.70941
	(0.43328)	(0.49887)	(0.44795)	(3.96389)
	[0.98418]	[1.13559]	[1.50676]	[-4.21541]
D(LOGENERGY(-3))	-0.126954	0.309910	0.392677	-13.04220
	(0.36309)	(0.41806)	(0.37539)	(3.32177)
	[-0.34965]	[0.74131]	[1.04605]	[-3.92628]
D(LOGENERGY(-4))	0.093348	0.322701	0.393829	-11.92462
	(0.33825)	(0.38946)	(0.34971)	(3.09452)
	[0.27597]	[0.82859]	[1.12616]	[-3.85346]
D(LOGEXDEBT(-1))	-0.003719	0.004307	0.003008	-0.104428
	(0.01305)	(0.01503)	(0.01350)	(0.11943)
	[-0.28486]	[0.28657]	[0.22288]	[-0.87440]
D(LOGEXDEBT(-2))	-0.008755	-0.003721	-0.001640	-0.137403
	(0.01279)	(0.01472)	(0.01322)	(0.11698)
	[-0.68472]	[-0.25272]	[-0.12404]	[-1.17454]
D(LOGEXDEBT(-3))	-0.019078	-0.007622	-0.025554	-0.246912
	(0.01293)	(0.01489)	(0.01337)	(0.11832)
	[-1.47515]	[-0.51189]	[-1.91112]	[-2.08683]
D(LOGEXDEBT(-4))	-0.021298	0.008707	-0.022110	-0.164073
	(0.01321)	(0.01521)	(0.01366)	(0.12088)
	[-1.61196]	[0.57234]	[-1.61860]	[-1.35737]
C	0.012572	0.036538	0.038977	-0.055071
	(0.01042)	(0.01199)	(0.01077)	(0.09529)
	[1.20706]	[3.04679]	[3.61965]	[-0.57795]
R-squared	0.376812	0.326913	0.479499	0.662614
Adj. R-squared	0.011496	-0.067655	0.174377	0.464835
Sum sq. resids	0.037426	0.049616	0.040005	3.132473
S.E. equation	0.035924	0.041363	0.037141	0.328658
F-statistic	1.031467	0.828534	1.571501	3.350287

Log likelihood	100.9950	94.36936	99.42904	-3.044477
Akaike AIC	-3.531703	-3.249760	-3.465065	0.895510
Schwarz SC	-2.823136	-2.541193	-2.756498	1.604077
Mean dependent	0.009644	0.024776	0.026888	0.033606
S.D. dependent	0.036133	0.040031	0.040876	0.449263

Determinant resid covariance (dof adj.)	4.76E-11
Determinant resid covariance	6.90E-12
Log likelihood	337.1942
Akaike information criterion	-11.11465
Schwarz criterion	-8.122920

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:05
Sample (adjusted): 1966 2011
Included observations: 46 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	2.505257 (0.15842) [15.8143]
LOGENERGY(-1)	-2.811651 (0.16702) [-16.8344]
LOGEXDEBT(-1)	0.051329 (0.01620) [3.16788]
C	-1.264683

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	0.503321 (0.23861) [2.10943]	0.285208 (0.28430) [1.00319]	0.607893 (0.24545) [2.47663]	-8.999239 (2.19727) [-4.09565]
D(LOGCO2(-1))	-0.746735 (0.43013) [-1.73606]	-0.126030 (0.51251) [-0.24591]	-0.285373 (0.44247) [-0.64495]	9.797367 (3.96100) [2.47346]
D(LOGCO2(-2))	-0.654357 (0.38251) [-1.71071]	-0.514775 (0.45576) [-1.12948]	-0.844742 (0.39348) [-2.14684]	8.733665 (3.52241) [2.47946]
D(LOGCO2(-3))	-0.354213 (0.38324) [-0.92426]	-0.386016 (0.45664) [-0.84535]	-0.638385 (0.39424) [-1.61930]	7.225780 (3.52916) [2.04745]
D(LOGCO2(-4))	-0.021521 (0.29350) [-0.07332]	0.036752 (0.34971) [0.10509]	-0.152153 (0.30192) [-0.50394]	8.517389 (2.70280) [3.15132]
D(LOGCO2(-5))	-0.087917 (0.28038) [-0.31356]	-0.095203 (0.33408) [-0.28497]	-0.267341 (0.28843) [-0.92690]	2.808981 (2.58197) [1.08792]
D(LOGGDP(-1))	-1.123821	-0.855430	-1.134913	20.07796

	(0.72674)	(0.86592)	(0.74759)	(6.69236)
	[-1.54640]	[-0.98789]	[-1.51810]	[3.00013]
D(LOGGDP(-2))	-1.116086	-0.869311	-1.353424	16.61339
	(0.61511)	(0.73292)	(0.63276)	(5.66443)
	[-1.81444]	[-1.18610]	[-2.13892]	[2.93293]
D(LOGGDP(-3))	-0.476221	-0.688090	-1.025544	10.34999
	(0.55960)	(0.66677)	(0.57565)	(5.15321)
	[-0.85101]	[-1.03198]	[-1.78153]	[2.00845]
D(LOGGDP(-4))	-0.330772	-0.797611	-1.052001	14.36411
	(0.42612)	(0.50772)	(0.43834)	(3.92401)
	[-0.77625]	[-1.57095]	[-2.39995]	[3.66057]
D(LOGGDP(-5))	-0.342699	-0.245239	-0.634948	5.932290
	(0.44712)	(0.53275)	(0.45995)	(4.11746)
	[-0.76645]	[-0.46032]	[-1.38046]	[1.44076]
D(LOGENERGY(-1))	1.110941	0.945184	1.134517	-21.58757
	(0.77808)	(0.92709)	(0.80040)	(7.16515)
	[1.42780]	[1.01951]	[1.41743]	[-3.01286]
D(LOGENERGY(-2))	1.246913	0.991292	1.503537	-17.41262
	(0.66960)	(0.79784)	(0.68881)	(6.16619)
	[1.86218]	[1.24247]	[2.18280]	[-2.82389]
D(LOGENERGY(-3))	0.547560	0.505557	1.018946	-14.63738
	(0.60357)	(0.71917)	(0.62089)	(5.55818)
	[0.90720]	[0.70298]	[1.64110]	[-2.63349]
D(LOGENERGY(-4))	0.408927	0.505528	0.890968	-15.15157
	(0.48663)	(0.57983)	(0.50059)	(4.48129)
	[0.84032]	[0.87186]	[1.77982]	[-3.38108]
D(LOGENERGY(-5))	0.359827	0.130869	0.461096	-5.229330
	(0.44436)	(0.52946)	(0.45711)	(4.09199)
	[0.80977]	[0.24717]	[1.00873]	[-1.27794]
D(LOGEXDEBT(-1))	0.005784	0.010678	0.014531	-0.166789
	(0.01483)	(0.01767)	(0.01525)	(0.13655)
	[0.39006]	[0.60434]	[0.95259]	[-1.22142]
D(LOGEXDEBT(-2))	-0.003118	-0.002280	0.000681	-0.158642
	(0.01378)	(0.01642)	(0.01417)	(0.12687)
	[-0.22631]	[-0.13887]	[0.04808]	[-1.25039]
D(LOGEXDEBT(-3))	-0.016871	-0.005528	-0.020226	-0.344191
	(0.01398)	(0.01666)	(0.01439)	(0.12877)
	[-1.20645]	[-0.33175]	[-1.40605]	[-2.67282]
D(LOGEXDEBT(-4))	-0.011958	0.015846	-0.012662	-0.216005
	(0.01553)	(0.01850)	(0.01597)	(0.14300)
	[-0.77009]	[0.85643]	[-0.79265]	[-1.51056]
D(LOGEXDEBT(-5))	0.024791	0.022220	0.017932	0.086677
	(0.01668)	(0.01987)	(0.01716)	(0.15359)
	[1.48634]	[1.11805]	[1.04512]	[0.56432]
C	0.014884	0.039215	0.047312	-0.086044
	(0.01301)	(0.01550)	(0.01338)	(0.11976)
	[1.14449]	[2.53070]	[3.53650]	[-0.71846]
R-squared	0.459637	0.371525	0.553207	0.642931
Adj. R-squared	-0.013181	-0.178391	0.162263	0.330496
Sum sq. resids	0.032450	0.046070	0.034339	2.751847
S.E. equation	0.036771	0.043813	0.037826	0.338615

F-statistic	0.972122	0.675603	1.415054	2.057806
Log likelihood	101.6326	93.57214	100.3313	-0.494684
Akaike AIC	-3.462287	-3.111832	-3.405708	0.978030
Schwarz SC	-2.587720	-2.237265	-2.531140	1.852597
Mean dependent	0.009607	0.025211	0.026864	0.006591
S.D. dependent	0.036531	0.040361	0.041327	0.413838

Determinant resid covariance (dof adj.)	4.96E-11
Determinant resid covariance	3.67E-12
Log likelihood	344.5114
Akaike information criterion	-10.97876
Schwarz criterion	-7.321473

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:06
Sample (adjusted): 1967 2011
Included observations: 45 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	2.529907
	(0.12868)
	[19.6609]
LOGENERGY(-1)	-2.926450
	(0.14613)
	[-20.0258]
LOGEXDEBT(-1)	0.069075
	(0.01485)
	[4.65157]
C	-0.638016

Error Correction:	D(LOGCO2)	D(LOGGDP)	D(LOGENERGY)	D(LOGEXDEBT)
CointEq1	0.803298	-0.160566	0.425739	-10.85548
	(0.28926)	(0.37163)	(0.30693)	(2.91027)
	[2.77704]	[-0.43206]	[1.38708]	[-3.73006]
D(LOGCO2(-1))	-1.331808	0.394315	-0.086666	11.86662
	(0.51248)	(0.65840)	(0.54378)	(5.15603)
	[-2.59875]	[0.59890]	[-0.15938]	[2.30150]
D(LOGCO2(-2))	-1.257157	-0.094048	-0.793313	12.75923
	(0.52913)	(0.67979)	(0.56145)	(5.32356)
	[-2.37589]	[-0.13835]	[-1.41297]	[2.39675]
D(LOGCO2(-3))	-1.073892	0.043886	-0.717132	11.76568
	(0.50072)	(0.64329)	(0.53130)	(5.03771)
	[-2.14470]	[0.06822]	[-1.34976]	[2.33552]
D(LOGCO2(-4))	-0.635033	0.196800	-0.425428	13.31294
	(0.46059)	(0.59174)	(0.48873)	(4.63401)
	[-1.37873]	[0.33258]	[-0.87048]	[2.87288]
D(LOGCO2(-5))	-0.607004	0.341320	-0.302839	9.032008

	(0.39443)	(0.50674)	(0.41852)	(3.96835)
	[-1.53893]	[0.67356]	[-0.72359]	[2.27601]
D(LOGCO2(-6))	-0.283679	0.692174	0.269149	6.780016
	(0.30598)	(0.39310)	(0.32467)	(3.07841)
	[-0.92712]	[1.76082]	[0.82900]	[2.20244]
D(LOGGDP(-1))	-2.095640	0.172779	-0.705744	23.15191
	(0.85286)	(1.09569)	(0.90495)	(8.58055)
	[-2.45720]	[0.15769]	[-0.77987]	[2.69818]
D(LOGGDP(-2))	-2.308995	-0.061978	-1.239082	21.26835
	(0.85484)	(1.09824)	(0.90705)	(8.60048)
	[-2.70109]	[-0.05643]	[-1.36605]	[2.47293]
D(LOGGDP(-3))	-1.608674	0.168725	-0.986973	16.68175
	(0.77577)	(0.99666)	(0.82316)	(7.80499)
	[-2.07364]	[0.16929]	[-1.19901]	[2.13732]
D(LOGGDP(-4))	-1.035846	-0.425845	-1.183417	19.24483
	(0.60496)	(0.77721)	(0.64191)	(6.08646)
	[-1.71226]	[-0.54791]	[-1.84358]	[3.16191]
D(LOGGDP(-5))	-1.064553	0.438051	-0.506572	11.24527
	(0.55868)	(0.71776)	(0.59281)	(5.62085)
	[-1.90548]	[0.61031]	[-0.85453]	[2.00064]
D(LOGGDP(-6))	-0.531700	0.734107	0.227026	8.234730
	(0.46257)	(0.59428)	(0.49083)	(4.65390)
	[-1.14945]	[1.23529]	[0.46254]	[1.76943]
D(LOGENERGY(-1))	2.103891	-0.255657	0.602512	-26.78728
	(0.93269)	(1.19826)	(0.98967)	(9.38379)
	[2.25571]	[-0.21336]	[0.60880]	[-2.85463]
D(LOGENERGY(-2))	2.492065	-0.001707	1.282790	-23.25304
	(0.92808)	(1.19234)	(0.98477)	(9.33737)
	[2.68518]	[-0.00143]	[1.30263]	[-2.49032]
D(LOGENERGY(-3))	1.869136	-0.329221	1.073221	-21.10920
	(0.85137)	(1.09379)	(0.90338)	(8.56560)
	[2.19544]	[-0.30099]	[1.18801]	[-2.46441]
D(LOGENERGY(-4))	1.324252	-0.029540	1.037001	-22.62106
	(0.72045)	(0.92559)	(0.76446)	(7.24841)
	[1.83809]	[-0.03191]	[1.35652]	[-3.12083]
D(LOGENERGY(-5))	1.142909	-0.806878	0.257085	-13.84483
	(0.62911)	(0.80824)	(0.66754)	(6.32946)
	[1.81670]	[-0.99831]	[0.38512]	[-2.18736]
D(LOGENERGY(-6))	0.244429	-1.030716	-0.652297	-9.147326
	(0.45445)	(0.58385)	(0.48221)	(4.57221)
	[0.53785]	[-1.76538]	[-1.35272]	[-2.00063]
D(LOGEXDEBT(-1))	-0.011681	0.014546	0.004969	0.038350
	(0.01768)	(0.02272)	(0.01876)	(0.17790)
	[-0.66059]	[0.64033]	[0.26482]	[0.21557]
D(LOGEXDEBT(-2))	0.002189	-0.012406	-0.004355	-0.150868
	(0.01371)	(0.01761)	(0.01455)	(0.13794)
	[0.15967]	[-0.70429]	[-0.29935]	[-1.09371]

D(LOGEXDEBT(-3))	-0.025773	-0.014572	-0.033262	-0.277663
	(0.01299)	(0.01669)	(0.01379)	(0.13072)
	[-1.98360]	[-0.87295]	[-2.41258]	[-2.12406]
D(LOGEXDEBT(-4))	-0.021181	0.002897	-0.029621	-0.165068
	(0.01474)	(0.01894)	(0.01564)	(0.14833)
	[-1.43667]	[0.15293]	[-1.89346]	[-1.11283]
D(LOGEXDEBT(-5))	0.022848	0.009116	0.001420	0.181233
	(0.01758)	(0.02259)	(0.01865)	(0.17687)
	[1.29965]	[0.40361]	[0.07615]	[1.02467]
D(LOGEXDEBT(-6))	0.021046	0.000807	0.000221	0.198581
	(0.01848)	(0.02375)	(0.01961)	(0.18596)
	[1.13865]	[0.03398]	[0.01127]	[1.06787]
C	0.034926	0.044071	0.063071	-0.111390
	(0.01532)	(0.01969)	(0.01626)	(0.15417)
	[2.27919]	[2.23857]	[3.87892]	[-0.72250]
R-squared	0.620649	0.467604	0.661224	0.701902
Adj. R-squared	0.121502	-0.232918	0.215466	0.309668
Sum sq. resids	0.022530	0.037186	0.025366	2.280501
S.E. equation	0.034435	0.044240	0.036538	0.346448
F-statistic	1.243420	0.667508	1.483369	1.789500
Log likelihood	107.1385	95.86371	104.4705	3.248779
Akaike AIC	-3.606156	-3.105054	-3.487578	1.011165
Schwarz SC	-2.562307	-2.061204	-2.443728	2.055015
Mean dependent	0.009041	0.023919	0.025885	0.001363
S.D. dependent	0.036739	0.039842	0.041252	0.416975

Determinant resid covariance (dof adj.)	2.71E-11
Determinant resid covariance	8.60E-13
Log likelihood	369.6731
Akaike information criterion	-11.62992
Schwarz criterion	-7.293926

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:06
Sample (adjusted): 1968 2011
Included observations: 44 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
LOGCO2(-1)	1.000000
LOGGDP(-1)	2.040494
	(0.15003)
	[13.6008]
LOGENERGY(-1)	-2.055374
	(0.18563)
	[-11.0722]
LOGEXDEBT(-1)	-0.042418
	(0.02023)
	[-2.09657]

C	-2.753414			
Error Correction:	**D(LOGCO2)**	**D(LOGGDP)**	**D(LOGENERGY)**	**D(LOGEXDEBT)**
CointEq1	0.220187	0.989331	1.536571	3.947153
	(0.61291)	(0.71264)	(0.50531)	(6.74108)
	[0.35925]	[1.38827]	[3.04085]	[0.58554]
D(LOGCO2(-1))	-1.026359	-0.223371	-0.825210	-6.069410
	(0.69967)	(0.81351)	(0.57684)	(7.69529)
	[-1.46692]	[-0.27458]	[-1.43058]	[-0.78872]
D(LOGCO2(-2))	-0.665031	-0.278705	-0.782649	-3.384585
	(0.55401)	(0.64415)	(0.45675)	(6.09322)
	[-1.20040]	[-0.43267]	[-1.71353]	[-0.55547]
D(LOGCO2(-3))	-0.237566	-0.063329	-0.296423	-3.742261
	(0.41535)	(0.48294)	(0.34244)	(4.56827)
	[-0.57196]	[-0.13113]	[-0.86563]	[-0.81919]
D(LOGCO2(-4))	0.319720	0.328683	0.497108	0.282220
	(0.35580)	(0.41369)	(0.29334)	(3.91326)
	[0.89859]	[0.79451]	[1.69466]	[0.07212]
D(LOGCO2(-5))	0.462866	0.413019	0.714664	-2.029099
	(0.41883)	(0.48698)	(0.34530)	(4.60648)
	[1.10514]	[0.84813]	[2.06968]	[-0.44049]
D(LOGCO2(-6))	0.695654	0.821207	1.277793	-1.177224
	(0.40278)	(0.46832)	(0.33207)	(4.42995)
	[1.72714]	[1.75354]	[3.84798]	[-0.26574]
D(LOGCO2(-7))	0.897614	0.026186	0.771434	-3.521407
	(0.40312)	(0.46872)	(0.33235)	(4.43374)
	[2.22665]	[0.05587]	[2.32113]	[-0.79423]
D(LOGGDP(-1))	-1.292618	-1.538266	-2.589068	-11.61552
	(1.31221)	(1.52572)	(1.08184)	(14.4323)
	[-0.98507]	[-1.00822]	[-2.39321]	[-0.80483]
D(LOGGDP(-2))	-1.305150	-1.061128	-2.078192	-10.27723
	(1.02809)	(1.19537)	(0.84760)	(11.3075)
	[-1.26949]	[-0.88769]	[-2.45184]	[-0.90889]
D(LOGGDP(-3))	-0.520885	-0.342033	-1.079358	-13.91484
	(0.80412)	(0.93496)	(0.66295)	(8.84406)
	[-0.64777]	[-0.36583]	[-1.62812]	[-1.57335]
D(LOGGDP(-4))	0.256700	-0.714513	-0.630279	-3.054711
	(0.49669)	(0.57750)	(0.40949)	(5.46280)
	[0.51682]	[-1.23724]	[-1.53918]	[-0.55918]
D(LOGGDP(-5))	0.058220	0.101221	-0.039375	-7.565405
	(0.43882)	(0.51022)	(0.36179)	(4.82638)
	[0.13267]	[0.19839]	[-0.10883]	[-1.56751]
D(LOGGDP(-6))	0.520441	0.663220	0.945771	-6.324314
	(0.39107)	(0.45470)	(0.32241)	(4.30117)
	[1.33082]	[1.45858]	[2.93340]	[-1.47037]

D(LOGGDP(-7))	0.698715	0.012375	0.487965	-10.23194
	(0.42817)	(0.49784)	(0.35300)	(4.70921)
	[1.63187]	[0.02486]	[1.38233]	[-2.17275]
D(LOGENERGY(-1))	0.751170	1.406707	2.006477	10.74387
	(1.21019)	(1.40710)	(0.99773)	(13.3102)
	[0.62071]	[0.99972]	[2.01104]	[0.80719]
D(LOGENERGY(-2))	1.167947	1.022426	1.897310	9.520326
	(1.00577)	(1.16942)	(0.82920)	(11.0619)
	[1.16125]	[0.87430]	[2.28812]	[0.86064]
D(LOGENERGY(-3))	0.545397	0.090197	0.859344	10.42951
	(0.80745)	(0.93883)	(0.66570)	(8.88073)
	[0.67546]	[0.09607]	[1.29089]	[1.17440]
D(LOGENERGY(-4))	-0.288367	0.101350	0.016957	2.708633
	(0.49326)	(0.57351)	(0.40666)	(5.42507)
	[-0.58462]	[0.17672]	[0.04170]	[0.49928]
D(LOGENERGY(-5))	-0.435133	-0.582302	-0.737830	7.992687
	(0.43927)	(0.51075)	(0.36216)	(4.83135)
	[-0.99057]	[-1.14009]	[-2.03732]	[1.65434]
D(LOGENERGY(-6))	-1.251316	-0.904460	-1.686500	5.820711
	(0.48456)	(0.56341)	(0.39949)	(5.32945)
	[-2.58236]	[-1.60534]	[-4.22158]	[1.09218]
D(LOGENERGY(-7))	-0.998658	0.113099	-0.545375	7.394359
	(0.52525)	(0.61072)	(0.43304)	(5.77698)
	[-1.90129]	[0.18519]	[-1.25941]	[1.27997]
D(LOGEXDEBT(-1))	0.006373	0.055654	0.072788	-0.229593
	(0.02959)	(0.03440)	(0.02440)	(0.32545)
	[0.21537]	[1.61762]	[2.98367]	[-0.70547]
D(LOGEXDEBT(-2))	0.022219	0.033366	0.072428	-0.095681
	(0.03317)	(0.03856)	(0.02734)	(0.36477)
	[0.66994]	[0.86525]	[2.64883]	[-0.26230]
D(LOGEXDEBT(-3))	-0.029962	0.040352	0.038917	0.024707
	(0.03593)	(0.04178)	(0.02962)	(0.39519)
	[-0.83387]	[0.96589]	[1.31375]	[0.06252]
D(LOGEXDEBT(-4))	-0.026128	0.059253	0.043627	-0.025507
	(0.03538)	(0.04114)	(0.02917)	(0.38916)
	[-0.73842]	[1.44026]	[1.49553]	[-0.06554]
D(LOGEXDEBT(-5))	0.037736	0.049661	0.072931	0.316430
	(0.03505)	(0.04075)	(0.02890)	(0.38549)
	[1.07664]	[1.21859]	[2.52390]	[0.82085]
D(LOGEXDEBT(-6))	0.051430	0.017423	0.057096	0.370432
	(0.03677)	(0.04275)	(0.03031)	(0.40438)
	[1.39883]	[0.40757]	[1.88361]	[0.91606]
D(LOGEXDEBT(-7))	0.030545	-0.014049	0.020628	0.155606
	(0.02880)	(0.03349)	(0.02375)	(0.31679)
	[1.06047]	[-0.41950]	[0.86869]	[0.49120]
C	0.042143	0.039670	0.062727	0.282151
	(0.02352)	(0.02735)	(0.01939)	(0.25869)

	[1.79176]	[1.45060]	[3.23480]	[1.09069]
R-squared	0.649179	0.596938	0.810515	0.669745
Adj. R-squared	-0.077520	-0.237977	0.418009	-0.014355
Sum sq. resids	0.020824	0.028152	0.014154	2.519046
S.E. equation	0.038568	0.044843	0.031797	0.424184
F-statistic	0.893326	0.714969	2.064978	0.979016
Log likelihood	105.9948	99.36160	114.4888	0.493511
Akaike AIC	-3.454309	-3.152800	-3.840401	1.341204
Schwarz SC	-2.237816	-1.936307	-2.623908	2.557697
Mean dependent	0.008916	0.023928	0.026183	0.004742
S.D. dependent	0.037154	0.040303	0.041680	0.421172
Determinant resid covariance (dof adj.)		5.02E-11		
Determinant resid covariance		5.15E-13		
Log likelihood		372.7617		
Akaike information criterion		-11.30735		
Schwarz criterion		-6.279180		

Vector Error Correction Estimates
Date: 02/07/18 Time: 14:06
Sample (adjusted): 1969 2011
Included observations: 43 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1			
LOGCO2(-1)	1.000000			
LOGGDP(-1)	1.080450			
	(0.12695)			
	[8.51059]			
LOGENERGY(-1)	-0.642172			
	(0.16454)			
	[-3.90281]			
LOGEXDEBT(-1)	-0.175459			
	(0.01811)			
	[-9.68669]			
C	-4.647854			
Error Correction:	**D(LOGCO2)**	**D(LOGGDP)**	**D(LOGENERGY)**	**D(LOGEXDEBT)**
CointEq1	-0.468245	0.900063	0.650220	2.219941
	(0.28666)	(0.34692)	(0.28572)	(2.70756)
	[-1.63344]	[2.59444]	[2.27572]	[0.81991]
D(LOGCO2(-1))	-0.749206	0.093733	0.037471	-3.101795
	(0.46085)	(0.55773)	(0.45934)	(4.35280)
	[-1.62570]	[0.16806]	[0.08158]	[-0.71260]
D(LOGCO2(-2))	-0.573911	0.139851	-0.049734	2.665232
	(0.53980)	(0.65327)	(0.53803)	(5.09849)
	[-1.06319]	[0.21408]	[-0.09244]	[0.52275]
D(LOGCO2(-3))	-0.248042	0.617893	0.565424	3.483777
	(0.52029)	(0.62966)	(0.51858)	(4.91421)
	[-0.47674]	[0.98131]	[1.09033]	[0.70892]
D(LOGCO2(-4))	-0.009030	1.098967	1.212597	2.659303
	(0.56037)	(0.67816)	(0.55853)	(5.29273)

	[-0.01611]	[1.62052]	[2.17106]	[0.50244]
D(LOGCO2(-5))	-0.415582	1.766099	1.535950	0.600200
	(0.68792)	(0.83252)	(0.68566)	(6.49746)
	[-0.60412]	[2.12139]	[2.24011]	[0.09237]
D(LOGCO2(-6))	-0.267496	2.455580	2.260859	-3.523997
	(0.71561)	(0.86604)	(0.71326)	(6.75903)
	[-0.37380]	[2.83543]	[3.16974]	[-0.52138]
D(LOGCO2(-7))	-0.086006	2.212687	2.119249	-3.963427
	(0.83091)	(1.00557)	(0.82818)	(7.84800)
	[-0.10351]	[2.20044]	[2.55893]	[-0.50502]
D(LOGCO2(-8))	-0.265232	1.713311	1.257902	-5.261904
	(0.63325)	(0.76636)	(0.63117)	(5.98108)
	[-0.41885]	[2.23566]	[1.99298]	[-0.87976]
D(LOGGDP(-1))	-0.561655	-0.333095	-0.217500	-11.27481
	(0.63849)	(0.77270)	(0.63639)	(6.03057)
	[-0.87967]	[-0.43108]	[-0.34177]	[-1.86961]
D(LOGGDP(-2))	-0.589800	-0.712283	-0.637942	-3.568125
	(0.76498)	(0.92578)	(0.76247)	(7.22530)
	[-0.77100]	[-0.76939]	[-0.83668]	[-0.49384]
D(LOGGDP(-3))	-0.145629	0.600517	0.596783	-4.487726
	(0.70969)	(0.85887)	(0.70736)	(6.70308)
	[-0.20520]	[0.69920]	[0.84368]	[-0.66950]
D(LOGGDP(-4))	0.503416	0.311496	0.825925	0.752051
	(0.71025)	(0.85955)	(0.70792)	(6.70843)
	[0.70878]	[0.36239]	[1.16669]	[0.11211]
D(LOGGDP(-5))	-0.332968	1.604734	1.392830	-6.675831
	(0.67600)	(0.81810)	(0.67378)	(6.38491)
	[-0.49256]	[1.96154]	[2.06718]	[-1.04556]
D(LOGGDP(-6))	-0.086772	1.998989	2.033669	-8.180353
	(0.64890)	(0.78530)	(0.64677)	(6.12894)
	[-0.13372]	[2.54551]	[3.14435]	[-1.33471]
D(LOGGDP(-7))	-0.058166	2.175016	2.004949	-9.588034
	(0.79869)	(0.96658)	(0.79607)	(7.54374)
	[-0.07283]	[2.25022]	[2.51856]	[-1.27099]
D(LOGGDP(-8))	0.036154	1.401257	1.052530	-8.964022
	(0.58736)	(0.71083)	(0.58543)	(5.54768)
	[0.06155]	[1.97131]	[1.79787]	[-1.61581]
D(LOGENERGY(-1))	0.463675	-0.735108	-0.945362	8.228944
	(0.61519)	(0.74451)	(0.61317)	(5.81057)
	[0.75371]	[-0.98737]	[-1.54175]	[1.41620]
D(LOGENERGY(-2))	0.765596	-0.494405	-0.357309	3.298348
	(0.68229)	(0.82571)	(0.68005)	(6.44435)
	[1.12209]	[-0.59876]	[-0.52541]	[0.51182]
D(LOGENERGY(-3))	0.365894	-1.266441	-1.071746	1.062952
	(0.76041)	(0.92026)	(0.75792)	(7.18220)
	[0.48118]	[-1.37618]	[-1.41407]	[0.14800]
D(LOGENERGY(-4))	-0.243986	-1.244083	-1.594728	-3.949771

	(0.83060)	(1.00520)	(0.82787)	(7.84512)
	[-0.29375]	[-1.23765]	[-1.92629]	[-0.50347]
D(LOGENERGY(-5))	0.426721	-2.785916	-2.523504	4.741623
	(0.90966)	(1.10087)	(0.90667)	(8.59184)
	[0.46910]	[-2.53064]	[-2.78326]	[0.55188]
D(LOGENERGY(-6))	-0.159253	-3.413934	-3.483040	7.838196
	(0.95289)	(1.15319)	(0.94976)	(9.00017)
	[-0.16713]	[-2.96042]	[-3.66727]	[0.87089]
D(LOGENERGY(-7))	-0.093032	-3.039571	-2.801591	9.801225
	(1.15220)	(1.39440)	(1.14842)	(10.8827)
	[-0.08074]	[-2.17984]	[-2.43952]	[0.90063]
D(LOGENERGY(-8))	-0.174689	-1.654267	-1.392388	8.685662
	(0.67352)	(0.81510)	(0.67131)	(6.36149)
	[-0.25937]	[-2.02953]	[-2.07414]	[1.36535]
D(LOGEXDEBT(-1))	-0.049026	0.146072	0.111831	-0.458289
	(0.04451)	(0.05387)	(0.04436)	(0.42041)
	[-1.10144]	[2.71171]	[2.52074]	[-1.09011]
D(LOGEXDEBT(-2))	-0.019992	0.082088	0.079375	-0.225556
	(0.03689)	(0.04464)	(0.03676)	(0.34839)
	[-0.54199]	[1.83890]	[2.15901]	[-0.64742]
D(LOGEXDEBT(-3))	-0.062101	0.080777	0.039397	-0.373841
	(0.03386)	(0.04098)	(0.03375)	(0.31980)
	[-1.83410]	[1.97133]	[1.16739]	[-1.16898]
D(LOGEXDEBT(-4))	-0.079922	0.057619	-0.001594	0.091966
	(0.03029)	(0.03666)	(0.03019)	(0.28610)
	[-2.63846]	[1.57178]	[-0.05278]	[0.32144]
D(LOGEXDEBT(-5))	-0.011658	0.052621	0.035737	0.444134
	(0.03264)	(0.03950)	(0.03253)	(0.30830)
	[-0.35716]	[1.33209]	[1.09845]	[1.44059]
D(LOGEXDEBT(-6))	-0.000899	0.057086	0.053686	0.344833
	(0.03654)	(0.04422)	(0.03642)	(0.34508)
	[-0.02461]	[1.29109]	[1.47427]	[0.99928]
D(LOGEXDEBT(-7))	-0.027773	0.041326	0.029515	-0.002010
	(0.03583)	(0.04336)	(0.03571)	(0.33843)
	[-0.77510]	[0.95303]	[0.82643]	[-0.00594]
D(LOGEXDEBT(-8))	-0.049925	0.042673	0.008635	-0.260089
	(0.02661)	(0.03220)	(0.02652)	(0.25131)
	[-1.87634]	[1.32523]	[0.32562]	[-1.03493]
C	0.039981	0.091935	0.103652	0.324186
	(0.03660)	(0.04429)	(0.03648)	(0.34566)
	[1.09247]	[2.07577]	[2.84160]	[0.93787]

R-squared	0.804024	0.754919	0.845369	0.863629
Adj. R-squared	0.085447	-0.143710	0.278387	0.363604
Sum sq. resids	0.011627	0.017029	0.011551	1.037239
S.E. equation	0.035943	0.043498	0.035825	0.339483
F-statistic	1.118911	0.840079	1.490997	1.727170
Log likelihood	115.6217	107.4178	115.7632	19.06535
Akaike AIC	-3.796359	-3.414783	-3.802937	0.694635
Schwarz SC	-2.403782	-2.022206	-2.410360	2.087212
Mean dependent	0.008789	0.023490	0.026157	0.001367
S.D. dependent	0.037584	0.040673	0.042173	0.425554

Determinant resid covariance (dof adj.)	3.72E-12
Determinant resid covariance	7.14E-15
Log likelihood	456.2671
Akaike information criterion	-14.71010
Schwarz criterion	-8.975956

BIOGRAPHY

I was born in Famagusta, December 6, 1985. My father retired in the year 2013, he was the General Director of T.R.N.C. Land Registry and Cadastre Office. I got married in the year 2007 and I have two children aged 10 and 4. I completed elementary school inPolatpasa Primary School and I thengraduated Eastern Mediterranean College. I completed undergraduate studies at Eastern Mediterranean University, Faculty of Business Administration with high honors degree. After graduating from the university between the dates of September 2006-2011 i served as director of our own family run companies. I received my degree in Master of Science in Banking and Finance at Eastern Mediterranean University in 2011. In the year 2012, I started studying and working for my Phd Candidate. During this time I started working part time as a teacher at Near East University in the Faculty of Economics and Administrative Sciences. Soon after I started working full time.

PLAGIARISM REPORT

ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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1	Salih Katircioglu, Aysem Celebi. "Testing the role of external debt in environmental degradation: empirical evidence from Turkey", Environmental Science and Pollution Research, 2018 Publication	2%
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ETHICS COMMITEE APPROVAL

Dear Ayşem Çelebi

Your project **“Testıng The Role Of External Debt In Augmented Envıronmental Kuznets Curve: Evıdence From Turkey"** has been evaluated. Since only secondary data will be used the project it does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Assoc. Prof. Dr. Direnç Kanol

Rapporteur of the Scientific Research Ethics Committee

Direnç Kanol