NEAR EAST UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
BUSINESS ADMINISTRATION PROGRAM

EMPIRICAL RELATIONSHIP BETWEEN ECONOMIC GROWTH, ENERGY CONSUMPTION, EXTERNAL DEBT, INTERNAL TRADE AND CO2 EMISSIONS AND EFFECT OF THE KYOTO PROTOCOL, THE ROLE OF THE TRANSPORT RELATED EKC HYPOTHESIS: EVIDENCE FROM COUNTRIES

CİHAN ÖZDEN

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I hereby declare that this dissertation entitled ‘Empirical Relationship Between Economic Growth, Energy Consumption, External Debt, Internal Trade and CO2 Emissions, and Effect of the Kyoto Protocol, The Role Of The Transport Related EKC Hypothesis: Evidence From Countries’ has been prepared by myself under the guidance and supervision of ‘Assoc. Prof. Dr. Salih Kalaycı’ partial fulfilment of the Near East University, Graduate School of Social Sciences regulations and does not to the best of my knowledge breach and 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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ABSTRACT

EMPIRICAL RELATIONSHIP BETWEEN ECONOMIC GROWTH, ENERGY CONSUMPTION, EXTERNAL DEBT, INTERNAL TRADE AND CO2 EMISSIONS AND EFFECT OF THE KYOTO PROTOCOL, THE ROLE OF THE TRANSPORT RELATED EKC HYPOTHESIS: EVIDENCE FROM COUNTRIES

In this study, the relationship between income and environmental degradation is discussed. It presents to existing literature regarding the linkage between maritime, industrial development and trade liberalization in the context of CO2 by using econometrical model in China. The environmental Kuznets curve is tested for the time between 1980 and 2013. According to analysis result from the environmental Kuznets curve hypothesis FMOLS, DOLS and CCR models show that shipping, trade liberalization, and industrial development are determinants of long-term carbon emissions, just like the results of the ARDL model.

Literature review on whether economic growth in Australia is causing environmental degradation has been analyzed for gross domestic product per capita for CO2 emissions and energy consumption variables. The first study in the literature review that uses NARDL model to examine the EKC hypothesis for Australia. The environmental Kuznets curve has analyzed for the period between 1960 and 2014. EKC hypothesis is not verified by the GH tests, ARDL, NARDL bounds tests and GH tests in Australia.

International trade, financial development and GDP data were analyzed for South Korea. The environmental Kuznets curve analyzed between 1977 and 2018. EKC hypothesis is verified by the FMOLS, DOLS and CCR models and there is a long-term stable relationship between variables. In addition, financial development affects economic growth consistent with the Johansen cointegration test and ARDL model.

The effect of external debt on carbon dioxide emissions was examined by taking EKC hypothesis as a basis for China. The environmental Kuznets curve was tested for the period between 1978 and 2014. EKC hypothesis curve is confirmed by ARDL and nonlinear ARDL models for the positive and significant effect of external debt on emissions. The results show that external debt and energy consumption significantly and positively affect emissions.

The relationship between coal consumption (CS) and growth (GH) were analyzed for Australia and China based on EKC hypothesis. EKC is confirmed the coal consumption for Australia and China for the periods between 1980 and 2016 and 1980-2014 respectively.

Keywords: Environmental Kuznets curve, Coal consumption, Environmental Kuznets curve, GDP

ÖZ

EKONOMİK BÜYÜME, ENERJİ TÜKETİMİ, DIŞ BORÇ, ULUSLARARASI TİCARET ve CO2 EMİSYONLARI ARASINDAKİ AMPİRİK İLİŞKİ ve KYOTO PROTOKOLÜNÜN CO2 EMİSYONLARI ÜZERİNDEKİ ETKİSİ, ULAŞIMA BAĞLI EKC "HİPOTEZİNİN ROLÜ: ÜLKELERDEN KANITLAR

Bu çalışmada, kişi başına düşen milli gelir ile çevre kirliliği arasındaki ilişki tartışılmıştır ve Çin' de denizcilik, ticaret serbestleşmesi ve endüstriyel gelişme arasındaki ilişkiye dair CO2 bağlamında ekonometrik model kullanarak mevcut literatür taraması incelenmiştir. Çevresel Kuznets eğrisi 1980 ve 2013 arasını kapsayan zaman dilimi için test edilmiştir. Çevresel Kuznets eğrisi hipotezi FMOLS, DOLS ve CCR modellerinden elde edilen bulgular, deniz taşımacılığının, ticaretin serbestleştirilmesinin ve endüstriyel kalkınmanın, tıpkı ARDL modelinin sonuçlarında olduğu gibi, uzun vadeli karbon emisyonlarının belirleyicileri olduğunu göstermektedir.

Avustralya'da ekonomik büyümenin çevresel bozulmaya yol açıp açmadığı ile ilgili literatür taraması; kişi başına düşen gayri safi yurtiçi hasılat, CO2 emisyonları, enerji tüketimi değişkenleri için incelenmiş ve Avusturalya için EKC hipotezi incelenmiştir. NARDL modelini kullanan literetürdeki ilk çalışma yapılmıştır. Çevresel Kuznets eğrisi test edilmiştir. 1960 ve 2014 arasını kapsayan zaman dilimi için çevresel Kuznets eğrisi hipotezi, BH testleri, ARDL, NARDL sınır testleri ve GH testleri tarafından onaylanmamıştır.

Uluslararası ticaret, finansal gelişme ve GSYH verileri, Güney Kore için incelenmiştir. Çevresel Kuznets eğrisi 1977 ve 2018 arasını kapsayan zaman dilimi için test edilmiştir. Çevresel Kuznets eğrisi hipotezi, FMOLS, DOLS ve CCR modellerinin sonuçlarına göre değişkenler arasında uzun dönemli

istikrarlı bir ilişki vardır ve finansal gelişme Johansen eşbütünleşme testi ve ARDL modeli ile tutarlı olan ekonomik büyümeyi etkilemektedir.

EKC hipotezini temel alarak Çin'in dış borcunun emisyonlar üzerindeki etkisi incelemiştir. 1978 ve 2014 arasını kapsayan zaman dilimi için çevresel Kuznets eğrisi hipotezi dış borcun emisyonlar üzerindeki olumlu ve anlamlı etkisi ARDL ve doğrusal olmayan ARDL modelleri ile teyit edilmektedir. Dış borç ve enerji tüketiminin emisyonları önemli ölçüde ve olumlu yönde etkilediğini göstermektedir.

Anahtar Kelimeler: Çevresel Kuznets eğrisi, Kömür tüketimi çevresel Kuznets eğrisi, Kyoto protokolü, GSYH

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVATIONS

ADF : Augmented Dickey–Fuller Test

AIC : Akaike Information Criteria

ARDL : Autoregressive Distributed Lag

ASEAN: Association of Southeast Asian Nations

B : Breusch Godfrey Serial Correlation Test

BH : Combined cointegration tests

BG : Breusch Pagan Godfrey Heteroskedasticity

BRIC : Emerging economies: Brazil, Russia, India, China, and South Africa.

C : CUSUM test

CH4 : Methane

CUPFM: Continuously updated fully modified

CUPBC: Continuously updated bias corrected

CCR : Canonical Cointegrating Regression

CNS : Coal consumption

CO : Breusch-Godfrey Serial Correlation LM Test

CO2 : Carbon dioxide emissions

CP : Oil Prices

CS : Coal Consumption

CCS : Coal Consumption

CT : Crude Oil Prices

DOLS : Dynamic Ordinary Least Square

DPTM : Dynamic Panel Threshold Model

DT : Carbon dioxide emission remaining for lagging one period

DU : Dummy Variable

DUSR : Dynamic Seemingly Unrelated Regression

ECM : Error Correction Model

EINV : Energy investment

EKC : Environmental Kuznets Curve

EM : Energy consumption

EMS : Positively affect emissions

ENE : Energy consumption

ENEC : Energy consumption

ERG : Environmental regulations

ES : Positive Impact of Emissions

ESU : Environmental sustainability curve relation

EXD : Energy

FDEV : Financial Development

FDI : Foreign direct investment

FID : Financial Development

FIN : Foreign direct investment
FMOLS: Fully Modified Ordinary Least Squares
FND : Financial Development
FSD : Financial sector development
GB : Globalization
GDP : Gross domestic per capita
GH : Gregory and Hansen
GMM : Generalized method of moments
GP : Gross Product
GW : Growth
HC : Household electricity consumption
HCS : Hydroelectricity consumption
IE1 : Standard Efficiency Motors
IE2 : High Efficiency Motors
IE3 : Premium Efficiency Motors
IE2 : Super Premium Efficiency Motors
MENA : Middle East and North Africa
MWALD: Modified Wald test
NARDL: Non-linear Autoregressive Distributed Lag
NO : Normality Test
NOx : Nitrogen Oxide
OCN : Oil consumption
OECD : Economic Co-operation and Development
OLS : Ordinary Least Squares
PM10 : Particulate Matter (PM10) Trends
PM2.5 : Particulate matter 2.5
PP : Phillips-Perron
PSS : Pesaran, Shin and Smith
PSTR : Panel smooth transition regression
R : Ramsey Reset test
R&D : Research and Development
RE : Ramsey Reset Test
RT : Unit root test
RW : Renewable energy consumption
SC : Schwarz information criterion
SO2 : Sulfur dioxide
SQ : Square of gross domestic per capita
SRR : Short run results
TE : Trade
TR : Trace

TR. STAT: Trace Statistics

TS **:** Trade Openness

TT **:** Trade Openness

TY **:** Non-causality test

UBN **:** Urbanization

UBZ **:** Social urbanization

UR **:** Unit Root Test

VAR **:** Vector Autoregressive Model

VECM **:** Vector Error Correction Model

WMO **:** World Meteorological Organization

ZA **:** Zivot and Andrews

ZU **:** Zivot and Andrews unit root test

INTRODUCTION

The Kyoto Protocol is based on reduce the current emissions of countries to a certain level and which is an agreement signed by developed and developing countries. EKC is studied in the literature mainly with CO2 being dependent variable and GDP is being the independent variable. The Kyoto Protocol is an agreement also discussed and effect of the Kyoto Protocol in the EKC literature. Effectiveness of Kyoto Protocol is discussed in the literature by signatory countries whether Kyoto Protocol had an impact on reducing CO2 levels.

In recent years, environmental destruction in the context of global warming and climate change is one of the most frequently discussed global issues. The main reason for global warming is the rapid increase in the rate of greenhouse gases in the atmosphere. Carbon dioxide (CO2) is the main gas that causes greenhouse effect through, which is released into the atmosphere using fossil fuels such as gasoline, coal and natural gas. Overconsumption and mass production were started with the industrial revolution thus increased the need for energy and this requirement was met mostly from fossil fuels. The demand for fossil fuel energy has grown exponentially and caused environmental pollution for many years. Lots of countries focused on the economic growth target without thinking effect of the CO2 emission and global warming. EKC studies and agreements to reduce greenhouse gases are important due to sustainability is one of the main issues in the whole world. Especially the emergence of environmental pollution and industrialization have started to be discussed in the academic literature and one of the most important resources of this trend is the “Limits to Growth” which is the report prepared by the Roma Club in 1972. The topic underlined in this report, “If the current growth of industrialization in terms of food production, consumption of natural resources and CO2 emissions continues, economic growth will damage the environment in our world in the next 100 years” (Meadows, Dennis, Randers, Jørgen, Behrens and William, 1979).

Opinion on the principle that leads economic growth has been a main effort of academicians in developing economies and both is developed. There are many macroeconomic components as trade openness, financial development, external debt, FDI approached by researchers to reveal the course of economic growth. Within this scope, recently in the academic literature trade liberalization and financial development have been considered as a theoretical aspect by economists in terms of economic growth. For example, definition of the relationship among economic growth (GDP), financial development and FDI became a main factor in making the long-term fiscal and monetary policy plans. The economists researched this subject after the 1997 Asian economic crisis. Therefore, many economies have focused more on trade liberalization and financial reforms to boost economic development.

The international trade and finance sector, which includes derivative markets, are two important components in terms of macroeconomic factors. In this regard, the financial sector offers a wide range of services to companies, public institutions and individuals that trigger economic growth.

In this study, EKC hypothesis is examined for Australia, China and South Korea by using new methodologies to cover the current gaps in the EKC literature. In addition, Kyoto Protocol is also investigated by using new methodologies to cover the gaps in the EKC literature.

In Chapter 1, literature review for Australia, China, South Korea studies are examined for the EKC. Studies for the effect of Kyoto Protocol on CO2 emissions are examined besides mentioned country studies.

In Chapter 2, data used in the study and the methodology of the study are explained in detail. The period of the study is determined according to the availability of the data for the studied counties.

In Chapter 3, the period of the study is determined according to the availability of the data for China. The major goal of this chapter is to focus on the existing

literature regarding the linkage between maritime, trade liberalization and industrial development in the context of CO2 by using econometrical model. Phillips-Perron (PP), Zivot-Andrews unit root tests, FMOLS, DOLS, CCR, ARDL and GMM methods are used in this chapter.

In Chapter 4, EKC is examined for Australia.In this chapter, it is analyzed the EKC hypothesis and the relationships between gross domestic product per capita, CO2 emissions, energy consumption and square of GDP by the ARDL model and NARDL model.

In Chapter 5, EKC is examined for South Korea. The impact of international trade or financial development on economic growth is analyzed. ADF unit root test, Johansen co-integration test and ARDL model are being used in this chapter.

In Chapter 6, EKC is examined for China. The relationships between CO2, gross domestic product per capita (GDP), square of GDP, energy consumption and EXD is examined. ARD and NARDL models are being used in this chapter.

In Chapter 7, EKC is examined for Australia and China. Coal consumption for EKC is analyzed for two countries. ARDL model is being used in this chapter.

Final part of the study is conclusion. In conclusion part, overall findings of the study are discussed.

Fundamental Research Questions

‘Is it great importance to examine energy economy, business management and engineering for the survival of our world?’

Sub-questions:

- What is the main cause of global warming?

- Has there been a change in the emission of CO2 in the world after the signing of the Kyoto Protocol?
- What should we do to reduce the use of fossil fuels?
- What is the role of the state in the use of fossil fuels?
- How can we support authorities and researchers?
- What are the independent variables that cause the most carbon dioxide emissions?
- Is it possible to combine the EKC hypothesis, renewable energy and engineering in the thesis?

Aim of the Study

In this study, it is tried to reveal the effects of independent variables on CO2 (dependent variable). The Kuznets curve hypothesis was tested in different chapters and econometric models were applied for China, Australia, South Korea.

The main purpose of these analyzes is to address the problem in terms of environmental economics by making some suggestions, to offer alternative solutions to the sectors in terms of business management, and to provide resources for authorities and future studies.

Importance of the Study

One of the most frequently discussed global issues in recent years is environmental destruction in the context of global warming and climate change. The main reason for global warming is the rapid increase in the rate of greenhouse gases in the atmosphere. Gasoline is the main gas that causes the greenhouse effect through carbon dioxide (CO2) gas released into the atmosphere by the use of fossil fuels such as coal and natural gas.

Mass production and over consumption, which started with the industrial revolution increased the need for energy and this need was largely met from fossil fuels. For many years, the demand for fossil fuel energy has grown exponentially, causing environmental pollution. Thus, countries focusing on

the goal of economic growth also caused CO2 emissions and global warming. The carbon dioxide footprint is the most important problem that may bring the end of the world right now and is the subject of my thesis.

In this thesis, the effects of variables such as transportation, maritime transport, trade liberalization, industrial development, fossil fuels, international trade, and foreign debt on the emission of CO2 were examined with the EKC hypothesis.

Reason for Choosing a Single Country Studies in the Thesis

The number of single country simulations showing a wide range of dates in the literature is very limited.

To interpret the wide range of dates before and after the Kyoto Protocol with meaningful values, single country studies were focused on.

Industry 4.0 studies will be soon replaced by industry 5.0 studies. Associated with renewable energy, artificial intelligence and simulations, this thesis can be used as a reference as it provides detailed analysis in macro and micro calculations.

Limitations of the Study

The time periods analyzed for China in Chapter 3 from 1960 to 2019 are the limits of the study. The number of articles in the academic literature in which transportation is associated with the EKC hypothesis is slightly less than other studies based on the EKC hypothesis.

The time periods analyzed for Australia in Chapter 4 from 1960 to 2014 are the data range of the study.

The time periods analyzed for South Korea in Chapter 5 from 1977 to 2018 are the limits of the study.

The time periods analyzed for China in Chapter 6 from 1978 to 2014 are the data range of the study.

The time periods analyzed in Chapter 7 from 1980 to 2014 for China and 1980 to 2016 for Australia are the limits of the study. Other boundaries of the study are China and Australia, the countries where the study was conducted.

CHAPTER 1
LITERATURE REVIEW

In today's globalizing world, forms of production are gradually divided into nations. In this regard, local consumption in any country is progressively realized throughout the supply chain world. Carbon emissions have increased day by day in some countries because the transportation sector has developed with the industrialization process. Consequently, in the circumstances, it is imposed some restrictions in terms of trade and supply chain. In academic literature, trade liberalization, transportation, industrial development, and CO2 are widely discussed related to the environmental consequences of trade.

1.1 Single country studies in the literature of Carbon Kuznets Curve

Benavides et al. (2017) used ARDL bounds test for the relation between methane emissions, economic growth, electricity production from renewable sources excluding hydro and trade openness for the period 1970 and 2012 for Australia. Benavides et al. (2017) confirmed EKC for Austria. They examined that long-term causality from GDP, GDP squared, electricity production from renewable sources and trade openness to methane emissions for Austria.

Hassan and Nosheen (2018) examined the effects of trade openness, energy usage and economic growth on carbon dioxide leakage in terms of the EKC hypothesis by applying annual data from 1980 to 2016 for Pakistan. To reach the results, they implemented econometric models including ADF unit root test, Johnsen co-integration test, which are reveal the long-term relationship between vector error correction and variables. Regards to their findings, economic growth is positively linked to carbon dioxide leakage. Population

growth and trade liberalization have a very negative impact on CO2 leakage in the short term, while in the long-term, the course is opposite Also, Granger causality test shows that there is bidirectional causality from energy consumption and economic growth to CO2 leakage. One-way causalities ranging from trade liberalization to CO2 emission as well.

Jebli and Belloumi (2017) examined that maritime transport, waste usage and combustible renewable resources significantly affect carbon dioxide emissions, while any increase in maritime transport reduces flammable renewable energy consumption and waste use. In addition, sea transportation is significantly associated with carbon dioxide leakage, demonstrating that the Tunisian transportation is so polluted due to the excessive consumption of non-renewable energy. As a result, maritime transport is the main contributor to air pollution and lead to the increased carbon dioxide leakage in Tunisia.

Nakayama, Zhu, Hirokawa, Irino and Yoshikawa-Inoue (2015) claim that Rishiri Island is the northernmost region of the Japan where weather is measured, although it has not been included yet by the WMO. Past studies show that inland sea transport causes CO2 emissions, when carried out at 90–150°E, 40–60°N.

Zhu, Yuen, Ge and Li's (2018) examined that sea transport emissions in terms of trading system can motivate main actors to benefit from new technologies, provide more carbon efficient ships in terms of green energy. Also, the effectiveness of the shipping emissions trading system is more evident when bunker fuel prices are excessive. In this context, the findings reveal that bunker fuel prices have a greater impact on CO2 reduction than applying stricter CO2 allowance allocation as well. Their work includes the formulation of sea transport emissions trading system policies and ensures recommendations to reduce the sea transport emissions to fulfill the shipping industry's impetus by providing its environmental performance.

Katircioğlu (2014a) examined that long-term energy use has a positive effect on incoming tourists, and economic growth has a negative effect on carbon dioxide leakage. It is elucidated that Singapore has an inverted U-shaped environmental Kuznets curve, and carbon dioxide leakage in Singapore follows a declining trend, regardless of energy use level. In addition, the relationship between environmental sustainability, energy efficiency and tourism industry development can be clarified with the tourism-induced environmental Kuznets curve hypothesis. Accordingly, the tourism sector causes environmental pollution in the beginning of its trend until the border point of the country's income is reached. In addition, as this income point is reached, it is expected to follow a downward point at the decline level.

Katircioglu, Katircioglu and Kilinc (2018) examined that industrial development, aggregate households, and consequently urban areas result additionally energy demand, which causes a raise in carbon dioxide emission. They empirically demonstrated the urbanization-induced environmental Kuznets curve hypothesis and thus explored the long-term equilibrium linkage causality between CO2 emissions and urban development from energy usage and real income growth in the world.

Katircioglu, Gokmenoglu and Eren (2018) explained that tourism industry is relied heavily on infrastructure potentials such as highways, harbors, airports, harbors, hotels, and holiday resorts. Nevertheless, it may be inevitable that tourism industry and its factors will significantly affect the environmental quality. In addition, abuse of natural resources is one of the actions that must be taken in terms of attracting more individuals and ensuring a competitive tourism industry. Deforestation, abusing the raw materials and overutilizing the natural water are some of the concessions made to emergence of the tourism industry with constructing hotels and other facilities. Therefore, the exploitation of natural resources can cause undesirable environmental effects such as excessive CO2 leakage, air pollution and erosion. When considering the potential adverse effects, connection between industrial development and environment quality has been studied in academic literature. In this way, the

findings of their study show that U-shaped is validated in the context of environmental Kuznets curve hypothesis for main tourist countries.
Consequently, main tourist countries subtly operate the tourism and urban development to control environmental pollution.
Katircioğlu (2014b) examined that tourism industry causes the increased CO2 leakage for Cyprus where is an economy known for its excessive demand for tourism activities. In addition, urbanism and the entire world population have been included in the research results for comparison purposes.

Koksal, Işik and Katircioğlu (2020) examined that developed economies focus more on light manufacturing industries including apparel, leather, wood, metal products and agricultural trade. Depending on their growth stage, the differentiation between these two economies allows them to differ their financial structure, which creates composition effect and Pollution Haven Hypothesis can explain this fact. In this respect, liberal trade theories show that countries decide to manufacture products for which they have a comparative advantage.

Mehrara and Rezaei (2013) investigated the connection between economic growth, CO2 emission and trade openness through econometric models of unit root test, cointegration test and a panel data analysis from 1960 to 1996 for BRICS countries. According to the information received, the data structure was tested to reveal the stationarity of the series by applying the ADF and PP unit root tests which show that the series are stationary in I(1).
In this context, using the Kao panel cointegration test, a cointegration link between CO2 emissions, economic growth and trade openness have been revealed. Evidence shows that long-term trade openness has a significantly positive effect on CO2 emissions and the impact of trade openness on emissions.

Kuik and Gerlagh (2003) found the effect of trade openness on CO2 emissions using econometric models. They used quantitative estimates of CO2 emissions, considering free trade, lowering the import tariff set in the Kyoto

Protocol in the Uruguay Round multilateral trade agreement. Besides, lowering import tariff causes CO2 emission and the costs of reducing the trade-induced CO2 emission are relative to the welfare gains of free trade. Within this scope, the analysis of CO2 emissions from trade show that there are significant differences between emissions caused by the reduction of import tariffs in energy products and non-energy products. It also shows that there are significant differences in leakage responses among developing countries.

Managi, Hibiki and Tsurumi (2008) examined that the effect of trade liberalization on environmental pollution by applying the instrumental variables technique. They shown that the effect is significant in the long-run, after the dynamic adjustment process, although it is small in the short-run and that trade is identified as an environmentally advantageous factor in OECD economies. However, biochemical oxygen demand in these countries (BOD) despite lowering emissions, have a negative impact on CO2 and sulfur dioxide SO2 non-OECD economies. Eventually, trade liberalization affects CO2 leakage through the environmental regulation effect and the capital influence.

Baek and Kim (2011) stated that trade volume to CO2 leakage and energy causation are valid for the developed economies, changes in degree of trade liberalization leads to corresponding changes in the growth rates in emission and energy usage. In this sense, the trade volume of CO2 leakage and energy use for developing economies; any shock in emissions and energy consumption affects the fluctuations in terms of trade liberalization.

Shahbaz, Tiwari, and Nasir (2013) examined the impact of trade liberalization, economic growth, and coal consumption on CO2 leakage by applying time series analysis for South Africa from 1965 to 2008. Autoregressive distributed lag (ARDL) bounds test approach for cointegration was applied to analyze the long-term connection between the variables and short-term dynamics were examined using the ECM model. Their results are demonstrated the long-term connection between the variables involved. The results revealed that the increase in GDP raises the CO2 leakage while financial development

decreases it. Likewise, coal consumption has a remarkable impact on pollute the environment in South Africa. The trade liberalization factor has a positive effect on environmental quality by reducing the growth of energy pollutants. Consequently, their findings validated the existence of EKC.
Shen (2008) shows that factor endowment hypothesis is consumed by several pollutants' academic works, there seems to be no evidence for the pollution haven hypothesis. Combined with all the predicted elasticities of scale and technique influences, compositional effects, and trade intensity on CO2 leakage, increasing trade volumes were found to have opposite effects on CO2 emissions due to different pollutants. Both SO2 and dust fall cause emissions, while trade openness reduces emissions.

Oh and Bhuyan (2018) demonstrated the connection between energy use, GDP, trade liberalization and carbon dioxide (CO2) leakage in Bangladesh from 1975 to 2013. They used ARDL bounds test to cointegration for
determining the existence of a long-term linkage. Inversely, the estimated coefficients for trade openness and GDP are negative both in long and short term. They recommend that the Bangladesh government should support the appropriate policy to use alternative energy facilities that do not emit much CO2.

Zandi and Haseeb (2019) examined the impact of trade openness on CO2 emissions. They applied panel data analysis for 105 developed and developing countries from 1990 to 2017. FMOLS and DOLS findings verify that all variables are linked in the long-term. The long-term coefficient findings verify that trade openness has a positive impact on CO2 emissions, and cause to increase environmental. Heterogeneous panel causality findings verify that there is unidirectional causal relationship between trade openness and environmental pollution and causality runs from trade openness to environmental pollution. They also identify a two-way causality relationship between renewable energy use and environmental pollution in all chosen countries. The findings of the ARDL bound test and the error correction model through autoregressive distributed lag mechanism showed evidence of the

EKC hypothesis as well as long-term connectivity between the relevant variables. They verified causal connection between the variables and propose a “polluter pays” mechanism to maintain a clean environmental awareness. Research studies in the literature have been examined the relationships between CO2, ENE and GDP for Australia as a single country study.

Marques et al. confirmed the EKC hypothesis for the period between 1965 and 2016 for Australia and found causality from GDP to CO2.

Leal et al. found bi-directional causality between CO2 and GDP in the long run for the period between 1965 and 2015 for Australia.

Shahbaz et al. did not confirm the EKC hypothesis for Australia for the period between 1970 and 2012 and found ENE to CO2 causality for Australia in the short-term.

Salahuddin and Khan did not find any cointegration between GPD, CO2 and ENE for Australia for the period between 1965 and 2007, and they found bidirectional causality between ENE and GDP and no causality between CO2 and GDP.

Marques, Leal and Shahbaz used the ARDL model and Salahuddin and Khan used the Johansen cointegration model for the most up-to-date research studies for the NARDL model.

Phiri analyzed the relationships between economic growth, environmental degradation and business cycles in Eswatini for the years 1970 and 2014 with the NARDL model and did not find any EKC for Eswatini.

Boufateh analyzed the relationships between real GDP, oil prices (CP), and emissions for China and the US over the period between 1976 and 2013, and found no EKC for China and the US.

Ahmad and Rahman verified an asymmetrical relationship between emissions and gross capital formation and EKC for Pakistan for the period between 1980 and 2016. Furthermore, Ahmad and Rahman found that coal consumption (CNS) and oil consumption (OCN) significantly affect emissions.

Iorember et al. confirmed that renewable energy consumption (RW), trade openness (TT) and GDP had asymmetric effects on emissions for Nigeria and South Africa between 1990 and 2014.

Munir and Ameer verified that foreign direct investment (FDI), GDP and industrialization had asymmetric effects on emissions in Pakistan between 1975 and 2016.

Ahmad et al. (2019) verified an asymmetric long-run relationship between emissions and remittances for China between 1980 and 2014.

Burakov and Bass (2019) analyzed the relationship between emissions, corruption and income inequality for Russia between 1996 and 2018 and verified that corruption causes emissions to increase. Asymmetric cointegration among the variables are verified and income inequality had an insignificant effect on emissions.

Rahman et al. (2019) examined the pollution haven hypothesis for Pakistan between 1975 and 2016 and verified a symmetric relationship between F inflow and emissions who verified the EKC hypothesis and pollution haven hypothesis for Pakistan.

Ben and Atil (2019) analyzed the impact of GDP, ENE, financial development (FND) and globalization (GB) on emissions for China between 1970 and 2015 and verified that ENE had a GDP, FND and GB had an asymmetric effect on emissions in the long run and asymmetric effect on emissions in the short run.

Haug and Ucal (2019) analyzed the effects of FDI and TT on emissions between 1970 and 2014, they also analyzed the effects of FDI, TT, FND and urbanization on CO2 intensity and verified EKC for emissions and CO2 intensity. In addition, asymmetric cointegration between FDI, TT and emissions was verified. Haug and Ucal found that FND and urbanization intensity was positively affected CO2 but TT and F was not effected CO2.

Toumi and Toumi (2019) analyzed the asymmetric relationships between RW, emissions and economic growth between 1990 and 2014 in Saudi Arabia and verified asymmetric cointegration between emissions and GDP, RW and

emissions, and GDP and RW. Asymmetric causality was found from negative and positive components of emissions to GDP in the long run, and joint asymmetric causality from negative and positive components and emissions from RW to GDP in the long run. Consequently, Toumi and Toumi found asymmetric causality from the positive and negative components of the emissions to the RW.

Karasoy (2019) found that non-RW, RW and TT have asymmetric effects on emissions in the long-term and RW has an asymmetric effect on emissions in the short run and did not verify the EKC for Turkey.

Chukwuemeka et al. (2019) analyzed the relationships between emissions, ENE, FND, GDP, population, CP and TT. Chukwuemeka verified a N-shaped relationship between emissions and GDP. Symmetric and Asymmetric relationships between ENE, GDP, manufacturing and emissions were found a negative relationship between emissions and ENE.

Khan et al. (2019) analyzed the relationships between environmental regulation (ERG), FND, urban population growth, ENE, research and development and emissions. Khan found no asymmetric cointegration among the variables and confirmed negative and significant linear relationships between ERG and emissions.

Luqman et al. (2019) analyzed the relationships between RW, economic growth, nuclear energy consumption, emissions, OCN and CP for Pakistan between 1990 and 2016. Loqman found that RW has a positive effect on GDP, there is an asymmetric cointegration between RW and GDP, CP has an insignificant effect on RW, there is an asymmetric cointegration between GDP and nuclear energy, there is asymmetric cointegration between emissions and RW.

Constantinos et al. (2019) analyzed the relationship between crude oil prices (CT) and emissions1987 and 2015 and verified asymmetric cointegration between CT and emissions and bi-directional causality between CT and emissions.

There are many articles in the academic literature on the link between international trade, financial development, and economic growth for many countries.

Hur, Raj and Riyanto (2006) analyzed that an increase in the level of financial development has a significant impact on the export volume of exports, especially in sectors where companies are excessively dependent on the use of domestic funds.

Liang and Jian-Zhou (2006) demonstrated that there is no connection between GDP and financial development for China. Moreover, fund redistribution of the 4 major public banks has no effect on GDP, they also state that higher bank credit does not affect higher economic growth (GDP) from 1952 to 2001 in China.

Shahbaz, Khan and Tahir (2013) empirically analyzed that financial development triggers GDP also enhanced financial infrastructure able to encourage entrepreneurs and increased the economic growth.

Omri, Daly, Rault, and Chaibi (2015) analyzed that there is a short-run unidirectional causality from financial development to GDP when liquid liabilities are considered in terms of financial development and these findings are consistent with the supply leading hypothesis.

Nyamongo, Misati, Kipyegon and Ndirangu (2012) analyzed the effect of economic growth on financial development of 36 Sub-Saharan African economies from 1980 to 2009. In fact, the depth of the financial system has an impact on remittance-based growth that drives financial development through financial liberalization.

Wolde-Rufael (2009) used the VAR analysis and Modified Wald test (MWALD) as annual data for Kenya from 1966 to 2005 and concluded that here is a two-way causality among financial development and GDP in three out of four measures of financial development.

Kar, Nazlıoğlu, Ağır (2011) examined that there is no clear consensus regarding the direction of causality between the financial development and

GDP when applying the six financial indicators for the MENA and Middle East countries.

Menyah, Nazlioglu and Wolde-Rufael (2014) analyzed the relationship between economic growth and financial development in terms of international trade for twenty-one African countries and the empirical findings were evaluated for finance-based and the trade-based growth thesis over the employment of panel bootstrapped approach to granger causality in their article.

Bolbol, Fatheldin, and Omran (2005) investigated that capital market growth triggered Egypt's economic growth between 1974 and 2002.

Ductor and Grechvna (2015) examined the interdependence between real sector output and financial development in terms of the effect of GDP based on panel data analysis among a several selected developed and developing countries and their studies demonstrated to impact of financial development on GDP is significantly affected by net credit to key industries and this effect becomes negative unless accompanied by a corresponding growth in real output.

Hassan, Sanchez, Yu (2011) examined that the major changes made in the derivatives market which contributes to the entry of conventional banks, and the main factor was liberalization of interest rates with the ambition to realize financial growth. According to this idea of financial reform followed the most supported theory that, domestic credit to private sector was an accelerator of GDP by effecting the investment and companies and improving resource allocation.

Katircioglu, Kahyalar and Benar (2007) examined the existence of a bidirectional causality between economic growth, financial development also economic growth was measured by financial sector credit activity in Poland.

Gokmenoglu, Amin and Taspinar (2015) analyzed that better financial system will trigger international trade and finally empirically demonstrated economic growth (GDP) for Pakistan. Moreover, financial growth may represent a full

degree of comparative advantage, at least for those sectors that have a higher dependence on external financing.

Isik, Kasimati and Ongan (2017) examined the unidirectional and bidirectional relationship between financial development, international trade and GDP for Greece from 1970 to 2017 as annual by using unlimited error correction model for the ARDL.

Soukhakian (2007) examined additional evidence on the positive impact of financial development on GDP concluded that financial development and trade openness have causal effect on GDP.

Shan (2005) executed impulse response and variance de-composition analysis for 10 OECD countries including China considering the connection between economic growth and financial development.

Lawal, Nwanji, Asaleye, and Ahmed (2016) used the ARDL model for Nigeria and revealed a growth impact in the short-term and negative long-term effect of financial development on GDP. In addition, a bidirectional causality has been determined between financial development and economic growth.

Katircioglu (2012) examined the long-term equilibrium link and direction of causality between real income growth, international trade and financial development for Sub-Saharan African countries and the bounds test founded verified that there is a long-term equilibrium relationship between exports, imports, financial development, and real income.

Lee and Chang (2009) examined the role of financial development and economic growth simultaneously considering that FSD instrumental to assist FDI to affect positively on GDP, also they did not consider the interactions between financial development and FDI while examining the finance-growth nexus.

Lee and Chang (2009) examined that capital and financial development have a statistically significant and positive effect on income also, there is a positive linkage between GDP and financial development.

Rahman, Shahbaz and Farooq (2015) shown the linkage between financial development, international trade, GDP in Australia from 1965 to 2010 and provided evidence of long-term co-integrated relationship between the GDP, financial development, and international trade.

1.2 Multiple country studies in the literature of Carbon Kuznets Curve

Abidin, Haseeb, Azam and Islam (2015) implemented the Johansen cointegration test and ARDL, that there is a long-term linkage among variables such as including financial development, international trade and GDP for ASEAN countries from 2005 to 2013.

Ghirmay (2004) examined the linkage between economic growth and financial development for 13 sub-Saharan African countries. They implemented VAR analysis, and the findings reveal that financial development leads GDP in 8 countries and there is a two-way causal connection in 6 countries.

Yucel (2009) analyzed the connection between financial development and economic growth by using Johansen Juselius cointegration test and vector error correction model from 1989 to 2007 and found a long-term stable relationship among variables in Turkey.

Ozataç, Gökmenoğlu and Taşpınar (2017) examined the EKC hypothesis for Turkey, considering the variables of energy consumption, trade openness, urbanization, and financial development between 1960 and 2013.

Tang and Tan (2014) examined the linkage between GDP and financial development by incorporating FDI and relative prices in the energy demand function for Malaysia. They found bidirectional causality between GDP and financial development both in the short-terms and the long-terms.

Jenkins and Katircioglu (2010) implemented cointegration and causality tests to determine the linkage between economic growth, financial development, and international trade in Cyprus. They do not find any long-term linkage between financial development and international trade apart from the linkage between exports and money supply in the case of Cyprus.

Bojanic (2012) examined time series models for data analysis and found a positive effect of financial development on GDP (economic growth)

Kim, Lin, and Suen (2012) found the link between GDP and financial development for 63 different economies by applying the trade value in local industries and the share of trade as a percentage of GDP. Regarding to the results, while there is an effect of trade liberalization in developed economies, its negative effect has been confirmed for many economies.

Kaushal and Pathak (2015) demonstrated that there is a short-term linkage between GDP, trade openness and financial development in India from 1991 to 2013. According to the empirical results, financial development has no effect on GDP as demonstrated by causality test and VAR analysis.

To our knowledge, the effect of EXD on EMS is not analyzed in the literature and the following studies are the most recent research analyzed in the literature for China.

Gui, Zhao and Zhang (2019) used spatial linkage analysis for 285 Chinese cities between 2006 to 2015 and did not validate a waste Kuznets curve. Increases in GDP per capita cause an increase in waste production.

Song, Zhang and Zhou (2019) examined the relationship between GW and EMS for China and the USA between 1965 to 2016 and verified the EKC hypothesis for both China and the USA.

Zhou, Wang and Wang (2019) analyzed the effects of social urbanization (UBZ), population UBZ, spatial UBZ, and economic UBZ on EMS for the Yangtze River Delta region between 1992 to 2013 and verified the EKC hypothesis.

He and Lin (2019) analyzed the relationship between income levels and pollution for a panel study in China between 2003 to 2017 and verified the EKC hypothesis relationships between income levels, energy intensity and EMS, and non-linear relationships between income levels and EMS.

Cohen, Tovar, Loungani, Marto and Wang (2019) diversified the EKC hypothesis for a panel study in China from 1990 to 2012, diversified a cyclical relationship between GW and EMS, and found that the cyclical relationship was symmetric.

Chai et al. (2019) examined the relationship between coal consumption (CCS) and GW in China between 1965 and 2016. Although they found a phased inverse U link between CS and GW, they did not been found an inverted U relationship between CCS and GW in the last cycle. In addition, they state that energy and industrial structure is the main contributor to the future of CCS in China.

Kacprzyk and Kuchta (2020) examined the relationship between GW and EMS between 1992 to 2012 and verified the EKC hypothesis for a panel of 161 countries and EKC turning point of the curve, evaluated in the time period of the study.

Liu and Lin (2019) examined the comprehensive environmental pollution index to examine the relationship between pollution and GW of Chinese provinces between 2000 to 2015. An inverted N relationship between pollution and GW was found for Chinese provinces, and industrial structure and R&D investments have a significant impact on pollution and the impact of foreign direct investment (FIN) on pollution is insignificant.

Nie, Li, Wang and Zhang (2019) analyzed the relationships between EMS and GW for the Western, Eastern and Central regions of China between 1995 to 2014. They verified the nonlinear relationship between EMS and GW for the studied regions of China.

Wang and He (2019) analyzed the relationship between EMS and GW by taking into consideration the spatial distance and economic distance between 1995 to 2013 in China and a N-shaped curve relationship between EMS intensity and GW is verified.

Xie, Xu and Liu (2019) verified the EKC relationship between GW and PM2.5 EMS in China by using data from 249 cities. Traffic development,

industrialization, population density and UBZ positively affect EMS and green coverage effect and technological innovation are not significant on EMS.

J. Liu, Qu and Zhao (2019) verified the EKC hypothesis and did not verified the pollution haven hypothesis in China between 1996 to 2015.

Yao, Zhang and Zhang (2019) tested the role of renewable EM in the EKC hypothesis and analyzed the renewable energy Kuznets curve for a panel of 17 countries including China between 1990 to 2014. They verified the renewable energy Kuznets curve for the panel countries.

Liang and Yang (2019) examined the relationships between environmental pollution, UBZ and GW in China for the between 2006 to 2015. The EKC hypothesis is verified for the panel provinces and an inverted U relation was found among pollution and UBZ.

Tan (2019) analyzed the link of EMS from household electricity consumption (HC), GW, UBZ and population density between 2005 to 2015 in China. There is an inverted N-shaped relationship between EMS from HC and GW. UBZ and population density positively affect EMS from HC and he raised that energy saving policies are very important to reduce EMS from HC.

Mele and Randazzo (2019) examined cointegration between GW, EM and trade (TE) between 1980 to 2017 for China. They found short-term causality from GW to TE, TE to EM, and GW to EMS.

Ahmad, Du, Tian and Wang (2019) analyzed the relationship between GW, EM, urban population and EMS between 1971 to 2014 for China therefore, there is a N-shaped relationship between GW and EMS.

The urban population has a remarkable and negative impact on EMS and EM has a positive effect on EMS. There is bidirectional causality between GW and EMS, EM and EMS, and GW and EM.

M. Ahmad et al. (2020) analyzed the link between SO2 EMS, energy investment (EINV) and GW between 2001 to 2017 for China and a long-run relationship among the variables were confirmed. The EKC hypothesis for the

relationship between GW and EMS is verified by the cubic EKC equation. Bidirectional causality was found between EINV and GW, GW and EMS.

Hao, Huang and Wu (2019) analyzed the relationship between EMS and GW between 2007 to 2016 for China. They found that there was an EKC relationship between EMS and GW and there was a different unbundling for individual provinces. The turning point of the EKC curve is found beyond the sampling period.

Zhang, Sharp and Xu (2019) demonstrated spatial correlation analysis to examine the relationship between GW and pollution between 2005 to 2015 for China. Air pollutants of environmental pollution are NOx, PM2.5, PM10, SO2 and VOCs. The EKC relationship was found between pollution and GW also the EKC relationship has not been verified for SO2 and CCS positively affects pollution. The EKC association for SO2 has not been verified and CCS has a positive effect on pollution.

Tzeremes (2019) analyzed the EKC hypothesis in China between 1997 to 2012. For individual analysis of 23 of the 30 Chinese provinces, the EKC hypothesis is verified in one province, and a N-shaped relationship between GW and EMS is verified in the majority of the 23 Chinese provinces and the EKC hypothesis is confirmed in the Sichuan region.

Fang, Hao, Wang and Hao (2019) examined the relationship between EMS, energy intensity, TE, UBZ and GW between 1995 to 2016 for China. There is an inverted N-shaped relationship between GW and EMS in East China, Central China regions and West China.

Bouheni, Lahiani, Atil and Shahbaz (2019) examined the link between EMS, GW, EM, financial development (FDEV) and globalization between 1970 to 2015 for China. GW's impact on EMS is symmetrical through social, political and overall globalization and GW's impact on EMS is asymmetrical through economic globalization.

Munir and Riaz (2020) analyzed the impact of oil, electricity, coal and gas consumption on EMS for the USA, China and Australia for the between 1975

to 2018. Gas, oil and coal consumption increases EMS in the US and China, also coal and oil consumption increases EMS in Australia.

Alam, Murad, Noman and Ozturk (2016) analyzed the link between EMS, EM, income and population growth in Brazil, Indonesia, China and India between 1970 to 2012. The EKC hypothesis is verified for China, Brazil and Indonesia.

Jian, Fan, He, Xiong and Shen (2019) analyzed the link between EMS, GW, FDEV and EM for China between 1982 to 2017. Bidirectional causality between EMS and EM in the long run has been verified. EM to FDEV causality has been found for China in the long term. There is bidirectional causality between EMS and GW in the short-term and there is causality from GW to EM in the short-term. There is bidirectional causality between EMS and GW in the short-term, also there is causality from GW to EM in the short-term.

Huang, Chen, Zhu, Huang and Tian (2019) analyzed the link between EMS, TE and FIN between 1997 to 2014 for China. The EKC relationship between GW and EMS has been verified in the most and least polluted provinces and the effects of FIN and TE are significant and negative on EMS.

L. Wang, Wang, Du, Li and He (2020) analyzed the link between EMS, exports, imports, FIN and GW in China for the between 1997 to 2015. GW to EMS causality is found in central and eastern provinces and causality from GW to EMS is found in central and eastern province also causality from EMS to GW is found in the western provinces and bidirectional causality is found between EMS and GW. The literature review demonstrates that some studies verified the EKC hypothesis, and some studies did not, also apart from the carbon Kuznets curve, the renewable energy Kuznets curve and the waste Kuznets curve were also examined.

Some studies have analyzed the EKC hypothesis and the pollution haven hypothesis in the same study. Impact of economic growth on emissions were examined through different variables. In addition to linear relationships, nonlinear link between economic growth and emissions were also examined. Relationships between economic growth and emissions were analyzed for air

pollutants other than carbon dioxide emissions. This study analyzed the Kuznets curve of coal consumption for China.

According to recent researchs suggest that there is a research gap for the analysis of the impact of external debt on emissions. Countries' internal regulations may affect their emissions intense industries to finance their operations from abroad. This regulations may requires countries to adapt additional policies for industries and control debt financing and fight climate change also this study considers perspective for analyzing the external debts emission effect for China. Future studies in the literature, additional evaluation may be considered for other developing countries such as Turkey and Brazil. Moreover for future studies, the effect of external debt on emissions, nonlinear relationships between economic growth and emissions can be considered. The trend in the literature is the analysis of symmetrical relationships between economic growth and emissions and analyze the non-linear relationships between economic growth and emissions of more studies are needed. The analysis of the relationship between coal consumption and economic growth is another perspective. Although the coal consumption Kuznets curve has been examined in the literature, the number of studies is very limited. Further studies are needed to examine the relationship between coal consumption and economic growth based on emissions from coal consumption rather than overall air pollutants such as carbondioxide emissions. Coal consumption is still one of the main energy sources for energy production in the world. Analysis of emissions from coal consumption and economic growth are important for emission reduction policies, as most of the world's countries aim for economic growth.

Jalil and Mahmud (2009) analyzed the EKC relationship between emissions, GDP, ENEC and trade openness (TS) from 1975 to 2005 for China. They verified the EKC hypothesis for China with ARDL methodology. Besides, they found that there is unidirectional causality running from GDP and ENEC to ES, and no causal relationship between ES and TS.

Pao and Tsai (2011) examined the EKC relationship between ES, ENEC, foreign direct investment (FIN) and GDP for a panel of countries between 1980 and 2007. They verified the EKC hypothesis for China using the panel cointegration framework.

Wang et al. (2014) examined the relationship between urbanization (UBN), ENEC and emissions for a panel of 30 China provinces between 1995 and 2011. They verified bi-directional causality between UBN and ENEC, UBN and ES, and ENEC and ES in the long-term also verified bi-directional causality between emissions and UBN, ENEC and ES, and unidirectional causality from UBN to ENEC in the short-term.

Wang et al. (2016a) verified the long term relationship between ES, GDP and ENEC for China between 1990 and 2012 by VECM and Johansen Multivariate cointegration tests. They verified bi-directional causality between GDP and ENEC, unidirectional causality from ENEC to ES, and no causality between GDP and ES.

Wang et al. (2016b) verified the long term relationship between ES, GDP and ENEC between 1995 and 2012 for China with panel cointegration test and they verified bi-directional causality between GDP and ENEC, ES and ENEC, and unidirectional causality from ENEC to ES.

Kang et al. (2016) analyzed the EKC hypothesis in China by spatial panel model between 1997 to 2012. They inverted N relation between GH and ES and found that CS and UBN positively and significantly affected ES in China and TS negatively affected ES in China.

Stern and Zha (2016) analyzed the relation between PM 2.5 particulate pollution, PM 10 particulate pollution and GH for 50 Chinese cities between 2013 to 2014 and they educed that the relatonship between GH and particulate pollutants was inverted U shaped but the GH coefficients were not statistically significant.

Wang et al. (2017) analyzed the EKC hypothesis for a panel of 30 Chinese provinces between 2000 to 2013. They verified the EKC relationship between UBN and manufacturing sector emissions and analyzed the relations between GH and ES, and found that the EKC hypothesis is existed in heat and electricity production sectors.

Riti et al. (2017) analyzed the EKC hypothesis in China between 1970 to 2015 and verified the EKC hypothesis by using multiple cointegration techniques in China.

Zhang et al. (2017) analyzed the relation between water pollution and GH for panel data for Chinese provinces and water pollution was investigated in terms of chemical oxygen demand discharge and ammonia nitrogen. They verified the EKC relationship between GH and chemical oxygen demand discharge, and growth of ammonia nitrogen and chemical oxygen demand discharge time period between 1990 to 2014 also ammonia nitrogen between 2001 to 2014 in China. Moreover, causality was verified from GH to chemical oxygen demand discharge and ammonia nitrogen in the long-term.

Pal and Kumar (2017) examined the relationships between ES, GH, ENEC and TS between 1971-2012 and they found a N-shaped relation between ES and GH for India and China.

Wang and Ye (2017) analyzed the EKC hypothesis for the city level ES and investigated the relation between ES and GH also they did not verified the EKC relation between ES and GHh for city level analysis and suggested that aimplementing of energy efficiency and carbon tax policies would help to lower ES verified the EKC hypothesis in China. They analyzed the EKC hypothesis for a panel of 27 capital cities between 2001 to 2015 and found a N shaped relation between haze pollution and GH in China.

Xu (2018) examined the relationship between sulfur dioxide emissions (SO2), GH and FIN between 1985 to 2015 for a panel data of 29 Chinese provinces and the EKC hypothesis was only verified at 5 provinces out of 29 provinces for SO2.

Hao et al. (2018) analyzed the EKC hypothesis between GH for a panel of 30 Chinese provinces and environmental quality between 2006 to 2015 and used environmental quality index which was constructed upon eight environmental factors. They used the environmental quality index built on eight environmental factors, which did not verified the EKC hypothesis in China but confirmed a N shaped relationship between environmental quality and GH.

He and Lin (2019) analyzed the relationships between ES, GH and energy intensity between 2003 to 2017 for a panel of 30 Chinese provinces and verified the EKC relationship between GH and ES, also confirmed the effect of GH on ES is non-linear.

Jiang et al. (2019) examined decoupling analysis and the EKC hypothesis analysis between ES and GH for Guangdong between 1995 to 2014 and verified expansive weak decoupling between ES and GH, also verified the EKC relationship between ES and GH for Guangdong.

Wang and He (2019) analyzed the relationship between ES and GH for a panel of 30 Chinese provinces between 1995 to 2013 with spatial data analysis and found a N shaped relation between ES and GH.

Sarkodie et al. (2020) analyzed the EKC hypothesis for ES and ecological footprint between 1961 to 2016 and verified the EKC relation between ES and GH, and ES and ecological footprint in China.

Lahiani (2020) examined the relation between ES, financial development (FID), GH and ENEC between 1977 to 2013 and verified that there was an

asymmetric relation between ES and FID, and raise in FID resulted in reduce of ES.

Further literature for Australia, Salahuddin and Khan (2013) analyzed the EKC hypothesis between the variables of GDP, ES and ENEC between 1965 and 2007 and did not verified the long-term relation and the EKC hypothesis among the variables with Johansen cointegration tests and did not verified causal relationship between ES and GDP, and verified bi-directional causal relationship between GDP and ENEC.

Beşe and Kalayci (2019) analyzed the EKC hypothesis and did not verify the EKC hypothesis between 1960 to 2014 for for Denmark, Spain and UK.

Solarin et al. (2017) analyzed the relation between ES, GH, UBN and hydroelectricity consumption (HCS) between 1965 to 2013 and verified the EKC hypothesis for China and India, also verified the causal relationship from HCS to ES in the long term, GH to HCS, HCS to GH, UBN to ES, and emissions to UBN for China and India.

Beşe and Kalayci (2019b) examined the EKC hypothesis between 1971 to 2014 with Johansen cointegration model but did not find any evidence for the EKC hypothesis for Egypt, Kenya and Turkey.

Wang et al. (2020) analyzed the EKC hypothesis for 76 countries between 1971 to 2014, also verified the EKC relationship between GH and ES for Australia, Uruguay, China, Turkey, Congo Democratic Republic, Myanmar, Costa Rica, Korea, Gabon, India and Hong Kong levels in China.

Sarkodie and Strezov (2018) analyzed the EKC relation and environmental sustainability curve relation (ESU) between 1971 to 2013 for Ghana, the USA, China and Australia. ESU was studied with the relationship between biocapacity(hectares per capita) and GH, biocapacity and ENEC, biocapacity and emissions verified by ESU in Australia and the USA.

Dong et al. (2018) analyzed the relation between ES, GH, fossil fuel consumption, nuclear ENEC and renewable ENEC between 1993 to 2016 and

Eriandani et al. (2020) examined the sector-specific foreign direct investment and CO2 emissions in terms of EKC hypothesis for 5 ASEAN countries which are Singapore, Malaysia, Philippines, Thailand, and Indonesia by implementing yearly data in the beginning 1980 to 2018. In order to reach the results, they implemented econometric models including Granger causality tests to reveal the association between specific foreign direct investment for industry and CO2 emissions. According to their findings show that, running from foreign direct investment in pollution intensive industries to CO2 emissions per capita. The results show that foreign-direct-investment in-flows in pollutant-intensive industries can be associated with rises in per-capita CO2 emissions and GDP per-unit, in the case of some ASEAN nations. Discriminating the environment impact of foreign direct investment through sectors is appropriate for policymakers. Foreign investments have been causing the high CO2 emissions hence pollutant intensive industries should be periodically controlled by governments .

Shabaz et al. (2016) indicated that the relationship between trade openness, and CO2 emissions include additional and potentially economic growth in terms of EKC hypothesis for 105 countries which are low, middle and high income as three groups from the year 1980 to 2014. In order to find the results they applied econometric models including Pedroni and Westerlund panel cointegration tests, which are found to cointegrated of three variables in the long run. Considering to their analysis result; high income, middle income , low income countries have been blocking of environmental quality by trade openness on panel data. According to VECM of Panel causality analysis results demonstrate a feedback impact between trade openness and CO2 emissions globally for middle-income countries also Granger of trade opennes test results have been causing CO2 emissions for the low and high income countries for trade openness.

Tsurumi and Managi (2011) find out the effect of trade openness on deforestation relation with CO2 emissions in terms of EKC hypothesis for 142 countries from the period of 1990 to 2003. In order to reach the results, they implemented econometric models including GMM tests to reveal to consider trade and income internally and to consider an adaptation process with implementing a dynamic model. Their result verified a raise in trade openness increases deforestation for non-OECD members while slowing down deforestation for OECD members. Developing countries have a negative impact on deforestation and CO2 emissions, however the opposite is valid in developed countries. Moreover, we should not forget that it is directly proportional to the destruction of forest and CO2 emissions.

Munir and Ameer (2019) demonstrated that the short and long run impact of trade openness, urbanization, economic growth and technology on development the SO2 (degradation of environmental) for emerging economies of 11 Asian countries which are Bangladesh, Hong Kong, India, Indonesia, Iran, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka and Thailand from 1980 to 2014. The STIRPAT model approach to cointegration has been implemented to analyze the long term and short term relation between panel cointegration and causality test. Their results verified environmental Kuznets curve lying between SO2 emissions and economic growth inverted by U-shape hypothesis. In the long term, SO2 emissions raises by trade openness and technology raise while SO2 emissions reduced by urbanization for emerging economies of Asia. In a short run, one-way causality moves from urbanization to SO2 emissions. Also SO2 emissions flows to economic growth.

Ulucak and Bilgili (2018) investigated that EKC hypothesis based on environmental degradation and economic growth for high, middle and low grouped income countries between 1961 to 2013. To find the results, they applied the CUPFM and CUPBC econometric models and validated the data for the EKC hypothesis of low, middle and high income countries and inverted U-shaped relationship between economic growth and environmental

degradation. They used the Ecological Footprint variable instead of CO2 emissions.

Lapinskienė, Peleckis and Nedelko (2016) indicated the linkage between greenhouse gases and selected indicators of economic development with the EKC hypothesis for 20 EU countries during the period between 2006 to 2013. The fixed effect panel model approach to cointegration has been implemented and their result confirmed the reduction in the level of greenhouse gases is possible with research and development, higher energy taxes and the number of sustainable businesses. Agricultural production and the size of the building has a positive signal, meaning that a higher indicator value is associated with higher levels of greenhouse gases.

Rafiq, Salim and Nielsen (2016) examined urbanization and trade openness impact on energy intensity and emissions for 22 countries which are emerging economies that are increasingly urbanizing for time period between 1990 to 2010. To complete the analysis, they applied econometric models, which are models of second-generation heterogeneous linear panel and techniques of nonlinear panel estimation. According to the results of the analyzes; population density, living in clover and nonrenewable energy raises CO2 emissions and density of energy. Probably, cleaner technologies has been assimilating by developing economies because of recent increasing trend.

Sadorsky (2014) demonstrated that urbanization effect on CO2 emissions for emerging economies of 34 Asian countries from 1990 to 2016. The STIRPAT model assesed the urbanization posibility role preventing emissions growth by examining nonlinear relationship possibilities or especially the possibility of the Kuznets' hypothesis. Their results confirmed, at first CO2 emissions increase with the growth of urbanization, higher urbanization is linked to reducing emissions as well as being second-order functional.

Heidari, Katircioglu and Saeidpoura (2014) indicated the relationship between economic growth, CO2 emissions, and energy consumption with the EKC

hypothesis for 5 ASEAN countries which are Indonesia, Malaysia, Philippines, Singapore, and Thailand for time period between 1980 to 2008. They implemented econometric models that include PSTR model to arrive at conclusion. The results demonstrated that linearity reject the null hypothesis, and the remaining nonlinearity test showed a model with a function of transition and two parameters of threshold. Moreover, the analyzes support the EKC hypothesis acording to result of energy consumption in the first or second regime causes to an increase in CO2.

Landolsi (2018) investigated the relationship between GDP, EC and CO2 emissions for 13 MENA countries which are Algeria, Egypt, Iran, Jordan, Kuwait, Morocco, Oman, Saudi Arabia (KSA), Sudan, Syria, Tunisia, Turkey and United Arab Emirates between 1973 to 2008. According to panel causality test and panel unit root tests result, in a short term there is no causative linkage between GDP, EC and CO2 emissions. Furthermore, FMOLS and DOLS analyzes are applied for one-way causality running from EC and CO2 emissions to GDP in the long-term.

Mohammed, Youssef and M'henni (2012) analyzed the relationship between CO2 emissions, consumption of energy, and real GDP of EKC hypothesis for 12 MENA countries which are Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and UAE beginning from 1980 to 2018. According to cointegration techniques and bootstrap panel unit root tests no-causal link between GDP, EC and CO2 emissions in short-term but energy consumption has a positive effect on CO2 emissions in the long-term. Moreover, the analyzes support MENA countries should sacrifice economic growth through energy savings without long-term adverse effects to reduce CO2 emission levels.

Musolesi, Mazannati and Zoboli (2010) examined the relationship between CO2 and GDP by the EKC hypothesis for 109 countries for based on annual data from 1959 to 2001. They implemented econometric models that include method of hierarchical bayes estimator to arrive at conclusion and they

confirmed the EKC hypothesis and they revealed to the view that there is a monotonous relation between GDP and CO2. Analyses of future performance, nevertheless, favor quadratic specifications, thus supporting EKC evidence for wealthier countries and non-EKC index for industrializing regions. However, analyzes of future performance support quadratic specifications thus supporting EKC evidence for wealthier countries.

Xu et al. (2013) investigated the EKC hypothesis for CO2 emissions by using the first-order derivative of the traditional quadratic EKC equation for 16 developing countries which are Algeria, Angola, Brazil, Cameroon, China, Djibouti, India and Mexico for the developed countries such as Australia, Canada, France, Germany, Italy, Japan, the United Kingdom and United States. These 16 countries were classed as developing and developed countries according to per capita income. In addition, they analyzed developed countries and developing countries as two separate groups with the EKC hypothesis. They also examined the data of CO2 emissions on a global scale, selecting 88 countries, including 9 developed and 69 developing countries. Their results confirmed short-term CO2 emissions widely supported and long-run CO2 emissions rarely supported the hypothesis of EKC .

Wang (2012) studied on the relationship between CO2 emissions and GDP with panel data in terms of EKC hypothesis for 98 countries during the time period between 1971 to 2007. In order to reach the results, they used econometric models covering methodology of DPTM causality tests to reveal the association between CO2 and GDP. According to their research, different levels of economic growth have different effects on emissions of oil CO2. In addition, short-run analyzes result panel of dynamic and static three-regime predictions demonstrate the effectiveness of a model of double-tri-regime. The effect of economic growth is negligible for growth regime of high economic for CO2 emission of oil and middle regime of economic growth have a positive impact also medium economic growth regime for CO2 emission of oil also low economic growth regime has a negative effect for CO2 emission of oil.

Borhan, Ahmed and Hitam (2011) observed relation between environmental pollution, production, capital and labor with terms of EKC hypothesis for 8 Asean countries during period 1965 to 2010. Environmental pollution may directly reduce the production of man-made and can improve the efficiency of capital and labor. Besides, the long-term damaging effect of this environmental pollution can have devastating consequences on human well-being and the economy. In this study, the three-equation simultaneous model was used and analyzed the relationship between CO2 on economic growth for ASEAN.

Zhang et al. (2019) evaluated the relationship between manufacturing, construction industries and CO2 emissions with terms of EKC hypothesis for 121 countries between 1960 to 2014. The manufacturing and construction industries have significantly contributed to the increase of CO2 emissions and analysis result shows that the EKC hypothesis was validated by 95 out of 121 countries. Also, the result of examining the presence of EKC at the four income levels show that higher income nations have a higher rates of countries, confirming the EKC hypothesis and reaching at TP.

Bibi and Jamil (2021) examined the relation between air pollution and economic growth with terms of EKC hypothesis for, East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, South Asia, the Middle East and North Africa, and Sub-Saharan Africa for the time period between 2000 to 2018. In order to reach the results, they used econometric models covering Random effect and causality tests of fixed effect models to reveal the association between air pollution and economic growth. This regional classifying was made to explore regional disparities in the relationship between CO2 emissions and EKC while Panel data econometric models are used to generate empirical results.

Seri and Fernandez (2021) indicated the relationship between income and CO2 emissions with the EKC hypothesis for 21 Countries of Latin American during period 1960 to 2017. They implemented econometric models that

include ARDL bounds test and Unrestricted Error Correction Model to arrive at conclusion. The EKC hypothesis does not effectively describe the long-run income-emissions relationship also does not supported by evidence most countries in the region. Countries geographical properties, applied policies, regulations of enviromental may clarify the population's different effect density and trade on CO2 emissions.

Farooq, Raji and Adeleye (2020) investigated the relationship between emission of CH4 and economic growth of EKC hypothesis for 6 ASEAN countries where are Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam during the time period between 1985 to 2012. They applied econometric models that include approaches of dynamic panel data in the manner that Mean Group to Pooled Mean Group techniques arrive at conclusion. According to the analysis results, CH4 emission was confirmed by the EKC hypothesis due to economic growth induces to reduced CH4 emissions also energy consumption pollutes the environment by increasing CH4 emissions. Asian countries have serious economic growth recently with foreign investments and pollution is increasing as a side effect. In addition to this information, production of CH4 is one of the gases that have the greatest impact on global warming and climate change. It has been reported that 18% of the total greenhouse gas emissions are of human origin by World Health Organization. The global warming coefficient of CH4 gas is 23 times higher than CO2.

Tenaw and Beyene (2021) studied on the relationship between environmental degradation, economic growth, energy consumption, renewable energy, nonrenewable energy, globalization and efficiency of EKC hypothesis for 28 OECD countries yearly data beginning from 1990 to 2015. They implemented econometric models that include utoregressive model of distributed lag and the method of Driscoll–Kraay arrive at final decision. The findings reveal that the EKC hypothesis for the high globalized countries proves to be valid and the low globalized countries have U-shaped relationship was confirmed by the Environmental Kuznets Curve. Global warming poses a serious threat to living

things all over the world. Economic activities such as production and construction cause great damage to the environment especially for developing countries. In order to reduce global warming and greenhouse gas effect, technological changes(causing of less fossil) and reduction of fossil fuel use are required.

Akan and Balın (2015) focused on the relationship between CO2 emission, GDP, innovative investments and industrial mass production of EKC hypothesis for 278 developed countries based on annual data from 1997 to 2009. The EKC is assessed through the Quadratic and cubic functions estimator and founded a N-shaped relationship between CO2 and GDP. The results obtained that there is an evidence for the EKC hypothesis indicated that, there is economic growth, CO2 emissions do not disappear on their own, on the contrary, they increase if not controlled. In addition, it has been determined that R&D studies are an important factor affecting CO2 emissions.

Halkos (2011) evaluated the relationship CO2 emissions of EKC hypothesis among 32 countries in 36 years. The correctness of EKC hypothesis is proved through the Pedroni Residual Cointegration Test, individual time series analysis. Few econometric methods were used to forecast the relationship between income and environment, and a N-shaped relationship was found between development and pollution. According to this study, a mix of monotonic U-shaped or N-shaped behavior was found using different countries from different geographical regions, and this result showed serious policy impotency.

Mehmood and Tariq (2020) examined that linkage between globalization and CO2 emissions with the EKC hypothesis for South Asian countries from 1972-2013. The econometric analysis results confirmed that, globalization increases CO2 emissions and CO2 emissions affect globalization through economic growth. The study found an U-shaped relationship between globalization and CO2 emissions in Afghanistan, Bangladesh, Nepal and Sri Lanka. An inverted U-shaped relationship was found in Bhutan and Pakistan also a bidirectional

causality linkage between globalization and CO2 emissions has been identified between Bangladesh, Nepal and Pakistan.These shapes verified that globalization raises emission of carbon dioxide which is affect globalization through economic growth. In recent years, low-cost-labour in developing countries has directed large investors to those regions, and the contract manufacturing industry has greatly increased in these countries. Today, environmental pollution (such as CO2, CH4, N2O, NH3, NMVOC, CO and NOx gases) poses a threat to our welfare level and negatively affects our health. Developing countries continue to grow regardless of environmental pollution and cause great harm to the environment. The environment began to renew itself with the lockdown during the pandemic process, but the dumping of chemical wastes such as masks and disinfectants into nature and the acceleration of these industries caused even more pollution. Today the life of all plants and animals is at the danger because of our insensitive.

Shahbaz (2019) investigated the relationship between CO2 emissions and globalization with bounds testing for evaluating the cointegration in terms of EKC hypothesis for N-11 countries which are Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan Philippines, Turkey, South Korea, and Vietnam during the time period between 1972 to 2015. When the short-term globalization flexibility is greater than the long-term globalization flexibility, CO2 emissions reduce and are shown with an inverted U shape. However, the exact opposite situation, the relationship between globalization and carbon emissions is U-shaped. The findings reveal that, there is an evidence that the EKC hypothesis is validated by comparing short-run and long-run globalization flexibilities.

Akbaş and Lebe (2021) indicated the relationship between CO2 emissions, consumption of energy, income inequality, and poverty in terms of EKC hypothesis for 14 developed and 10 developing countries between 2000 to 2018. In order to reach the results, they implemented econometric models including Fourier unit root test and DSUR to reveal the association between for CO2 emission, poverty, and energy consumption which are effected

positively. In addition, the results obtained show that there is an inverted U-shaped relationship between carbon dioxide emissions and income per capita and according to the EKC hypothesis valid, in developed countries and invalid in developing countries.

Bekun et al. (2021) focused on the relationship between CO2 emission and GDP growth within the framework of the Environmental Kuznets Curve in EU member states over the period 1990 to 2017. The EKC is assessed through the analysis of Dumitrescu and Hurlin causality estimator for causality direction. Considering the open border or policy of trade approximation, the investigate valids an econometric analysis battery consisting of average or augmented average group and co-related effect average group predicators. In addition, findings reveal that the feedback Granger causality from GDP growth and CO2 emissions are observed. Considering the results evidence for the EKC hypothesis show that, the long term equilibrium linkage between variables in the EU is visible also GDP increase at the expense of environmental quality, proved by EKC.

Alhassan et al. (2020) analyzed the relationship between CO2 emissions, per capita GDP and trade with the EKC hypothesis for 79 Countries over the period 2008 to 2018. The results were verified that the EKC hypothesis is evidence for OLS and GMM methods, GDP per capita and government integrity improve environmental performance but trade hinders reduce of CO2 emissions. According to the results of the GMM method, it has been confirmed that the interaction of government integrity with trade is positive and developed governments can control the negative effects of trade on the environment.

Lorente et al. (2019) investigated the linkage between CO2 emissions, innovations of energy, corruption affect of EKC hypothesis for 16 OECD countries based on annual data from 1995 to 2016. When corruption in economic systems is supported by politicians, the amount of economic growth grows unbalanced. In addition, environmental quality is affected in the long and short term because the impact of energy innovations on environmental

protection reduces. The dynamo of economies is agriculture, construction, industrial production and tourism, and these activities should be periodically inspected by the states. As a result of political rants as corruption, the environmental policies of the states are unfortunately ignored and toxic chemicals are released into the environment uncontrollably. These chemicals and toxic gases cause various epidemic diseases occurred and the environment is destroyed. Our drinking water sources, fertile lands and forests has been disappearing every passing minute.

CHAPTER 2
METHODOLOGY AND DATA OF THE STUDY

The study aims to analyze to reveal the effects of independent variables on CO2. The EKC hypothesis was tested in different chapters and econometric models were applied for China, Australia, South Korea.
The data used in the study is explained in section 2.1 and the methodology of the study is discussed in section 2.2 also, methodology is explained in detail for each chapter.

2.1 Data

GDP is gross domestic product per capita. CO2 is carbon dioxide emissions per capita. ENC is energy consumption (kg of oil equivalent per capita). SQ is gross domestic product squared. CS is coal consumption (million tons of oil equivalent). In this study, annual data was obtained from UNCTAD's (2020), Worldbank's (2020), US energy information administration official website, TÜİK, IMF and FED database and analyzed with E-Views in the next step. The effects of variables such as GDP, SQ, ENC, transportation, sea transport, trade liberalization, industrial development, fossil fuels, international trade, and foreign debt on the emission of CO2 were examined in the light of the EKC hypothesis.

2.2 Methodology

For time series analysis of China first model is used also, Phillips-Perron (PP) and Zivot - Andrews unit root tests are applied to analyze providing those variables are stationary then FMOLS, DOLS, CCR and ARDL models are used. In the results section, GMM test is used. The EKC hypothesis is investigated for China for the period between 1980 and 2013. In this study,

China was chosen because it is the second largest economy in the world according to academics and number one economy according to projections. China has experienced highly appreciated economic growth since 1978. Although China was affected by the 2008 crisis, it managed to generate economic growth above a certain percentage. China produced half of the 1.2 million electric media used worldwide. This means that one of every two electronic devices in the world uses China's electronic circuit. The Chinese government has turned its attention to the rehabilitation and reuse of all these lithium-ion batteries. Because renewable energy has gained great importance now. Today, China leads the world in both production and maritime transport. Unfortunately, there is not enough incentive by the government to use renewable energy in transportation to reduce CO2 emissions. For this reason, in my thesis, the existing literature on the connection between maritime, trade liberalization and industrial development has been examined in the context of CO2 using an econometric model.

For time series analysis of Australia second model is used. TY test, BH tests, ARDL and NARDL bounds tests, and the GH tests are used. The significance of the study is that it is the first study in the literature to use NARDL model to examine the EKC hypothesis for Australia. The EKC hypothesis is investigated for Austria for the period between 1960 and 2014. Australia was chosen because there is a shortage of single country studies in the EKC literature. In addition, the study is important as Australia is heavily dependent on fossil fuels for its energy demands and is among the top 11 countries in the world for energy demands for coal consumption and has grown consecutively for the past 28 years.

For time series analysis of South Korea third model is used. ADF unit root test, Johansen co-integration test, FMOLS, DOLS and CCR models, ARDL model are used to examine the EKC hypothesis for South Korea. The EKC hypothesis is investigated for South Korea for the period between 1960 and 2014The economy of South Korea is the 11th largest economy in the world in nominal

terms and the 13th largest economy in terms of purchasing power parity and the 4th largest economy in Asia so was chosen for thesis.

As far as we know, the impact of international trade and financial development on emissions has not been analyzed in the literature. Therefore, there is a research gap on this subject in the literature.

For times series analysis of China, fourth model is used. In this study, the ARDL and nonlinear ARDL models are used. EKC relationship between GW and EMS is not checked by the ARDL and nonlinear ARDL models. The aim of this study is to examine the effect of EXD on EMS by ARDL and nonlinear ARDL models. The EKC hypothesis for China is investigated during the period between 1978 and 2014 to examine the symmetric and asymmetric relationships between the variables, respectively. I rechose China because the debt of the real estate sector in China is 30% of GDP in 2008. In 2015, it increased to 60% of GDP. To our knowledge, the effect of external debt on emissions has not been analyzed in the literature. Therefore, there is a research gap in the literature to examine the effect of external debt on emissions. The contribution of this study is to examine the impact of external debt on emissions in China. China has a problem with its growing foreign debt generating from local governments and private companies. This section examines this problem based on the EKC hypothesis.

Last model is used for times series analysis of China and Australia. ARDL bounds test is used to determine the symmetric relationships between the variables. In this study, it is examined the symmetric relationships between GDP, GP, and CS for Australia and between GDP, GP, CS and ENEC for China with ARDL bounds test. Then ARDL-ECM (error correction model) cointegration is found by ARDL bounds test between variables. Time period of the analysis is between 1980 and 2016 for Australia and 1980 and 2014 for China. Australia and China were chosen because there are among the countries that are heavily dependent on coal for their energy demand. Moreover, China is the current leader in the world in coal consumption. It is the

first study for time series studies in the literature of single country studies, which is based on the EKC hypothesis of Coal Consumption as a theoretical basis. The Coal Consumption variable, which is based on the EKC hypothesis, is important because the world is still heavily dependent on coal for its energy demands.

The addition of energy consumption, one of the major variables of the EKC hypothesis, to the model together with coal consumption has brought a new approach in terms of the originality of the study.

CHAPTER 3
EKC FOR CHINA

In this section, examines the nexus between sea transportation, trade liberalization, industrial development, and carbon dioxide emission by implementing FMOLS, DOLS, CCR and ARDL model with annual datas which are obtained from World bank's (2020) and UNCTAD's (2020) official website.

Firstly, Phillips-Perron (PP) (1988) and Zivot-Andrews unit root tests are used to analyze whether variables are stationary. After that FMOLS, DOLS, CCR and ARDL method are used to find out the co-integration intercourse among sea transportation, trade liberalization, industrial development, and CO2 emission.

GMM test is assumed to prove the impact of sea transportation, trade liberalization and industrial development on CO2 emission from 1980 to 2013 in China. In this chapter, log-linear conditions of the variables are executed to presume the equation below:

$$InCO2t = \beta 0 + \beta 1In\ Sea\_trns\ t + \beta 2In\ Trade\_lbr\ t + \beta 3In\ Indust\_dev\ t + \varepsilon t \quad (1)$$

CO2t, Sea_trnst, Trade_lbrt, Indust_devt indicate carbon dioxide emission, sea transportation, trade liberalization and industrial development, respectively. β1, β2 and β3 ensure the elasticity of the expositive variables.

3.1 Phillips-Perron (PP) Unit Root Test for China

Phillips-Perron (PP) test is performed to reveal the structure of the series in terms of stationarity. In this regard, according to Phillips-Perron test results, not all series are stationary which are including maritime transport, trade liberalization, industrial development, and carbon dioxide emissions.

Therefore, first differences of all series are taken to understand the structure of series in terms of stationarity. According to the Phillips-Perron (PP) test results, after the first differences of the variables are taken, the series become stationary. Thus, FMOLS, DOLS, CCR test can be implemented but performing traditional Phillips-Perron (PP) unit root test without considering these structural breaks in the model. These models may give false results and lose reliability in terms of estimation (Perron, 1989).

Variables	**PP (Fixed and trending) (Level 0)**	**PP (Fixed and trending) (First Difference)**	**Decision**
ln Sea_trns	-2.9843 **(-3.9958)**	-6.5246***** **(-3.7245)**	I(1)
ln Trade_lbr	-1.4527 **(-5.2358)**	-4.1235****** **(-2.9152)**	I(1)
ln Indust_dev	-1.9751 **(-3.9614)**	-5.7286***** **(-3.2724)**	I(1)
ln CO_2	-3.1262 **(-3.8261)**	-6.5192***** **(-3.4786)**	I(1)
Note: - * and ** The statements define 1% and 5% significance levels of the unit root test results of the variables used in the estimation process, , respectively.			

Table 1: Phillips-Perron (PP) Unit Root Test Results of China

3.2 Zivot-Andrews Unit Root Test for China

Zivot and Andrews (1992) developed a series of tests to consider endogenous structural changes, which are allows to evaluate the presence of a unit root against the alternative of a stationary process through a structural change both in level and trend. By this way, the ZA test investigates the possibility of the existence of a segmented trend. The ZA test attempts to identify structural breakage in the selected sample and treat it endogenously and the following equation regarding ZA test is indicated.

$$CO2_t = a + \theta DU(\lambda) + \beta_t + \varphi CO2_{t-1} + \sum_1^k p\triangle CO2_{t-1} + \mathcal{E}_t \quad (2)$$

$$CO2_t = a + \theta DT(\lambda) + \beta_t + \varphi CO2_{t-1} + \sum_1^k p\triangle CO2_{t-1} + \mathcal{E}_t \quad (3)$$

$$CO2_t = a + \theta_1 DU(\lambda) + \theta_2 DT(\lambda) + \beta_t + \varphi CO2_{t-1} + \sum_1^k p\triangle CO2_{t-1} + \mathcal{E}_t \quad (4)$$

Consequently, the model for CO_2 emissions in China would be as follows:

$$CO2_t = a + \theta_1 DU(\lambda) + \theta_2 DT(\lambda) + \beta_t + \varphi CO2_{t-1} + \sum_1^k p\triangle CO2_{t-1} + \mathcal{E}_t \quad (5)$$

CO2 is the logarithm of the carbon dioxide emission expressed in levels, α is constant, DU (λ) is the dummy variable that takes the value as 1 from the series in which the structural change is accepted as 0 in previous years. The variable t represents the time, while CO2 -1 is the carbon dioxide emission remaining for lagging one period. DT (λ) = t - Tλ, if t> Tλ and this is not the case 0. The next term is the sum of the change in the interest variable for the periods between t - j and k; the regressors of this term are added to eliminate the possible dependence on the limit distribution used in statistical tests resulting from the temporal dependence of the distributions and ε is the error term.

Variables	Level	First Difference	Model Selection	Decision
ln Sea_trns	-2.9314 **(-4.72)**	-6.9241* **(-4.98)**	C/T	I(1)
ln Trade_lbr	-3.8456 **(-4.96)**	-7.1247* **(-4.68)**	C/T	I(1)
ln Indust_dev	-4.6871 **(-5.62)**	-6.9413* **(-4.98)**	C/T	I(1)
ln CO_2	-2.6135 **(-4.56)**	-7.9346* **(-5.48)**	C/T	I(1)

Note: C/T: Indicates structural break together in constant trend. The expression "*" defines the results of the unit root test for the 1% significance level for the variables used in the estimation process. Expressions in parentheses are 1% significance, respectively.t shows the critical value for the level and the structural break dates. The findings substantiate that the variables used in the model are stationary I(1) at the first difference.

Table 2: Zivot-Andrews Unit Root Test Results of China

3.3 FMOLS, DOLS and CCR Models for China

According to results of FMOLS, DOLS and CCR models, there is a long-term stable relationship between trade liberalization, industrial development, sea transportation and CO2 emission which is demonstrated empirically. The p-value of sea transportation, trade liberalization and industrial development are less than 0.05 at Table 3. Thus, there are independent variables that affect the dependent variable (CO2). When it is analyzed the coefficients of the FMOLS model; 1 percent increase in industrial development increases CO2 by 0.1678 percent, a 1 percent increase in sea transport increases real CO2 by 0.3784 percent, a 1 percent increase in trade liberalization increases real CO2 by 0.2862 percent. According to coefficients of the DOLS model, a 1 percent increase in industrial development increases CO2 by 0.2156 percent, a 1 percent increase in maritime transport increases real CO2 by 0.2979 percent and a 1 percent increase in trade liberalization increases real CO2 by 0.3374 percent. Eventually, considering the coefficients of the CCR model; a 1 percent increase in industrial development increases CO2 by 0.1879 percent, a 1

percent increase in maritime transport increases real CO2 by 0.3216 percent and a 1 percent increase in trade liberalization increases real CO2 by 0.3247 percent.

The ARDL method is applied from FMOLS, DOLS and CCR analyzes whether there is a long-term causality relationship between maritime transport, trade liberalization, industrial development, and carbon dioxide emissions. Table 3 presents the results obtained from the ARDL method the results of the ARDL model are compatible with FMOLS, DOLS and CCR analysis.

Variables	**Dependent variable: CO_2**					
	Fully modified least square (FMOLS)		**Dynamic least square (DOLS)**			**Canonical co-integrating regression**	
	T-statistics	**P-value Coefficient**	**T-statistics**	**P-value Coefficient**		**T-statistics**	**P-value Coefficient**
Sea_trns	*-0.693462**	***0.0257*** ***0.3784***	*-0.617731**	***0.0482***	***0.2979***	*-0.786156**	***0.0317*** ***0.3216***
Trade_lbr	*-1.842746**	***0.0486*** ***0.2862***	*-2.678134**	***0.0179***	***0.3374***	*-2.124734**	***0.0454*** ***0.3247***
Indust_dev	*-1.23575**	***0.0368*** ***0.1678***	*-1.678965**	***0.0456***	***0.2156***	*-1.896543**	***0.0246*** ***0.1879***
C	*2.962458**	*0.0013* *1.9321*	*3.124237**	*0.0306*	*2.6479*	*3.118965**	*0.0067* *1.7895*

Table 3: Cointegration Estimation Results (FMOLS, DOLS and CCR Models of China)

FMOLS, DOLS and CCR co-integration analysis depends on the condition on which the series is applied, such as traditional common integration method requiring stationary series. Moreover, we can have the opportunity to commentate the provides derived coefficients course of process in terms of CO2 emission through considering independent variables including trade liberalization, industrial development, and sea transportation. The ARDL equation is indicated as econometric symbols in which the determinants of long-term economic growth are examined in equation (6) below:

$$\Delta lnCO2_t = a_0 + \sum_{i=1}^{m_1} \sigma_{it}\, \Delta lnCO2_{t-i} + \sum_{i=0}^{m_2} \beta_{it}\, \Delta\, lnSeatrns_{i,t-i} + \sum_{i=0}^{m_3} \theta_{it}\, \Delta lnTradelbr_{i,t-i} + \sum_{i=0}^{m_4} \theta_{it}\, \Delta lnIndustdev_{i,t-i} + \delta_{1i}\, lnCO2_{t-1} + \delta_{2i}\, lnSeatrns_{t-1} + \delta_{3i}\, lnTradelbr_{t-1} + \delta_{3i}\, lnIndustdev_{t-1} + \varepsilon_{it}$$

(6)

The long-run relationship between carbon dioxide emission $CO2_t$, trade liberalization $Tradelbr_t$ and industrial development $Industdev_t$ and sea transportation $Seatrns_t$ are investigated through f bounds test which is considered the zero hypothesis.

$$H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$$
$$H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$$

(7)

3.4 ARDL Bound Test for China

Findings from the FMOLS, DOLS and CCR models show that trade liberalization industrial development and maritime transport are determinants of long-term carbon emissions, just like the results of the ARDL model. It is also significant that the findings obtained from FMOLS, DOLS and CCR models, which are described as new co-integration techniques and allowed the separation of short and long-term relationships, consistent with the long-term results obtained from the ARDL model in Table 5. In this regard, trade relations should be increased by policy makers through improving maritime transport substructures and further accelerate their industrial growth through research and development.

Model	Optimal lag length	F-Statistics	Bound Critical	Test Value	Decision
			I (0)	I (1)	
$flnCO2; lnSea\_trns; lnTrade\_lbr; lnIndust\_dev$	(4,1,4,1)	5.0847*	4.03	5.06	
Note: * The critical values for F statistics are 4.03 for the lower limit and 5.08 for the upper limit at the 5% significance level. In the circumstances, there is a long-term cointegration relationship between the variables at the 5% significance level in the estimated model.					

Table 4: ARDL Bound Test Results of China

Considering the ARDL F-bound test, long-term ARDL estimates were made, respectively by revealing the long-term co-integration with the empirical model used among the variables. Long term ARDL forecast results are given in Table 4 which Long-term ARDL forecast results reveal that trade liberalization, industrial development and sea transport are key determinants of CO2 changes.

Dependent Variable: $lnCO_2$				
Variables	**Coefficient**	**Standard error**	**t-Statistics**	**P-Val**
Long-run Results				
ln Sea_trns	0.3017	0.0372	3.9562	0.0021*
ln Trade_lbr	-0.0756	0.2178	-0.3681	0.5987
ln Indust_dev	0.2972	0.0728	4.9852	0.0012*
Constant	3.1673	0.7235	2.9641	0.0035*
Trend	0.0059	0.0032	2.9246	0.0031*
Note: * The statement defines the unit root test results of the variables used in the estimation process at a 1% significance level.				

Table 5: Long-Term ARDL Estimation Results of China

In accordance with to the long-term ARDL results summarized in Table 5, a 1 percent increase in industrial development increases the CO2 rate by 0.2972 percent, while a 1 percent increase in sea transport increases the CO2 value by 0.3017 percent. Discrepant from other econometric models (FMOLS, DOLS and CCR), trade liberalization has no statistically significant effect on CO2. Long-run ARDL results are like short-run ARDL test result in terms of the relationships between CO2 and key economic determinants.

The short-term ARDL estimation results reveal that the main determinants of CO2 in the short-term change at a significance level of 1% in industrial development and sea transport. Table 6 summarizes the short-term ARDL results and the findings on error correction model.

As regards to Table 6, error correction model works to reach short-run adjustment. In the short term, approximately 78% of shocks in industrial development, sea transport and trade liberalization are compensated within a certain period and the system is re-established in the long term.

Dependent Variable: $lnCO_2$				
Variables	**Coefficient**	**Standard error**	**t-Statistics**	**P-Val**
Short-run Results				
D ($lnCO_2$ (-1))	0.2144	0.0926	1.2856	0.2124
D ($lnCO_2$ (-2))	0.1785	0.0868	1.9825	0.0356**
D ($lnCO_2$ (-3))	0.3286	0.1162	2.3175	0.0437**
D (lnIndust_dev)	0.5267	0.0679	5.9245	0.0089*
D (lnSea_trns)	0.1877	0.0518	2.8954	0.0000*
D (lnSea_trns (-1))	0.0042	0.0784	0.0317	0.8965
D (lnSea_trns (-2))	-0.2169	0.0829	-2.2886	0.0467**
D (lnSea_trns (-3))	-0.1657	0.0736	-3.1627	0.0491**
D (lnTrade_lbr)	-0.2878	0.1973	-1.9348	0.0965***
Constant	3.1674	0.4817	3.9523	0.0089*
Trend	0.0089	0.0028	5.0167	0.0037*
CointEq(-1)	-0.7319	0.2147	-3.8176	0.0026*
Note: *, ** and *** expressions indicate 1%, 5% and 10% significance levels, respectively.				

Table 6: Short Term ARDL Results and Error Correction Model of China

3.5 GMM Root Test for China

In the last part of the methodology, the generalized method of moments (GMM) is implemented to reveal the linear relationship between variables. The

generalized moments (GMM) are a general analysis used to estimate the parameters in terms of a statistical approach in econometrics. In this context, the generalized moments method (GMM) is a form of statistical model that matches pairs up macroeconomic data with knowledge of population moment conditions to forecast unknown components of economic analysis. After these components are obtained, the probability values should be investigated and inferences about the basic questions should be made.

(GMM) the equation of linear relationship among relevant variables.

$gt(wt, \delta 0) = xt\, \varepsilon t = xt\,(yt - zt\delta 0)$ is first equation.

(8)

$yt = zt\delta 0 + \varepsilon t,\ t = 1, n$

$zt = L \times 1$ descriptive variables vector

$\delta 0 = L \times 1$ unknown coefficients vector

$\boldsymbol{\varepsilon t}$ = random error term

Instrumental variables are.

$E[gt(wt;\delta 0)] = E[xt\varepsilon t] = E[xt\,(yt - zt\,\tau\,\delta 0)] = 0$

(9)

$K \times 1$ Instrumental Variables xt assumed as a vector.

zt includes part or full of components.

$wt, \{yt, zt, xt\}$ represent the vector of unique and non-constant elements. $\{wt\}$ is supposed to be a static and ergodic stochastic process.

Time series may have self-relationships. It can be said that this leads to false results and internality problems. GMM technique has been applied to minimize the internality problem. Different TSLS (Two-Stage Least Squares), White and HAC, TSLS method is selected and different GMM methods were implemented. Analysis results of GMM are given below (Table 7).

GMM Methods Errors Comparison	Root Mean Square Error (RMSE)
GMM/TSLS	**4.96**
GMM/White	6.72
GMM/HAC	5.32

Table 7: GMM Root Mean Square Error Results of China

Table 7, the lowest root mean square error is found in GMM-TSLS methods. Therefore, GMM-TSLS method was chosen for analysis.

Regarding the GMM-TSLS analysis (Table 8), there is no validation problem since the t-statistic value is more than 0.05. AR (1) is significant, and AR (2) is meaningless. The correlation between time series variables and variables leading to or behind a fixed amount of time for these parameters is clearly confirmed. Also, considering the generalized moments method - TSLS (Two Stage Least Squares) model, there is no autocorrelation problem since the Durbin Watson value (1.76 - see Table 5.) is close to 2.

Dependent Variable: CO_2				
Applied Analysis: GMM				
Sample Size: 1980 - 2013				
Observations: 34				
Estimation Weighting Matrix: TSLS Two Stage Least Squares				
Standard Errors & Covariance Computed Using Estimation Weighting Matrix: C D(GDP) D(Ext_debt) D(Energy)				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-8968554.	29243784.	4.235713	0.0028
Sea_trns	2.124562	0.317263	5.263267***	**0.0092**
Trade_lbr	0.673212	0.335861	3.261862***	0.0062
Indust_dev	-0.371519	0.076314	-3.547268***	0.0042
AR(1)	-0.767874	0.296781	-2.975379	0.0064
AR(2)	-0.619623	0.213673	-1.435296	0.3267
R-squared	0.819672		Mean dependent var	2.163681
Adjusted R-squared	0.786532		S.D. dependent var	1.471676
S.E. of regression	0.163578		Sum squared reside	13.1628
Durbin-Watson stat	1.761825		J-statistic	0.251231

Table 8: GMM (Generalized Method of Moments) Test Results of China

Instrumental variables are also added to the analysis. Three dummy variables are implemented for periodic intervals. The first dummy variable is GDP, which

represents China’s total economic growth from 1980 to 2013. Another dummy variable shows China's overall external debt for the years 1980-2013. The last dummy variable is used as energy consumption for China. In the generalized moments method, sea transportation, trade liberalization, industrial development influence CO2 in China which results are very important.

3.6 Effect of the Result in China

Our empirical findings show that trade relations should be increased by policy makers by improving maritime transport infrastructures in terms of environmental pollution. China should further accelerate their industrial growth through research and development.

As a growing economy, China is one of the leading countries in container maritime transport, so reducing costs are of great importance in terms of business management and competitive advantage.

CHAPTER 4
EKC FOR AUSTRALIA

The unit root levels of the variables were examined with the unit root test (RT test) of Zivot and Andrews (1992) (H Test). Perron (1990) stated that traditional RT tests may create biased results because traditional RT tests do not use structural breaks such as the Ng and Perron (2001) RT test (P Test).
Perron (1990) stated that RT tests that do not use structural breaks can show a unit root for a variable without structural breaks. The P test is also used to show traditional RT test results for variables.

In this study, the H-test model was used. Structural breaks and intersection, intersection and trend was used, as suggested by Sen (2003), Narayan's (2005) critical breakpoints are used to compare with the limit test results, as the sample size is small. Akaike Information Criteria (AIC) was selected to determine the lag length.

The Cusum (Stability Test A) and Cusum frames (Stability Test B) tests are used to determine the stability of the ARDL model results. Bayer and Hanck (2013) combined cointegration tests (BH Tests) were applied first since BH tests do not use structural breaks in the data. BH tests calculate Fisher-type statistics and test them against 5% critical values and the null hypothesis of the GH tests is that there is no cointegration among the tested variables. The ARDL model with the unrestricted intercept and no trend of Pesaran et al. (2001) model is used in this study .

The ARDL bounds test for cointegration is applied to examine the symmetric relationships between variables and ARDL model is the common methodology used in the literature of EKC studies and used in this study to compare results

with other studies in Australia such as tests was Breusch-Pagan-Godfrey Heteroskedasticity Test (BP Test), Breusch-Godfrey Serial Correlation LM Test (B test) and normality test (N Test).

The non-linear ARDL model developed by Shin (2014) was applied to examine the asymmetrical relationship between ENE, CO2, GDP and GDP squared, while no trend was applied due to the ARDL model analyzes the symmetrical relationship between the variables and as a result of the analysis, no symmetric relationship among variables is found. The stability of the nonlinear ARDL model is inspected with Stability Test A, Stability Test B, Test B, N test, BP Test and RESEt test (R Test).

The ARDL and NARDL models are applied including the structural break and which are also included in further analysis with the ARDL and NARDL models. In this study, Gregory and Hansen (1996a, 1996b) tests (GH Test) are used and the E-Views program is used for all calculations. Moreover, the GH tests have three models for investigating cointegration between variables, which are regime shift, level shift with trend, and level shift models.

All these three models were used in this study to investigate the relationships between variables. The test results of each model were checked with the values given by Gregory and Hansen (1996b). The EKC relationship between CO2 and GDP is analyzed with the ENE, CO2, GDP and GDP squared connection. In this study, the model applied is as below. The estimated parameters are h0, h1, h2 and h3 in the model. Also time index is t and error term is e in both models.

$$\ln(CO2)_t = h_0 + h_1 \ln(GDP)_t + h_2 \ln(GDP)_t^{\,2} + h_3 \ln(ENE)_t + e_t \quad (1)$$

The ARDL model is shown in the figure below for emissions, growth and energy consumption nexus.

$$\Delta LnCO2_t = J_0 + J_1 LnCO2_{t-1} + J_2 LnGDP_{t-1} + J_3 LnGDP^2{}_{t-1} + J_4 LnENE_{t-1} + \sum_{i=1}^{s} J_{5i} LnCO2_{t-i} + \sum_{i=0}^{h} J_{6i} LnGDP_{t-i} + \sum_{i=0}^{h} J_{7i} LnGDP^2{}_{t-i} + \sum_{i=0}^{w} J_{8i} LnENE_{t-i} + \mu_t \quad (2)$$

μ_t is for white noise residuals and $J_1, J_2, J_3 \; and \; J_4$ are long run coefficients. Moreover, $J_5, J_6, J_7 \; and \; J_8$ are short run coefficients in calculations.

Firstly, hypothesis of no cointegration $J_1, J_2, J_3 \; and \; J_4$ are all equal each other and zero, secondly hypothesis of cointegration is $J_1, J_2, J_3 \; and \; J_4$ are not all equal each other and zero.

The NARDL model is shown in the figure below for the linkage of emissions, growth and energy consumption.

$$\Delta LnCO2_t = Z_0 + Z_1 LnCO2_{t-1} + Z_2 LnGDP^-{}_{t-1} + Z_3 LnGDP^+{}_{t-1} + Z_4 LnGDP^2{}_{t-1} + Z_5 LnENE_{t-1} + \sum_{i=1}^{s} Z_{6i} LnCO2_{t-i} + \sum_{i=0}^{h} Z_{7i} LnGDP^+{}_{t-i} + \sum_{i=0}^{h} Z_{8i} LnGDP^-{}_{t-i} + \sum_{i=0}^{w} Z_{9i} LnGDP^2{}_{t-i} + \sum_{i=0}^{w} Z_{10i} LnENE_{t-i} + \mu_t \quad (3)$$

μ_t is for white noise residuals and $Z_1, Z_2, Z_3, Z_4, and \; Z_5$ are long-run coefficients. $Z_6, Z_7, Z_8, Z_9, and \; Z_{10}$ are short-run coefficients.

Firstly, hypothesis of no cointegration is $Z_1, Z_2, Z_3, Z_4, and \; Z_5$ are zero and all equal each other. Secondly, hypothesis of cointegration is Z_1, Z_2, Z_3, Z_4, Z_5 are not zero and not all equal each other.

Toda-Yamamoto (1995) Granger non-causality test (TY test) is applied. First the VAR model is established, and then the stability tests are applied. After the VAR model that satisfies the stability tests is established, the TY test is applied for CO2, GDP, square of GDP and ENE.

4.1 BH Test for Australia

The BH tests are applied. There is no cointegration between the variables according to Fisher-type statistics for the Engle-Granger, Johansen, Banerjee and Boswijk tests (see Table 9).

Null Hypothesis: No Cointegration	Fisher Type Test Statistics	5% Critical Value	Result
EG-J	9.1425774	10.637	No Cointegration
EG-J-Ba-Bo	15.112779	20.486	No Cointegration
Note: EG-J resembles Engle and Granger, and Johansen. Ba-Bo resembles Banerjee and Boswijk.			

Table 9: BH Test

The symmetrical and asymmetrical relationships between CO2, GDP, square of GDP and ENE are found with the ARDL and NARDL models, including structural break. The GH test was also applied for the relationship between CO2, GDP, square of GDP and ENE and maximum lag lengths was selected. (see Table 10).

Lag	AIC	SC
0	-11.72969	-11.42666
1	-21.97072*	-21.06163*
2	-21.68691	-20.17175
3	-21.41718	-19.29596
4	-21.31601	-18.58873
Note: SC resembles Schwarz Information Criteria		

Table 10. Lag Length Results

The optimum lag lengths was identified by ARDL and NARDL models. (see Figure 1 and Figure 2).

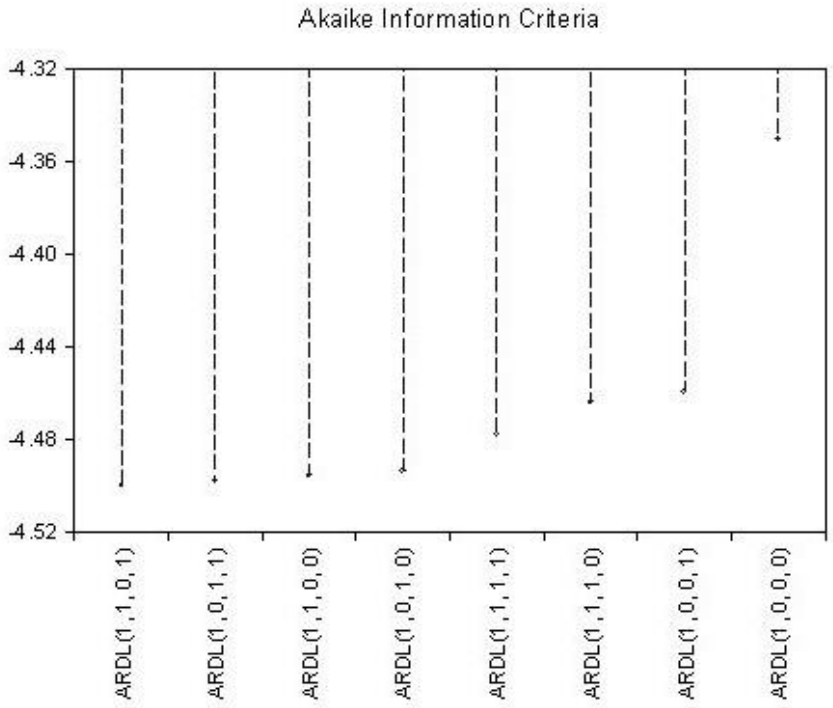


Figure 1: ARDL Model Graph

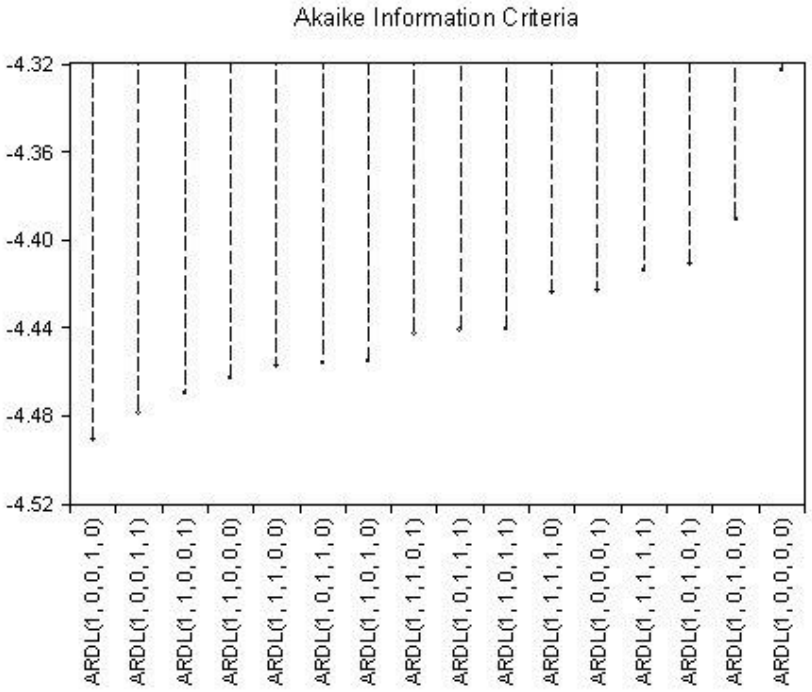


Figure 2: NARDL Model Graph

Variables are at I(1) levels (see Table 11 and Table 12).

LNCO2		**MZa**	**MZt**	**MSB**	**MPT**
Test statistics		0.14897	0.17913	1.20249	80.6862
D(LNCO2)					
Test statistics		-26.2758*	-3.54897*	0.13507*	1.17771*
LNGDP					
Test statistics		1.36841	1.46892	1.07345	85.0097
D(LNGDP)					
Test statistics		-24.2412*	-3.48137*	0.14361*	1.01099*
LNGDP2					
Test statistics		1.41383	1.52403	1.07794	86.3901
D(LNGDP2)					
Test statistics		-24.2029*	-3.47870*	0.14373*	1.01231*
LNENE					
Test statistics		0.46073	0.61042	1.32490	104.002
D(LNENE)					
Test statistics		-26.3732*	-3.56088*	0.13502*	1.15728*
ACV	1%	-13.8000	-2.58000	0.17400	1.78000
	5%	-8.10000	-1.98000	0.23300	3.17000
	10%	-5.70000	-1.62000	0.27500	4.45000
Notes: * Indicates the statistical significance for 1% levels. ACV indicates asymptotic critical values.					

Table 11: P Test

	Intercept	Lag	Break	Result	Trend + Intercept	Lag	Break	Result
LNCO2	-1.767175	0	1977		-2.146336	0	1978	
DLNCO2	-8.398569*	0	1993	I(1)	-8.769331*	0	2005	I(1)
LNGDP	-2.113969	0	1978		-3.119936	0	1973	
DLNGDP	-6.912995*	0	1993	I(1)	-7.183015*	0	1971	I(1)
LNGDP2	-2.294873	0	1997		-3.052157	0	1973	
DLNGDP2	-6.903919*	0	1993	I(1)	-7.097735*	0	1971	I(1)
LNEN	-2.446864	9	2005		-3.300569	9	2007	
DLNEN	-5.821035*	5	1993	I(1)	-5.589163*	5	1993	I(1)

.

Notes: * denotes the statistical significance for 1% levels.

Table 12: H Test

4.2 The ARDL and the NARDL models Stability Test for Australia

The data is obtained from the official web site World Bank official website as annual for Australia and analyzed time period is between 1960 and 2014. The ARDL and the NARDL models are stable as regards to the stability test results. (see Table 13 and 14, Figure 3, 4, 5 and 6).

Stability Test	F-Statistics	Probability	Jarque-Bera Statistics
R Test	0.849487	0.3616	-
Heteroskedasticity Test	1.326894	0.2595	-
Correlation Test	1.553104	0.2191	-
Normality Test	-	0.139067	3.945601

Table 13: ARDL Model Stability Test

Stability Test	F-Statistics	Probability	Jarque-Bera Statistics
R Test	0.039382	0.8436	-
Heteroskedasticity Test	1.230878	0.3057	-
Correlation Test	0.524775	0.4726	-
Normality Test	-	0.265448	2.652674

Table 14: NARDL Model Stability Test

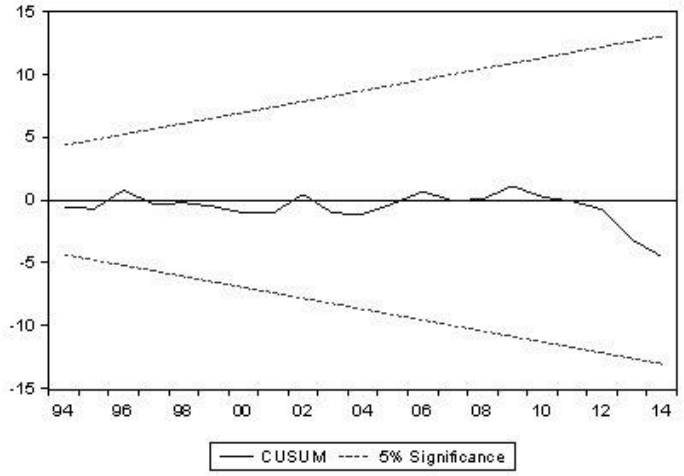


Figure 3: Stability Test A for ARDL Model

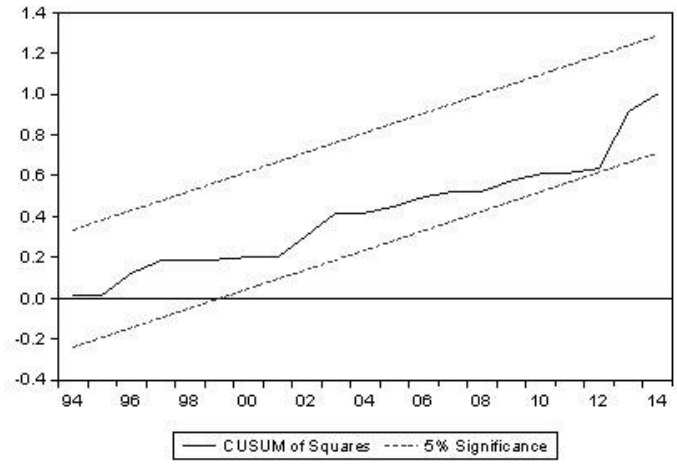


Figure 4: Stability Test B for ARDL Model

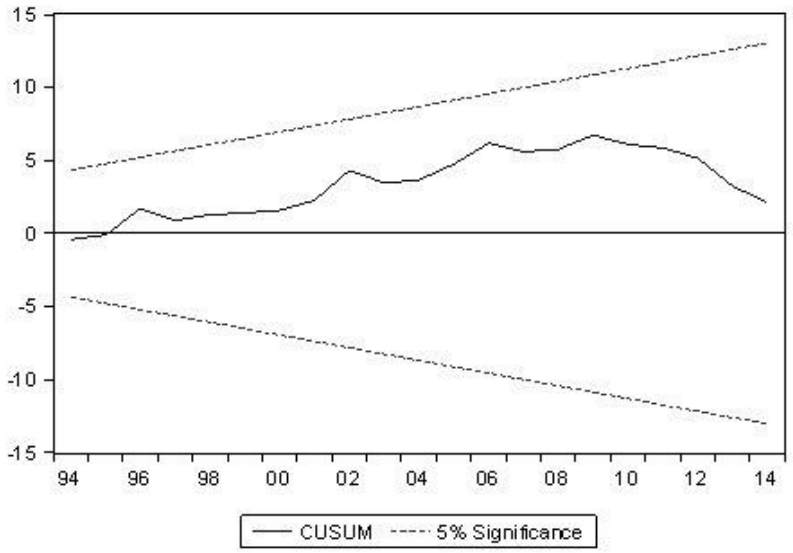


Figure 5: Stability Test A for NARDL Model

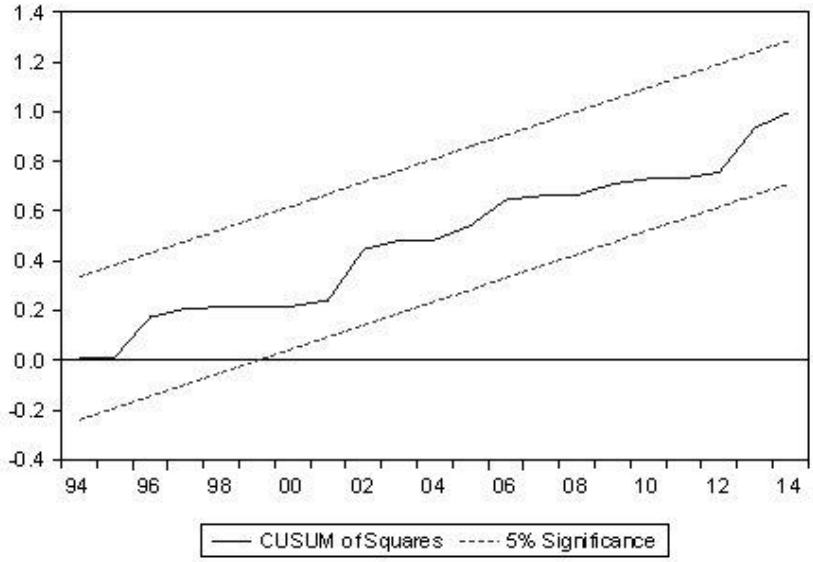


Figure 6: Stability Test B for NARDL Model

4.3 The ARDL and the NARDL Bound Test for Australia

Date of 1993 is the only date that satisfies the stability tests which is used for break date in the ARDL and NARDL models. The GDP is devided into positive and negative components while square of GDP and energy consumption are used as control variables in NARDL model. Considering to the F-statistics

values of the ARDL and NARDL bounds tests, no cointegration exists (see Table 15).

		5%			
Break	**F-Statistics**	**I0 Bound**	**I1 Bound**	**Model**	**Durbin Watson Statistics**
1993	3.097638	3.23	4.35	ARDL	2.232868
1993	2.199841	2.86	4.01	NARDL	2.143093

Table 15: Bounds Test Results

4.4 GH Test for Australia

First of all the ARDL and NARDL models are implemented which are uses one structural break in the model. Afterwards, the GH cointegration test is implemented which are include 1978 as the structural breaks in the model (see Table 16). In this study, GH test have three models which are T statistics, Za statistics and Zt statistics are not significant at 1% and 5% critical values. (see Table 16 and Table 17).

Model	**Level Shift**	**Regime Shift**	**Level Shift with Trend**
ADF Procedure			
T statistics	-4.214769	-5.222430	-5.373122
Break	1978	1978	1978
Philips Procedure			
Za Statistics	-28.63301	-40.09428	-39.43582
Break	1978	1978	1978
Zt Statistics	-4.230459	-5.271468	-5.423575
Break	1978	1978	1978

Table 16. GH Test

ADF, Zt	.01	.05
C	-5.77	-5.28
C/T	-6.05	-5.57
C/S	-6.51	-6.00
Zα		
C	-63.64	-53.58
C/T	-70.27	-59.76
C/S	-80.15	-68.94

Table 17. Critical Values for GH Test

4.5 TY test for Australia

TY test is implemented since there is no cointegration. The VAR model is created and fulfill the stability test results (see Table 18, 19 and 20).

Component	Jarque-Bera	Df	Prob.
1	1.795771	2	0.4074
2	1.865356	2	0.3935
3	2.501137	2	0.2863
4	1.978563	2	0.3718
Joint	8.140827	8	0.4198

Table 18: N Test

Lags	LM-Stat	Prob
1	13.32751	0.6487
2	13.01692	0.6715
3	13.76903	0.6159

Table 19: Test for Serial Correlation

Chi-sq	df	Prob.
195.5481	220	0.8810

Table 20: Heteroskedasticity Test

In accordance with TR test results, there is no causality from GDP, GDP squared and ENE to CO2 in the short run (see Table 21).

Excluded	Chi-sq	df	Prob.
GDP	3.865488	3	0.2764
GDP2	3.917530	3	0.2705
ENE	2.725968	3	0.4358
All	9.302788	9	0.4098

Table 21: TY Test

The Environmental Kuznets Curve for Australia has not been validated by BH tests, ARDL and NARDL bounds tests and GH tests.

4.6 Effect of the Result in China

Australia should continue its efforts to reduce oil consumption, increase renewable energy production levels and support existing market mechanisms that favor renewable energy production over fossil fuel consumption.

Australia can continue its economic growth without worrying that reducing CO2 emissions will negatively affect GDP.

For further policy advice, Australia should increase investment in public transport because public transport is not adequate for Australian cities.

Increasing use of public transport can reduce the use of passenger cars, which is beneficial in terms of emission reduction.

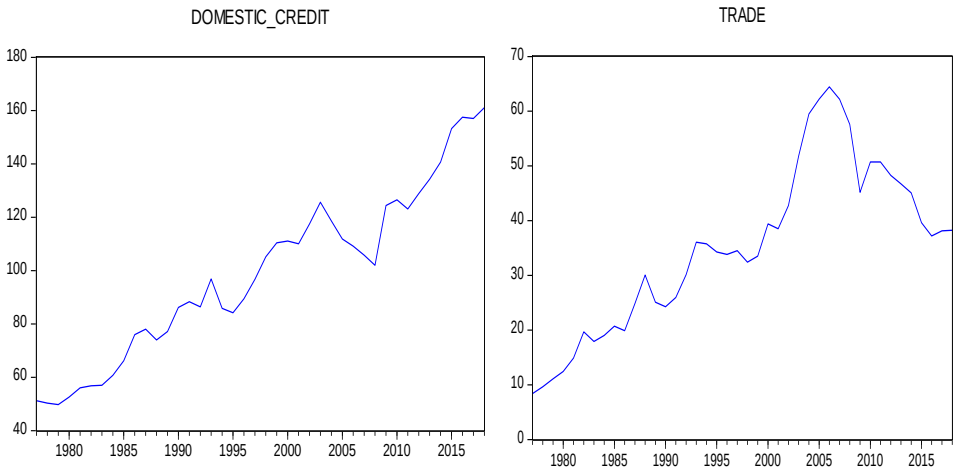
Emissions from the transport sector have the second highest amount of emissions after the energy sector.

CHAPTER 5
EKC FOR SOUTH KOREA

International trade, financial development and GDP annually data are taken from the worldbank's official website for South Korea. The economic growth variable is determined annually as GDP for South Korea between 1977 to 2018 from the world bank's official website. Moreover, International trade data is obtained from the same source as the sum of exports and imports of goods and services. Ultimately, financial development data is derived as domestic credit to the private sector.

5.1 ADF Unit Root Test for South Korea

The stationary test should be applied by using ADF unit root test in order to begin co-integration analysis. Based on the results of extended Dickey-Fuller ADF tests, all series are not stationary at I(0) (see Table 22). Therefore, in order to understand whether it is stationary, it must be converted from I(0) to I(1) using the ADF unit root test. Also, there is no symmetrical distribution in the course of the series between 1977 to 2018. (see Figure 7).



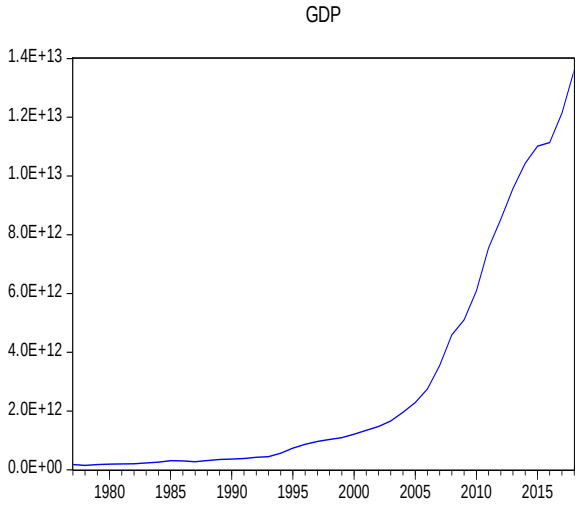


Figure 7: Financial Development, International Trade **(**the sum of exports and imports of goods and services) and GDP at I(0).

South Korea	**Variables**	**Series at I(0)**
		t-statistic / crit-val (%5) / p-value
	Economic Growth (GDP)	*5.47 / -2.95 / 1.0000*
	International Trade	*-1.80 / -2.93 / 0.3741*
	Domestic Credit to PS	*0.06 / -2.93 / 0.9593*

Table 22: ADF Unit Root Test Results, 1977 to 2018 at I(0)

After taking the first difference of the variables and transforming from I(0) to I(1), all series become stationary regards to Augmented Dickey Fuller test results (See Table 23) which is mandatory to continue Johansen co-integration test.

South Korea	Variables	Series at I(I)
		t-statistic / crit-val (%5) / p-value
	Economic Growth (GDP)	*-3.73 / -2.96 / 0.0085*
	International Trade	*-6.97 / -2.94 / 0.0000*
	Domestic Credit to PS	*-5.89 / -2.93 / 0.0000*

Table 23: ADF Unit Root Test Results, 1977 to 2018 After Taking First Difference I(I)

There is also a symmetrical distribution throughout the series from 1977 to 2018 (see Figure 8).

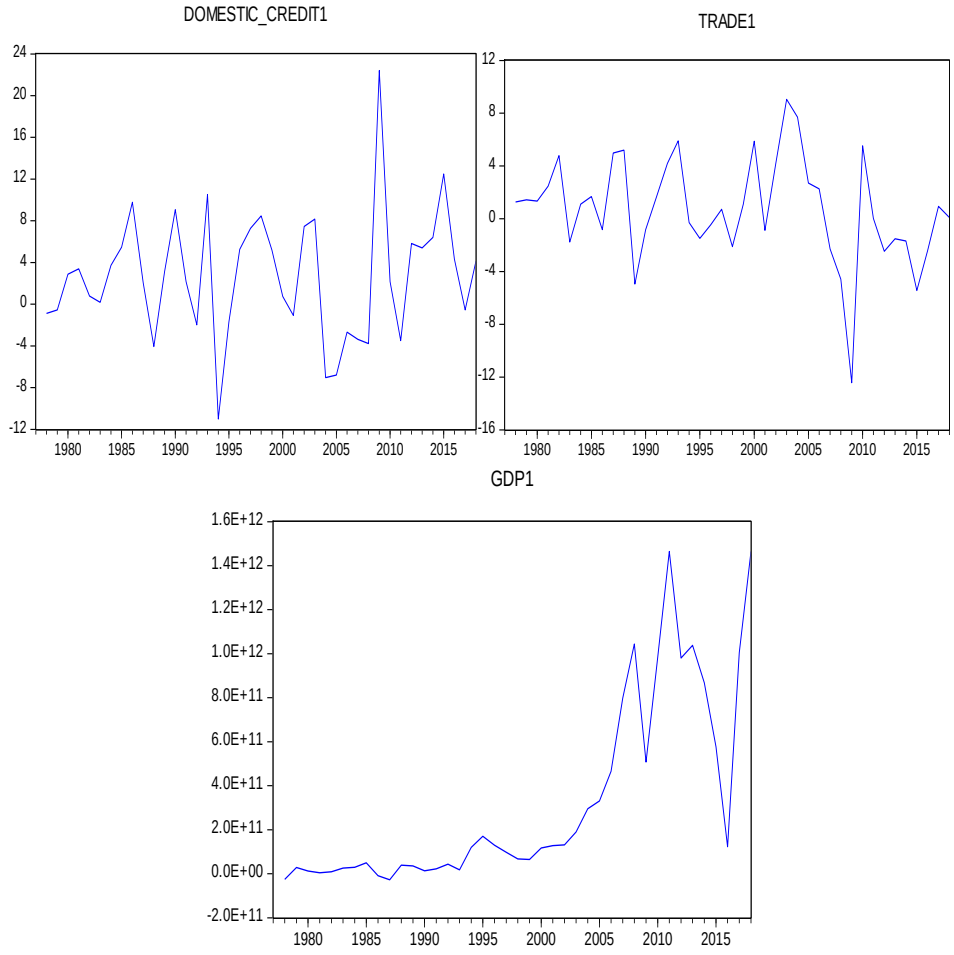


Figure 8: Financial Development, International Trade and Economic Growth at I(I)

5.2 Johansen Co-integration Test for South Korea

Considering to the co-integration test results in Table 24, there is a long-term relationship between GDP, the sum of exports, domestic credit to the private sector, and imports of goods and services (international trade). After transforming from I(0) to (I) all series become stationary. The ADF test is implemented to GDP, Financial Development and International Trade variables to analyze for stability. Additionally, the maximum lag length is chosen as 2 (considering the AIC Akaike Information Criteria) as recommended by Serena and Perron (2001). The VAR model is implemented for South Korea to understand the linear interdependence between three variables, including International Trade, GDP and Financial Development.

	Hypothesis	Eigenvalue	Trace Statistics	0.05 Critical Value	p-Value
South Korea	r=1, r=>1	*0.623005*	*56.63732*	*29.79707*	*0.0000*
	r=2, r=>2	*0.372198*	*18.59187*	*15.49471*	*0.0165*
	r=3, r=>3	*0.011121*	*0.436163*	*3.841466*	*0.0090*

Table 24: Johansen Co-integration Test Results of South Korea 1977-2018

The lag order is 2 in the analysis. All the roots fell into the circle in the figure after applying the inverse roots of the features AR polynomial. Therefore, the VAR analysis is stationary (see Figure 9).

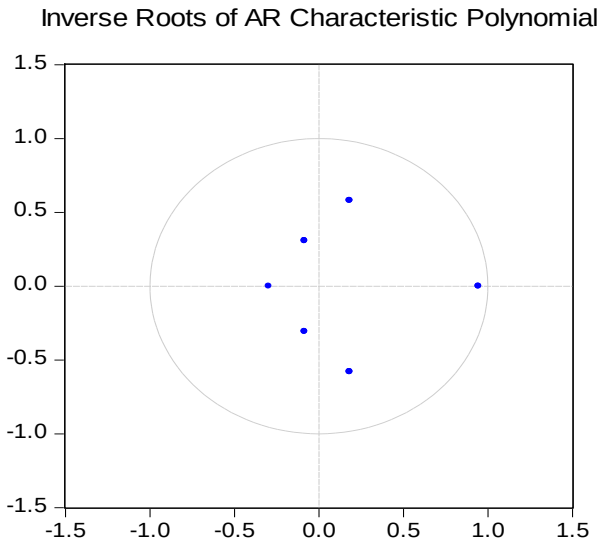


Figure 9: Result of VAR Analysis

Both of impulse response and variance decomposition analysis are applied for domestic credit to private sector also, domestic credit are used for economic growth. Within this scope, two analyzes were conducted to tenor the grade of the relationships between the variables. The findings remark that domestic credit to the private sector has the biggest effect on economic growth (GDP) according to total imports and exports of goods and services in South Korea (see Table 25 and Figure 10).

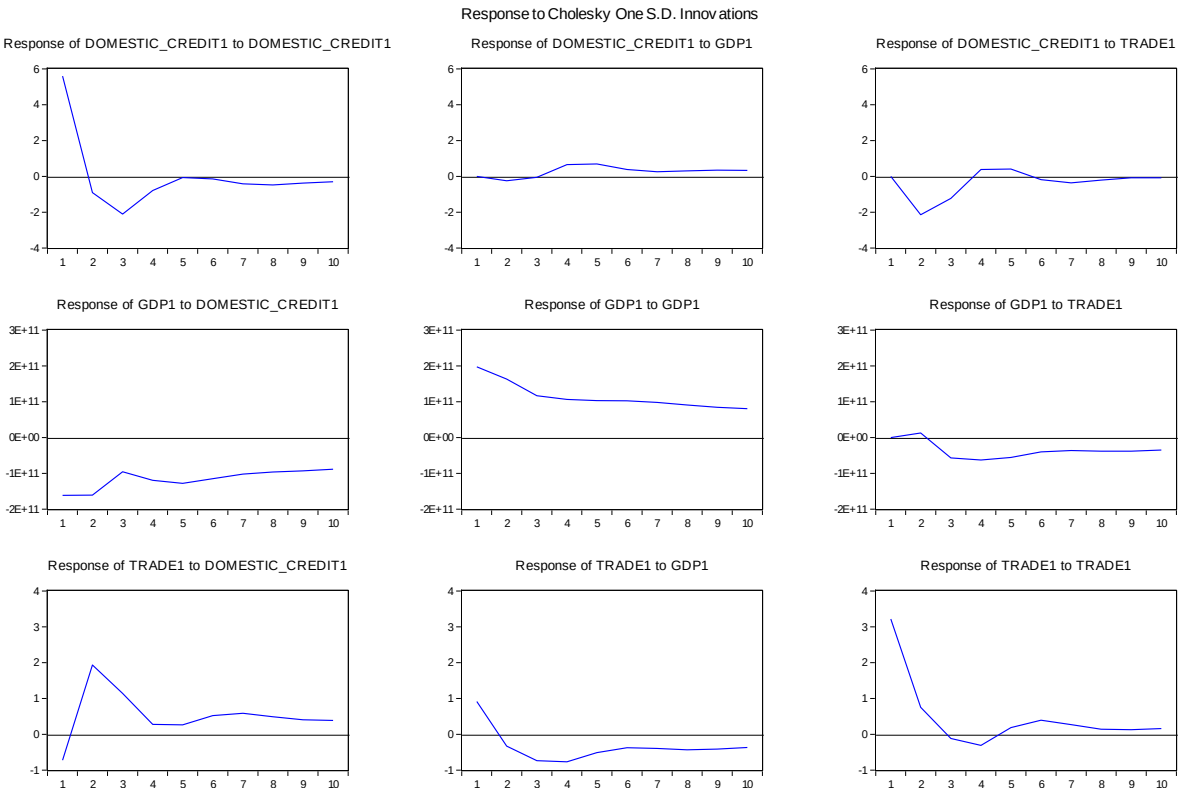


Figure 10: Impulse Response Analysis

The variance decomposition results confirm the verify impulse response results (see Table 25 and Figure 10). Therefore, the empirical results indicate that triggers economic growth by the policy of giving incentives to the establishment of new local companies in South Korea.

Period	S.E.	DOMESTIC_CREDIT1	GDP1	TRADE1
1	2.55E+11	40.21116	59.78884	0.000000
2	3.43E+11	44.30442	55.56405	0.131524
3	3.79E+11	42.67145	54.94849	2.380061
4	4.16E+11	43.64432	52.09143	4.264246
5	4.51E+11	45.25353	49.58352	5.162944
6	4.78E+11	46.03406	48.66501	5.300930
7	5.00E+11	46.28591	48.33770	5.376391
8	5.19E+11	46.47522	47.98452	5.540255
9	5.35E+11	46.70113	47.58357	5.715293
10	5.49E+11	**46.90991**	**47.25575**	**5.834340**

Table 25: Variance Decomposition

On the purpose of apply the FMOLS, DOLS and CCR analysis, the series must be stationary. In this context, AFD unit root test should be done. Considering to the findings of the ADF unit root test, all variables including GDP, domestic credit to the private sector, and the sum of exports and imports of goods and services (international trade) are not constant (see Table 22). The main problem is that the t-statistics scores are less than 1%, 5% and 10%, assuming the absolute value of the findings. Moreover, the p values of all variables are not less than the critical value (See Table 22). Then, the ADF unit root test was performed again to determine the stationarity structure of the series by taking the first difference of three variables. Mentioned three variables become stationary according to the ADF unit root test results (See Table 23).

5.3 FMOLS, DOLS, and CCR Analysis for South Korea

FMOLS, DOLS, and CCR models may applied to reveal the long-run connection between GDP, total exports and imports of goods and services (international trade) and domestic credit to the private sector (financial development). In reference to the results of FMOLS, DOLS and CCR models, there is a stable long-run connection between the variables, affects economic growth and financial development (domestic credit to the private sector), which is consistent with the Johansen cointegration test (see Table 24 and Table 26).

Variables	**Dependent variable: Economic Growth (GDP)**					
	Fully modified least square		**Dynamic least square**		**Canonical cointegrating regression**	
	T-statistics	**P-value**	**T-statistics**	**P-value**	**T-statistics**	**P-value**
Trade_lbr	*-0.717778**	***0.4774***	*-0.739928**	***0.4653***	*-0.498044**	***0.6214***
Domestic_cr	*-2.131823**	***0.0397***	*-2.553702**	***0.0162***	*-2.065123**	***0.0460***
C	*3.310437**	*0.0021*	*2.742889**	*0.0103*	*2.991811**	*0.0049*

Table 26: FMOLS, DOLS, and CCR Analysis for South Korea (1977 – 2018)

Pesaran, Shin and Smith (2001) developed the ARDL model based on the econometrical models are frequently applied in the analysis of short- and long-term links between macroeconomic factors. The ARDL method demonstrates proper results without causing loss of information in the sample though the series used are stationary in level or difference. It can also provide reliable estimates in the case of a small sample as well. To summarize, traditional co-integration analysis is applied to indicate stable long-run connection between series. Hansen and Phillips (1990) developed FMOLS because of the inherent problem in the estimation process and the inability to interpret the long-term coefficients obtained. FMOLS method left to the DOLS methods which developed by Stock and Watson (1993).

Concordantly, the ARDL equation is evidenced with econometric symbols, where the determinants of long-term economic growth are examined in equation (1) below:

$$\Delta lnGDP_t = a_0 + \sum_{i=1}^{m_1} \sigma_{it}\ \Delta lnGDP_{t-i} + \sum_{i=0}^{m_2} \beta_{it}\ \Delta\, lnDomestic_{i,t-i} + \sum_{i=0}^{m_3} \theta_{it}\ \Delta lnTradelbr_{i,t-i} + \delta_{1i}\ lnGDP_{t-1} + \delta_{2i}\ lnDomestic_{t-1} + \delta_{3i}\ lnTradelbr_{t-1} + \varepsilon_{it} \quad (1)$$

The long-run relationship between economic growth (GDP_t), domestic credit $domestic_t$ and trade liberalization $Tradelbr_t$ is investigated by the f-bounds test, which is accepted as the null hypothesis, see equation (2) below.

$$H_0: \delta_1 = \delta_2 = \delta_3 = 0$$

$$H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq 0 \quad (2)$$

Findings from FMOLS, DOLS and CCR models demonstrate that domestic credit and trade liberalization are the determinants of long-term GDP, just as in the results of the ARDL model. Acquiring from the FMOLS, DOLS and CCR

models indicate that trade liberalization and domestic credit are determinants of long-term GDP, as are the results of the ARDL model. The findings acquired from FMOLS, DOLS and CCR models, which are described as new co-integration techniques and allowed the separation of short and long-run relationships, consistent with the long-run results acquired from the ARDL model in Table 27. Within this scope, policy makers should be supported to increased trade relations allowing via permitting more domestic credit and further accelerate their economic growth through research and development.

5.4 ARDL Test for South Korea

Take an account the ARDL F-bound test, long-run ARDL estimates were made respectively via the revealing long-run co-integration with the empirical model which is used between the variables. Long-term ARDL forecast results reveal that the main determinants of GDP changes in trade liberalization and domestic credit. Long-term ARDL forecast results are shown in Table 27.

Dependent Variable: lnGDP				
Variables	**Coefficient**	**Standard error**	**T Statistics**	**P-Val**
Long-run Results				
ln Trade_Ibr	-0.0861	0.3264	-0.2982	0.6138
ln Domestic Cr	0.3123	0.0461	4.0157	0.0032*
Constant	2.8965	0.6827	3.0237	0.0046*
Trend	0.0068	0.0041	3.0137	0.0042*
Note: * the expression defines the unit root test results of the variables used in the estimation process at the 1% significance level.				

Table 27: Long-Term ARDL Estimation Results of South Korea

Considering to the long-run ARDL results summarized in Table 28; when domestic credit increases by 1 percent, GDP increases by 0.3123% and trade liberalization has no statistically significant effect on GDP. Short-term ARDL results are like long-term ARDL test results in terms of relationships between GDP and key economic determinants.

Model	Optimal lag length	F-Statistics	Bound Test Critical Value	
			I(0)	I(1)
$flnGDP; lndomestic_{cr}; lnTrade\_lbr$	(4,1,4,1)	5.0958*	4.04	5.07

Table 28. ARDL Bound Test Results of South Korea

The short-term ARDL estimation results reveal that the main determinants of GDP in the short-term change at a significance level of 1% in domestic credits. The short-term ARDL results and the findings on the error correction model are summarized in table 29. Considering to Table 29, the error correction model works to reach short-term correction. In the short run, approximately 72.26% of the shocks in domestic credit and trade liberalization are compensated within a certain period and the system is re-established in the long run.

Dependent Variable: lnGDP				
Variables	**Coefficient**	**Standard error**	**t-Statistics**	**P-Val**
Short-run Results				
D (lnGDP (-1))	0.2233	0.1017	1.2962	0.2231
D (lnGDP (-2))	0.1678	0.0971	1.8914	0.0468**
D (lnGDP (-3))	0.3375	0.1251	2.4265	0.0442**
D (ln Domestic Cr)	0.1766	0.0627	2.9162	0.0000*
D (ln Domestic Cr (-1))	0.0031	0.0563	0.0421	0.8862
D (ln Domestic Cr (-2))	-0.2271	0.0738	-2.3197	0.0458**
D (ln Domestic Cr (-3))	-0.1766	0.0824	-3.2734	0.0412**
D (lnTrade_lbr)	-0.2767	0.2062	-1.8951	0.0987***
Constant	3.1743	0.5120	3.9634	0.0092*
Trend	0.0090	0.0031	4.9854	0.0035*
CointEq(-1)	-0.7226	0.2258	-3.7961	0.0019*
Note: *, ** and *** expressions indicate 1%, 5% and 10% significance levels, respectively.				

Table 29: Short Term ARDL Results and Error Correction Model of South Korea

5.5 Effect of the Result in South Korea

Analysis results show that the South Korean government should try to contribute to financial development to build a resilient financial system and triggering the Gross Domestic Product (GDP) will be beneficial for sustainable economic development.

In this context, the removal of all trade barriers, a well-developed logistics infrastructure and a suitable macroeconomic environment are essential for the realization of the determined policies.

The South Korean government should encourage the flow and use of RMB (Chinese Yuan) across countries and support the private sector, local companies by providing incentives. Therefore, building a better state bank infrastructure and government financial system cooperation is also extremely important.

CHAPTER 6
EKC FOR CHINA

The ARDL model is implemented to analyze the symmetrical relationships among variables. Pesaran, Shin, and Smith (2001) developed the ARDL model to analyze the relationships between variables with a combination of level and first difference stability levels. If one of the variables have I(2) level stability, The ARDL model is not applied. In this study, Zivot and Andrews (1992), developed the the unit root test (ZU test). ZU test takes into account the structural breaks in the variables. The ZU test deal with three scenarios; the break in the trend, the break in the intercept, and the break in the intercept and the trend. Moreover, Sen (2003) developed the two scenarios implemented, which are the break in the intercept and the break in the intercept with the trend. ARDL model assumes that the symmetrical relationship between independent and dependent variables. Nonlinear asymmetric ARDL model is applied to examine the relationships between variables. Shin, Yu and Greenwood-Nimmo (2014) developed the nonlinear ARDL model to examine the asymmetric relationships between the variables. The nonlinear ARDL model is used to analyze the relationships between first difference stability levels and variables that have a combination of level. The ARDL and nonlinear ARDL models are also used to examine the relationship between EMS and GW in this chapter. EM and EXD variables are used as control variables and their effects on EMS were also analyzed. Based on the EKC hypothesis, the relationships between the variables are analyzed.

To test the stability of the models are Breusch-Pagan-Godfrey Heteroskedasticity test (Test 1), Ramsey Reset test (Test 2), White Heteroskedasticity test (Test 3), Arch Heteroskedasticity test (Test 4),

Breusch-Godfrey Serial Correlation LM test (Test 5), normality test (Test 6), CUSUM test (Test 7) and CUSUM of Squares test (Test 8) are used.

6.1 Lag Selection Schwarz Criteria for China

Schwarz Information criterias are used to selection number of delays (see Fig. 11 and 12).

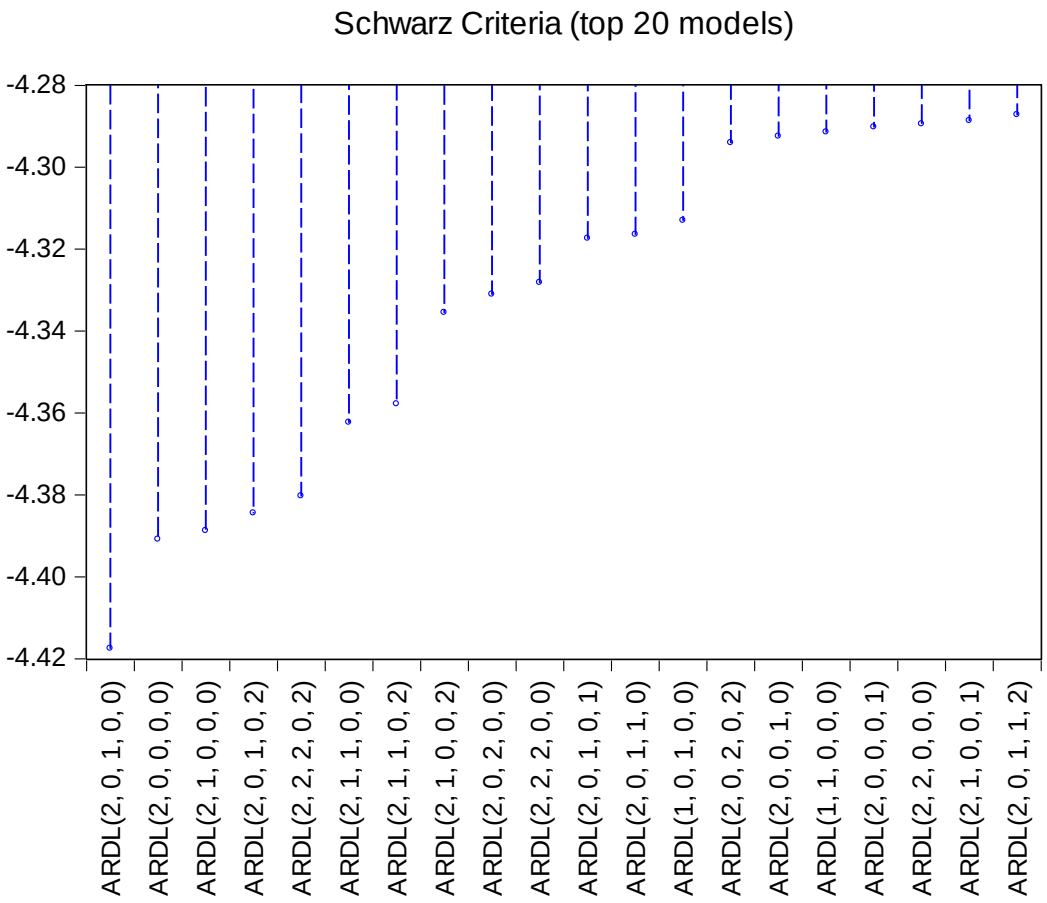


Figure 11: Lag Selection - ARDL

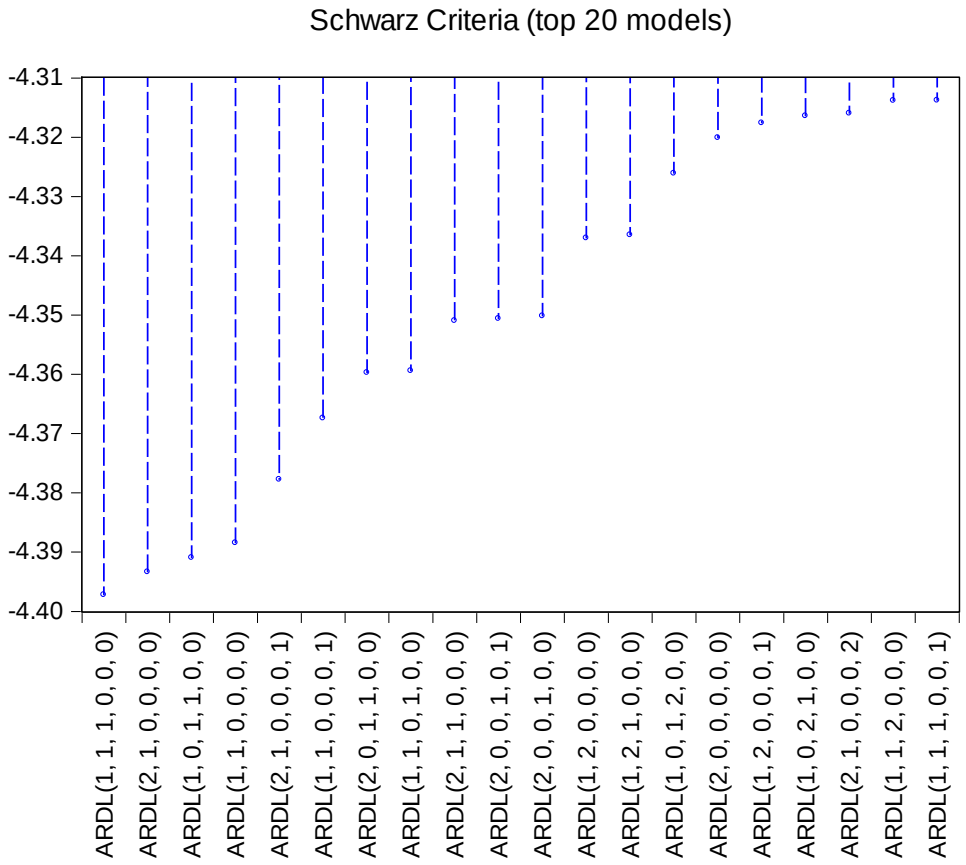


Figure 12: Lag Selection – Nonlinear ARDL

The model of the study is as follows. r_1,r_2,r_3 and r_4 are estimated parameters. Also T is the times index and E is the error correction term.

$$ln(CO2)_t = r_0 + r_1\, ln(GDP)_t + r_2\, ln(GD)_t + r_3\, ln(EM)_t + r_4\, ln(EXD)_t + e_t \quad (1)$$

The ARDL model is specified for the EMS, GW, EM and EXD nexus as below.

$$\Delta LnCO2_t = R_0 + R_1\, LnCO2_{t-1} + R_2\, LnGDP_{t-1} + R_3\, LnGD_{t-1} + R_4\, LnEM_{t-1} + R_5\, LnEXD_{t-1} + \sum_{i=1}^{s} R_{6i}\, LnCO2_{t-i} + \sum_{i=0}^{h} R_{7i}\, LnGDP_{t-i} + \sum_{i=0}^{g} R_{8i}\, LnGD_{t-i} + \sum_{i=0}^{z} R_{9i}\, LnEM_{t-i} + \sum_{i=0}^{w} R_{10i}\, LnEXD_{t-i} + \mu_t \quad (2)$$

μ_t represents white noise residuals. $R_1, R_2, R_3, R_4 \, and \, R_5$ are long-run coefficients and $R_6, R_7, R_8, R_9 \, and \, R_{10}$ are short-run coefficients.

The nonlinear ARDL model is specified for the EMS, GW, EM and EXD nexus as below.

$$\Delta LnCO2_t = R_0 + R_1 LnCO2_{t-1} + R_2 LnGDP^+{}_{t-1} + R_3 LnGDP^-{}_{t-1} + R_4 LnGD_{t-1} + R_5 LnEM_{t-1} + R_6 LnEXD_{t-1} + \sum_{i=1}^{s} R_{7i} LnCO2_{t-i} + \sum_{i=0}^{h} R_{8i} LnGDP^+{}_{t-i} + \sum_{i=0}^{v} R_{9i} LnGDP^-{}_{t-i} + \sum_{i=1}^{s} R_{10i} LnGD_{t-i} + \sum_{i=0}^{w} R_{11i} LnEM_{t-i} + \sum_{i=0}^{y} R_{12i} LnEXD_{t-i} + \mu_t \quad (3)$$

μ_t is for white noise residuals. $R_1, R_2, R_3, R_4, R_5 \, and \, R_6$ are long-run coefficients. $R_7, R_8, R_9, R_{10}, R_{11} \, and \, R_{12}$ are short-run coefficients.

The hypothesis of no cointegration is that long-run coefficients are zero and are all equal to each other for ARDL and nonlinear ARDL models. The cointegration hypothesis is that the long-run coefficients are not zero and they are not all equal.

6.2 ARDL Model for China

The unit root test results show that none of the variables are at the I(2) level (see Table 30).

	Intercept			Intercept + Trend		
Variable	**Level**	**First Difference**	**Break**	**Level**	**First Difference**	**Break**
CO2	-4.173916	-4.822856***	2002	-4.963225***	-	1997
GDP	-3.258378	-5.073593**	1994	-3.622182	-5.028785**	2007
EM	-5.068243**	-	2003	-4.038738	-5.359761**	2003
EXD	-3.630325	-7.095942*	1988	-2.692407	-6.808222*	2001

Table 30: Unit Root Test with Structural Break

The F-statistics value (F value) is 8.91, which is 5.06 higher than the I1 breakpoint of 1%. Symmetric cointegration among the variables are confirmed. The ARDL model's stability is checked and validated. (See Table 31, Fig. 13, and Fig. 14).

Test Type	F	P
Test 1	1.615020	0.1688
Test 2	1.055943	0.3140
Test 3	1.530317	0.1950
Test 4	0.692603	0.5081
Test 5	0.192516	0.8261
Test 6	0.746618	0.688452
*P denotes probability value		

Table 31: Stability Test Results – 1

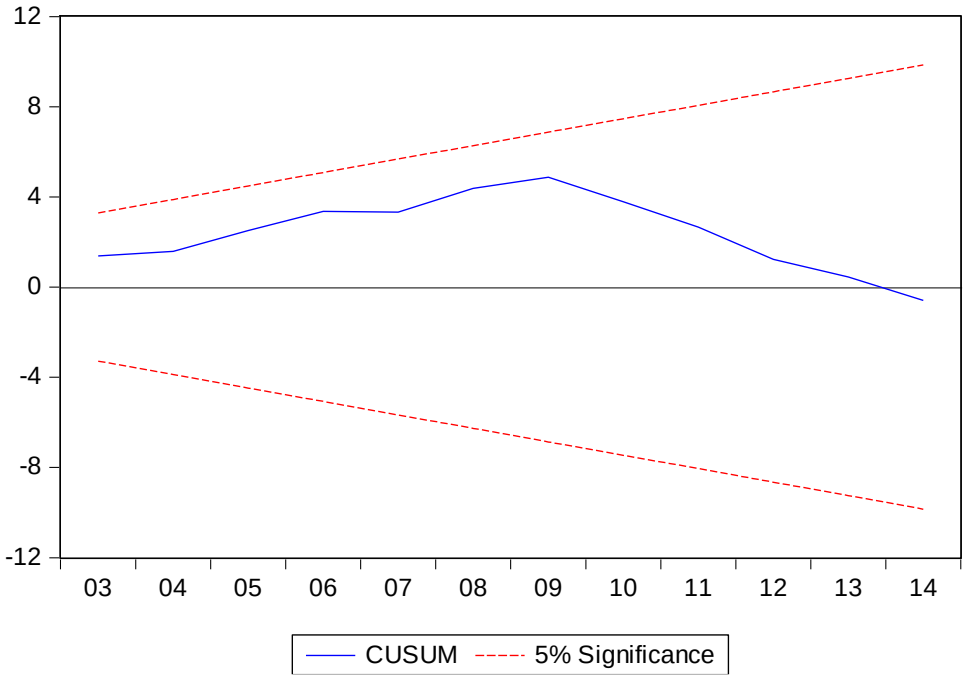


Figure 13: Test 7

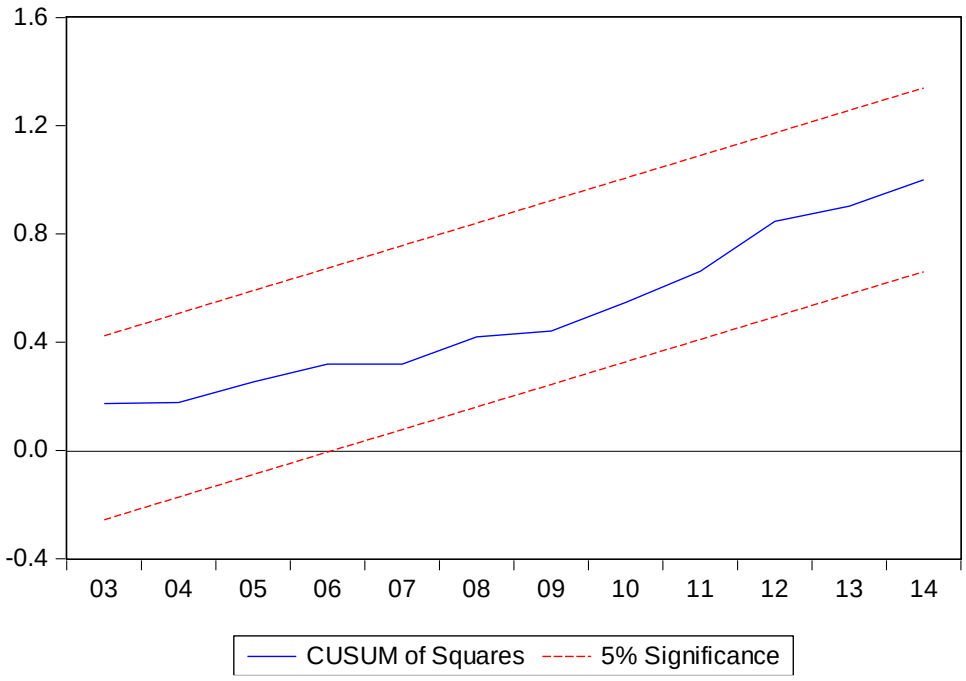


Figure 14: Test 8

The Durbin-Watson value of 1.752928 also confirms the stability of the ARDL model. In the long term, EXD and EM have positive and significant effects on EMS according to ARDL model test results. (See Table 32).

Short-run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCO2(-1))	0.279092	0.114407	2.439463	0.0218
D(LGDP)	0.135719	0.086324	1.572206	0.1280
D(LGD)	-0.003200	0.009625	-0.332464	0.7422
D(LEM)	0.579847	0.154685	3.748576	0.0009
D(LEXD)	0.078953	0.013892	5.683492	0.0000
D(R2002)	0.043082	0.025475	1.691178	0.1028
CointEq(-1)	-0.585073	0.103492	-5.653298	0.0000
Long-run Coefficients				
LGDP	0.231969	0.133424	1.738584	0.0939
LGD	-0.020645	0.010279	-2.008496	0.0551
LEM	0.991067	0.160418	6.178049	0.0000
LEXD	0.134945	0.019871	6.791005	0.0000
R2002	0.073636	0.052072	1.414100	0.1692
C	4.201554	1.007396	4.170709	0.0003

Table 32: ARDL Model Test Results

The EKC hypothesis is not confirmed, as the GDP and GD coefficients are not significant at the 5% level.

6.3 Nonlinear ARDL Model for China

Symmetrical cointegration is confirmed, but the GDP coefficient is insignificant. Asymmetric cointegration is implemented as there may be a secret significant relationship between the positive and negative components of GDP and EMS. The test results of the non-linear ARDL model show that there is asymmetric cointegration among the variables as the F value of the boundary test is 10.55, which means that the I1 limit value of 1% is higher than 4.68. The stability of the nonlinear ARDL model has been tested and validated. (See Table 33, Fig. 15 and 16).

Stability Test	F	P
Test 1	1.135860	0.3755
Test 2	3.353171	0.0795
Test 3	0.955985	0.4973
Test 4	0.000782	0.9779
Test 5	0.009319	0.9239
Test 6	0.269819	0.873795

Table 33: Stability Test Results – 2

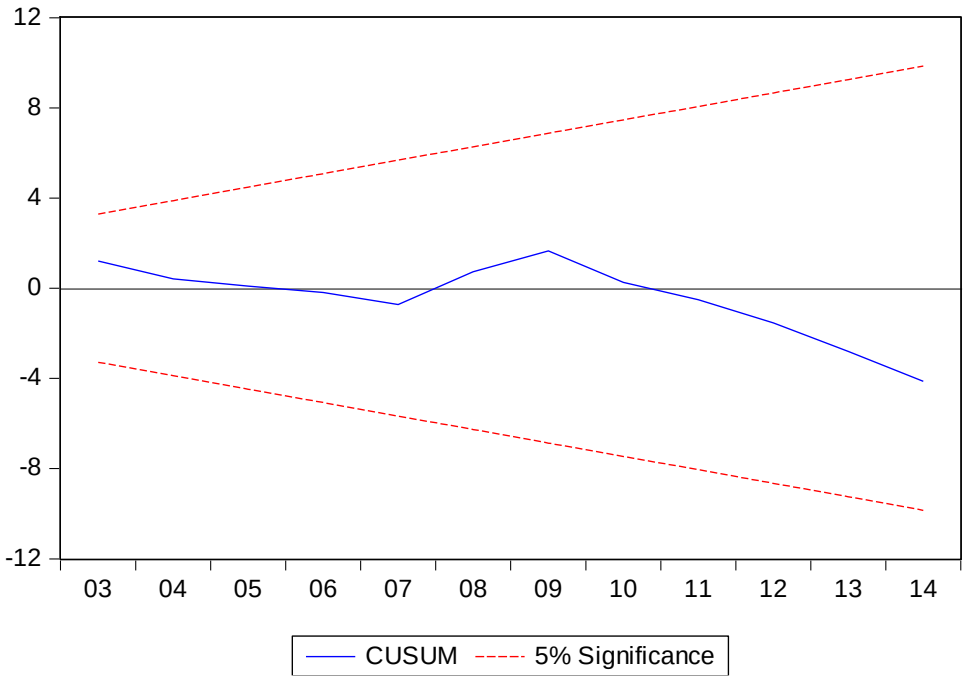


Figure 15: Test 7

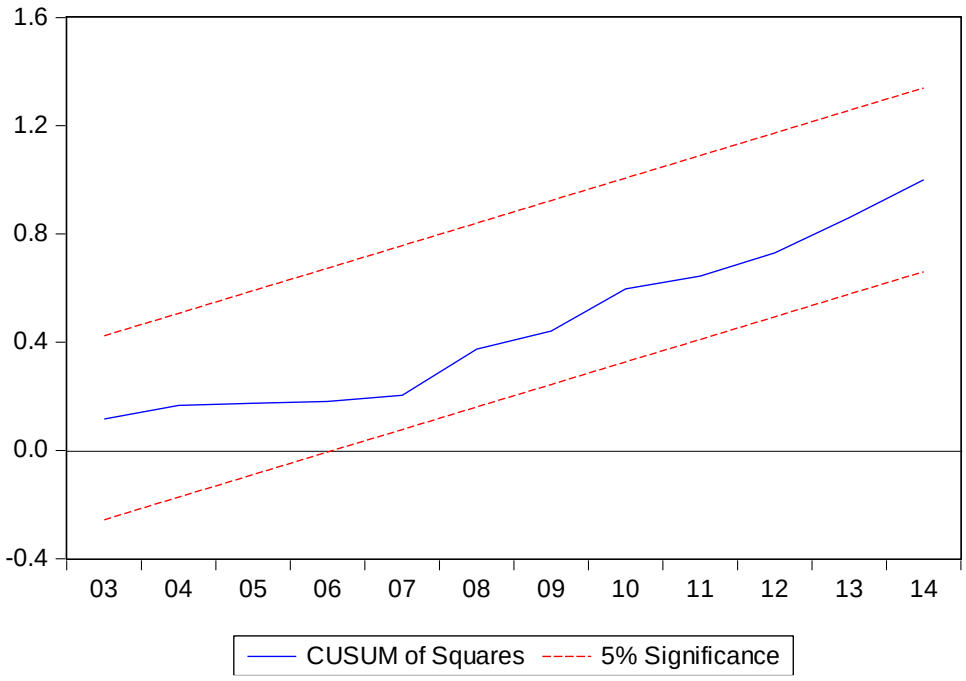


Figure 16: Test 8

The Durbin-Watson value of 1.959260 also confirms the stability of the nonlinear ARDL model. An asymmetrical relationship between GDP and EMS is validated. Because the positive component of GDP has a significant effect on the EMS in the long run. Moreover, the negative component of GDP has an insignificant effect on the EMS (see Table 34 and Figure 17) and EXD, EM have positive and significant effects on EMS In the long run.

Short-run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LGDP_POS)	0.385611	0.077763	4.958820	0.0000
D(LGDP_NEG)	0.194112	0.255915	0.758504	0.4552
D(LGD)	-0.018942	0.006374	-2.971723	0.0065
D(LEM)	0.603123	0.146960	4.103983	0.0004
D(LEXD)	0.094793	0.017042	5.562206	0.0000
D(R2002)	0.062438	0.024824	2.515188	0.0187
CointEq(-1)	-0.508425	0.110197	-4.613800	0.0001
Long-run Coefficients				
LGDP_POS	0.339260	0.146876	2.309842	0.0294
LGDP_NEG	1.039483	0.522077	1.991054	0.0575
LGD	-0.037256	0.012983	-2.869719	0.0082
LEM	1.186257	0.171140	6.931514	0.0000
LEXD	0.186444	0.046009	4.052323	0.0004
R2002	0.122806	0.068213	1.800338	0.0839
C	3.396964	1.324714	2.564300	0.0167

Table 34: Nonlinear ARDL Model Test Results

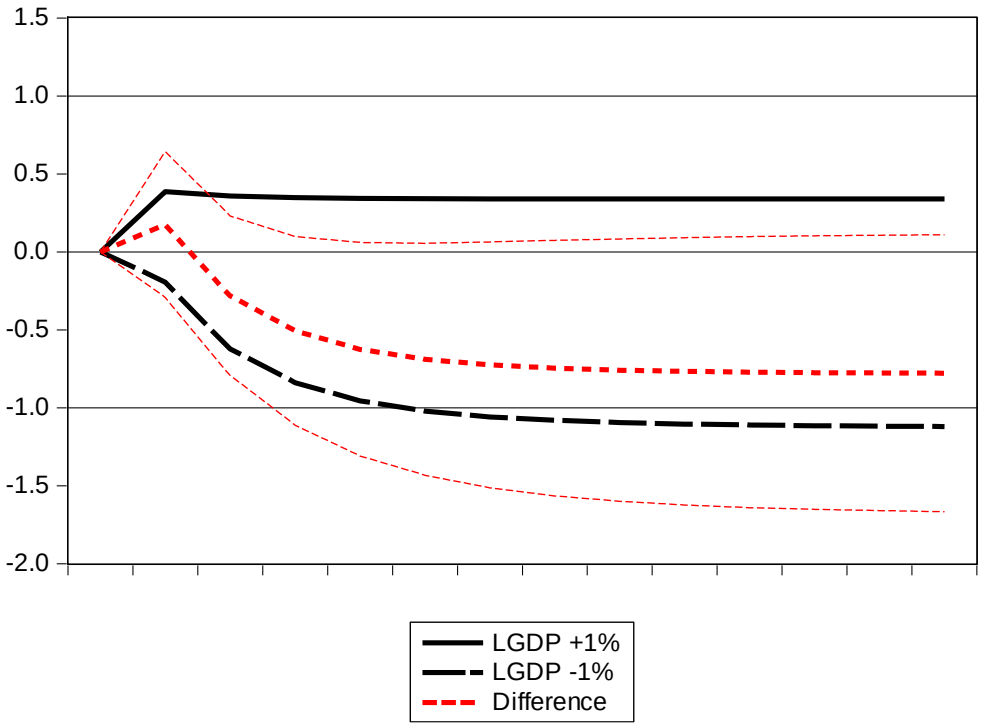


Figure 17: Multiplier Graph

The effect of external debt on emissions is significant and positive in China which is the importance of the results. Chinese government should take additional measures to stabilize the borrowing from foreign markets regards to the result. Chinese government has been considering to important restructure the economy, solve overcapacity problems and meet emissions target.

6.4 Effect of the Result in China

The results of the study are compatible with the current economic structure of the Chinese economy.

The Chinese economy is still dependent on the construction, heavy industry and real estate sectors.

Although China's current external debt is 13% of GDP, private companies and local governments continue to heavily fund construction and real estate investments. While the borrowing policies of the central government cover operational costs as it causes domestic borrowing, foreign debt grows as it increases borrowing from abroad.

CHAPTER 7
EKC FOR CHINA AND AUSTRALIA

Augmented Dickey and Fuller (1981) implemented to unit root test methodology for determining the stationarity levels of GDP, GP, ENEC and CS variables. GDP is stationary at first difference for GP and CS Australia. GDP is stationary at first difference for GP, CS and ENEC China (see Table 35 and Table 36).

Variable	Level	First Difference
CC	0.740734	-4.371451 (1%)
GDP	0.904630	-4.320487 (1%)
GP	1.445236	-3.563160 (5%)
ENC	0.207433	-3.102568 (5%)
Notes: The statistical significance of results are shown in parentheses		

Table 35: Stationary Levels for China

Variable	Level	First Difference
CC	-2.352509	-7.186485(1%)
GDP	-0.830792	-4.281287(1%)
GP	-0.761263	-4.220965(1%)
Notes: The statistical significance of results are shown in parentheses		

Table 36: Stationary Levels for Australia

Pesaran and. al. (2001) implemented cointegration analysis for the study. ARDL bounds test is used to determine the symmetric relationships among the variables. Firstly, ARDL bounds test is used to analyze the symmetric relationships between GDP, GP, CS and ENEC for China.

Secondly, ARDL bounds test is used to analyze the symmetric relationships between GDP, GP, and CS for Australia in this study. According to Shahbaz

and Sinha (2019), ARDL methodology is a commonly used methodology in EKC literature.

The first variables find cointegration by ARDL bounds test. Afterwards ARDL-ECM (error correction model) is implemented to calculate the short-term and long-term coefficients of the variables.

Stability of the Models was examined with Breusch Pagan Godfrey Heteroskedasticity Test (BG Test), Breusch Godfrey Serial Correlation Test (B Test), CUSUM test (C Test), Ramsey Reset test (R Test), normality test, and CUSUM of squares test (C squares Test).

In the study, two models are used, which are the reduced model of EKC model in the literature. The variables are CS (coal consumption in thousand metric tons), GDP (in constant 2010 $US), GP and ENEC (kg of oil equivalent per capita). Firstly, the relationship is examined between CS, GDP, GP and ENEC for China. Secondly, the relationship linkage between CS, GDP and GP is examined for Australia.

Two models that are used below, first model is for China, and second model is for Australia. First model, m_0, m_1, m_2 and m_3 is estimated parameters for China, and second model, m_0, m_1 and m_2 are estimated parameters for Australia. e_t is error term and t are time index for China and Australia. The time period for the analysis is 1980 to 2014 for China and 1980 to 2016 for Australia. The time period is determined by the availability of data from data sources. Coal consumption data took of US energy information administration website and GDP and ENEC data took of World Bank's website.

$$\ln(CS)_t = m_0 + m_1 \ln(GDP)_t + m_2 \ln(GDP)_t^{\,2} + m_3 \ln(ENEC)_t + e_t \quad (1)$$

$$\ln(CS)_t = m_0 + m_1 \ln(GDP)_t + h_2 \ln(GDP)_t{}^2 + e_t \quad (2)$$

For first model, ARDL model is as below.

$$\Delta LnCS_t = U_0 + U_1 LnCS_{t-1} + U_2 LnGDP_{t-1} + U_3 LnGDP_{t-1}{}^2 + U_4 LnENEC_{t-1} + \sum_{i=1}^{e} U_{5i} LnCS_{t-i} + \sum_{i=0}^{d} U_{6i} LnGDP_{t-i} + \sum_{i=0}^{p} U_{7i} LnGDP_{t-1}{}^2 + \sum_{i=0}^{w} U_{8i} LnENEC_{t-i} + \mu_t \quad (3)$$

Long run coefficients are shown with $U_1, U_2, U_3 and U_4$ *and s*hort run coefficients are shown with $U_5, U_6, U_7 and U_8$. White noise residuals are shown with μ_t.

Hypothesis of no cointegration equation is $H_0 = U_1 = U_2 = U_3 = U_4 = 0$.

Hypothesis of cointegration equation is $H_1 = U_1 \neq U_2 \neq U_3 \neq U_4 \neq 0$.

The long-run coefficients of the first model are calculated as follows after the cointegration between the variables is verified.

$$LnCS_t = A_0 + + \sum_{i=1}^{e} A_{1\,i} LnCS_{t-i} + \sum_{i=0}^{d} A_{2\,i} LnGDP_{t-i} + \sum_{i=0}^{p} A_{3i} LnGDP_{t-i}{}^2 + \sum_{i=0}^{w} A_{4\,i} LnENEC_{t-i} + \mu_t \quad (4)$$

The short-term coefficients of the first model is calculated as follows, after confirming the cointegration between variables.

$$LnCS_t = D_0 + \sum_{i=1}^{e} D_{1\,i} \Delta LnCS_{t-i} + \sum_{i=0}^{d} D_{2i} \Delta LnGDP_{t-i} + \sum_{i=0}^{p} D_{3i} \Delta LnGDP_{t-i}{}^2 + \sum_{i=0}^{w} D_{4i} \Delta LnENEC_{t-i} + nECT_{t-1} + \mu_t \quad (5)$$

The error correction model of the first ARDL model is calculated as follows after verifying the cointegration between the variables.

$$ECT_t = LnCS_t - \sum_{i=1}^{e} R_{1\,i}\Delta LnCS_{t-i} - \sum_{i=0}^{d} R_{2i}\,\Delta LnGDP_{t-i} - \sum_{i=0}^{p} R_{3i}\,\Delta LnGDP_{t-i}^{\,2} - \sum_{i=0}^{w} R_{4i}\,\Delta LnENEC_{t-i} \quad (6)$$

ARDL model is as below for second model.

$$\Delta LnCS_t = U_0 + U_1\,LnCS_{t-1} + U_2\,LnGDP_{t-1} + U_3\,LnGDP_{t-1}^{\,2} + \sum_{i=1}^{e} U_{4i}\,LnCS_{t-i} + \sum_{i=0}^{d} U_{5i}\,LnGDP_{t-i} + \sum_{i=0}^{p} U_{6i}\,LnGDP_{t-1}^{\,2} + \mu_t \quad (7)$$

Long run coefficients are shown with $U_1, U_2\ and\ U_3\ and\ s$hort run coefficients are shown with $U_4, U_5, and\ U_6$. White noise residuals are shown with μ_t.

Hypothesis of no cointegration equation is $H_0 = U_1 = U_2 = U_3 = 0$.
Hypothesis of cointegration equation is $H_1 = U_1 \neq U_2 \neq U_3 \neq 0$.

The long-run coefficients of the second model are calculated as follows after the cointegration between the variables is verified.

$$LnCS_t = A_0 + \sum_{i=1}^{e} A_{1\,i}LnCS_{t-i} + \sum_{i=0}^{d} A_{2\,i}LnGDP_{t-i} + \sum_{i=0}^{p} A_{3i}\,LnGDP_{t-i}^{\,2} + \mu_t \quad (8)$$

The short run coefficients of the second model are calculated as follows after the cointegration between the variables is verified.

$$LnCS_t = D_0 + \sum_{i=1}^{e} D_{1\,i}\Delta LnCS_{t-i} + \sum_{i=0}^{d} D_{2i}\,\Delta LnGDP_{t-i} + \sum_{i=0}^{p} D_{3i}\,\Delta LnGDP_{t-i}^{2} + nECT_{t-1} + \mu_t \quad (9)$$

The error correction model of the second ARDL model is calculated as follows, after verifying the cointegration between the variables.

$$ECT_t = LnCS_t - \sum_{i=1}^{e} R_{1\,i}\Delta LnCS_{t-i} - \sum_{i=0}^{d} R_{2i}\,\Delta LnGDP_{t-i} - \sum_{i=0}^{p} R_{3i}\,\Delta LnGDP_{t-i}^{2} \quad (10)$$

7.1 Results of CS, GDP, GP and ENEC NEXUS – ARDL Model for China

The relationship between CS, GDP, GP and ENEC is analyzed with the ARDL model. Regarding to ARDL bounds test results, there is cointegration and long term relationship between CS, GDP, GP and ENEC. Because the F-statistics limit test result is 4.737007 and the I1 limit value is higher than 4.35 which is 5%. ARDL-ECM is implemented to find the coefficients of the variables, after the cointegration is found. (see Table 37).

	Variable	Coef.	Standard Error	t-Stat.	Probability
Short-run Coefficients	D(LNGDP)	2.579127	1.536386	1.678697	0.1052
	D(LNGP)	-0.202243	0.115005	-1.758565	0.0904
	D(LNENEC)	1.727421	0.131236	13.162718	0.0000
	CointEq(-1)	-0.624760	0.151159	-4.133123	0.0003
Long-run Coefficients	LNGDP	0.860133	0.289061	2.975609	0.0062
	LNGP	-0.056637	0.022872	-2.476277	0.0201
	LNENEC	1.379005	0.131555	10.482362	0.0000
	C	1.490930	1.713012	0.870356	0.3921

Table 37: ARDL-ECM Test Results for China

The CointEq(-1) coefficient is negative and significant at 5% which shows that there is a long-run relationship between the variables.The long run coefficients

of LNGDP, LNGP and LNENEC are significant at 5%. In addition, the coefficient of LNGDP is positive, while the coefficient of LNGP is negative. This result validates coal consumption EKC for China and the stability test results of the model is given in Table 38.

	F-statistic	Jarque-Bera
R Test	2.848766 (0.1039)	-
BG Test	0.455451 (0.8573)	-
B Test	0.195552 (0.6621)	-
Normality Test	-	1.999416 (0.367987)
Notes: The probability of results are shown in parentheses.		

Table 38: The Stability Test Results for China

C and C Squares test results are given in Figure 18 and Figure 19 respectively.

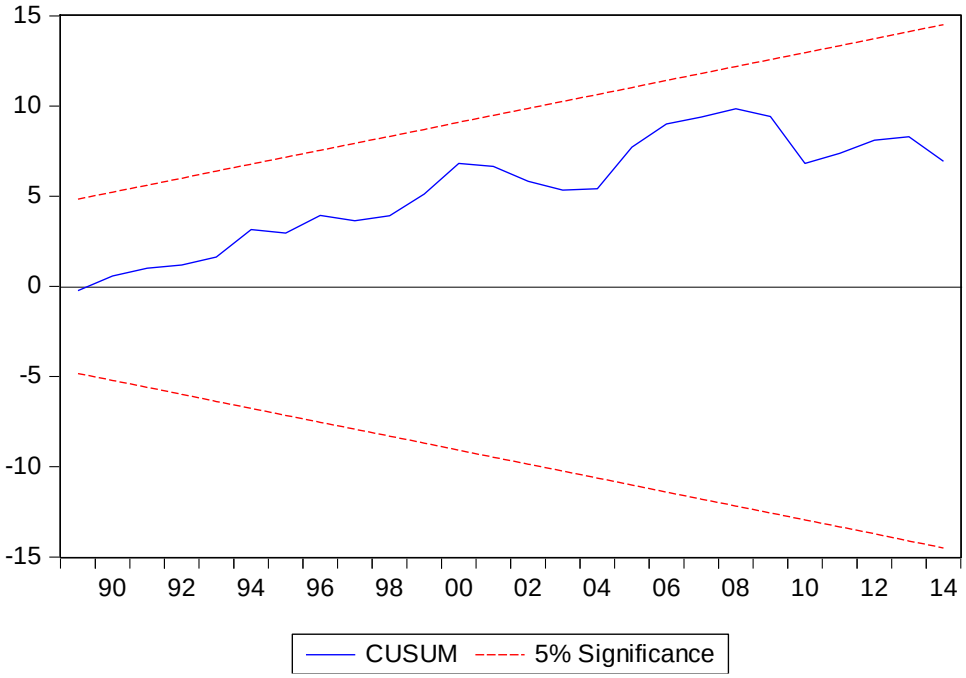


Figure 18: C Test for China

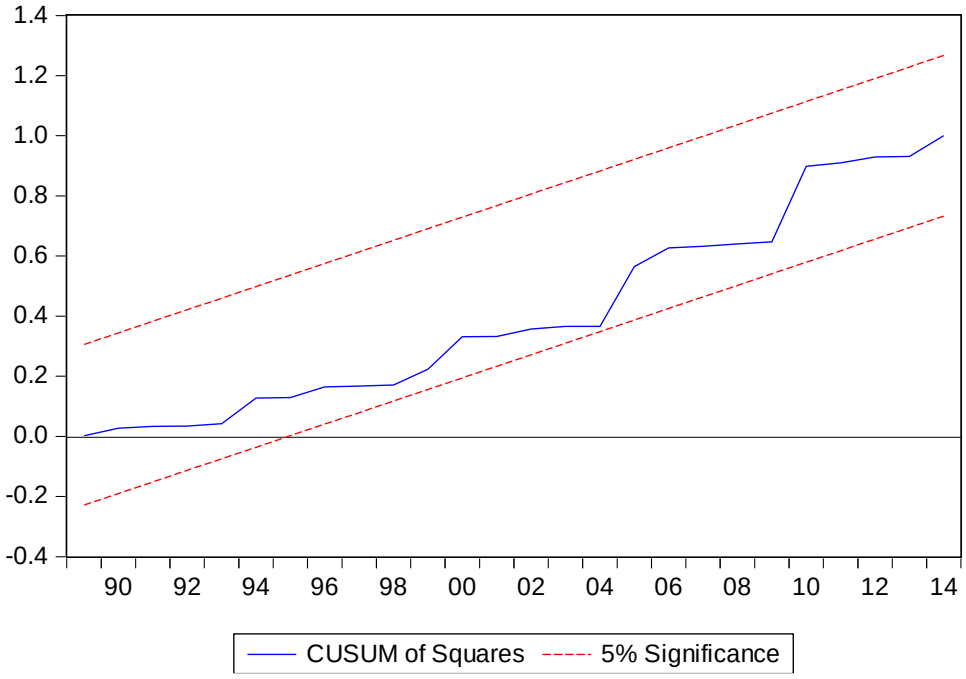


Figure 19: C Squares Test For China

7.2 CS, GDP and GP NEXUS – ARDL Model for Australia

The relationship between CS, GP and GDP is analyzed with the ARDL model for Australia and ARDL bounds test is implemented to analyze the cointegration among the variables. Considering the boundary test results, since the F-statistics boundary test result is 5.052469, there is cointegration between the variables, which is above the I1 limit value of 4.85, which is 5%. ARDL-ECM is implemented to calculate the long and short run coefficients of the variables, after finding the cointegration between the variables (see Table 39 and 40).

	Variable	Coef.	Standard Error	t-Stat.	Probability
Short-run Coefficients	D(GDP)	2.767263	0.940153	2.943417	0.0060
	D(GP)	-0.132191	0.044886	-2.945050	0.0060
	CointEq(-1)	-0.342809	0.106128	-3.230160	0.0029
Long-run Coefficients	GDP	8.072309	1.808034	4.464688	0.0001
	GP	-0.385610	0.088699	-4.347403	0.0001
	C	-38.296592	9.188446	-4.167907	0.0002

Table 39: ARDL-ECM Test Results for Australia

	F-statistic	Jarque-Bera
R Test	2.215318 (0.1468)	-
BG Test	1.867364 (0.1550)	-
B Test	2.361122 (0.1345)	-
Normality Test	-	0.976463 (0.613711)

Notes: The probability of results are shown in parentheses

Table 40: The Stability Test Results for Australia

C Test and C Squares Test results are given in Figure 20 and Figure 21 respectively.

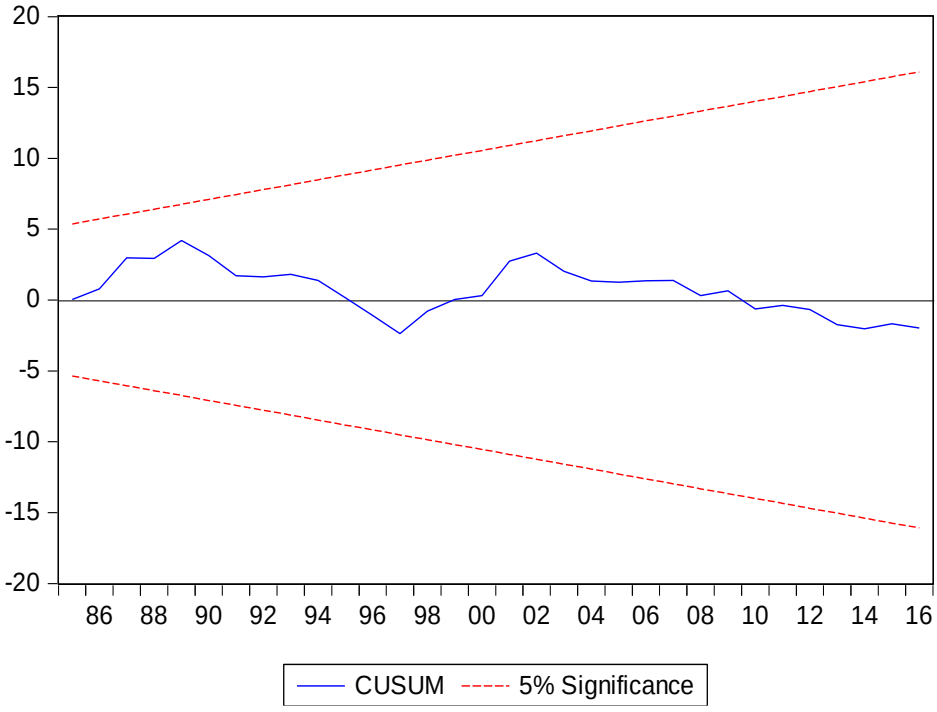


Figure 20: C Test for Australia

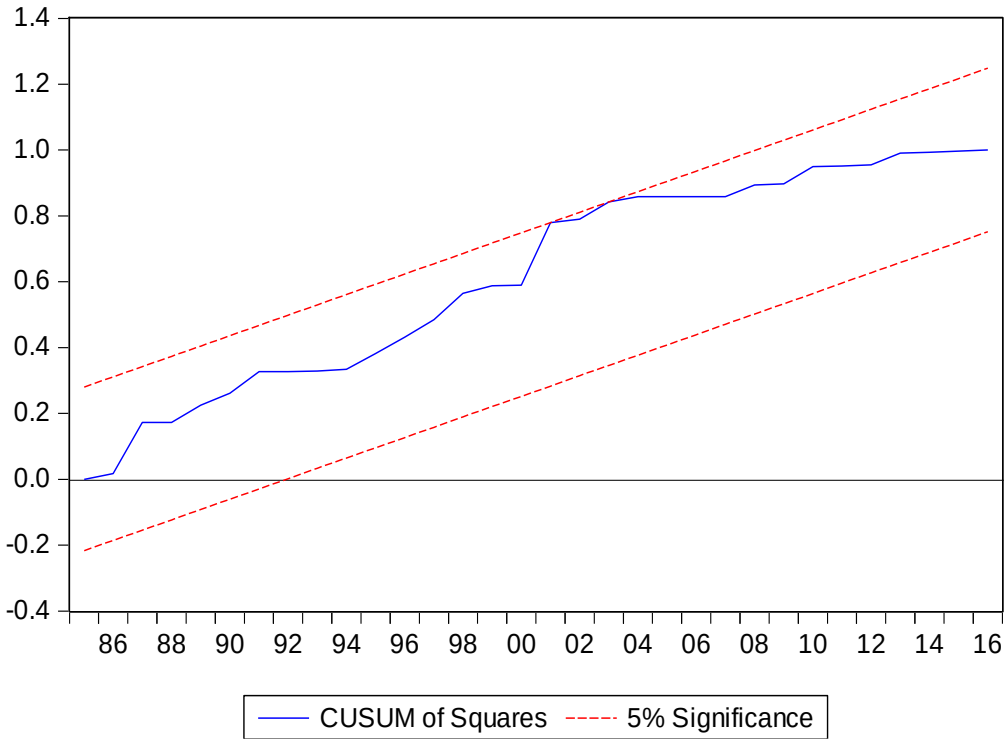


Figure 21: C Squares Test for Australia

Symmetric relationships between CS, GDP and GP are analyzed for Australia and this is a first in the literature, in addition CS EKC has been analyzed for Australia, one of the country's most dependent on CS in the world's energy demands for the period between 1980 to 2016. According to the results of CS EKC has been validated for Australia, indicates a success in Australia's efforts to reduce coal consumption for energy demands. Increasing build of wind and solar energy systems mean less coal use in Australia. In addition, existing coal power plants are shutting down due to the inability of the operating costs of coal plants to compete with renewable energy plants, the unwillingness of companies and creditors to invest in coal plants and legislation supporting alternative energy systems. Coal plants also cannot compete with market economic systems of renewable energy systems. Due to this reason, coal plants already started to shut down. By 2050, almost all coal plants are expected to be shut down in Australia by not building new coal plants and not extending the operational life of existing plants.

Symmetric relationships between CS, GDP, GP and ENEC are examined for China between 1980 and 2014 and as being the first in the literature for time series studies, coal consumption EKC is confirmed. China is the leader in coal consumption in the world. Moreover, China is heavily depended on coal consumption for energy demands. China established new policies to replace coal consumption with renewable energy, gas, nuclear energy, systems. In addition, structural changes in the energy market, shifting from manufacturing-based market to service-based market also subscribe to the decline of CS in China. Slowing economic growth is also contributing to the decrease of CS in China. Decreased utilization rate of coal power plants in China, similar scenario in Australia has a chance to happen in China as well. Reduced financial support for coal plants and decreasing prices of renewable energy systems could increase coal plant closure rates in China, as expected in Australia. The power generation of coal-fired power plants is decreasing, but further legislations and financial support is needed to sustain the decreasing of CS for power generation in China. Besides, China is investing heavily in hydro power systems. Decreasing the use of existing coal power plants, carbon capture and storage technologies should be used more efficiently in the fight against climate change. Digitalization the renewables energy transition will help China increase its share of renewable energy in its energy supply. Energy efficiency standards need to be constantly updated for coal. China should complete its power sector reforms, implement carbon emissions trading, increase energy efficiency standards, and apply new carbon pricing policies for iron and steel sectors. Moreover, China should increase energy efficiency standards and implement new carbon pricing policies for the iron and steel industries.

7.3 Effect of the Result in Australia and China

The results of the study are important for understanding current policies, as China is the leading country in coal consumption and Australia is among the top 10 countries that are heavily dependent on coal consumption for their energy demands.

Firstly, China's policies have been successful in reducing coal consumption and may be sustainable for the foreseeable future.

Secondly, current market dynamics in Australia are compatible with supporting coal consumption reduction. These market dynamics may help end policies to reduce coal consumption in Australia for the foreseeable future.

CONCLUSION

The Contribution Of Our Suggestions To The Sector In Terms Of Business Management And Emissions

Transforming the transport industry to run on renewable energy is vital to a more sustainable society. Many countries are concerned with their carbon footprints so Chinese transport sector effected by clean energy revolution.
China produced half of the 1.2 million electric media used worldwide in 2017. Also, the government directs its attention to the rehabilitation and reuse of all these lithium-ion batteries. A few more years are needed for large-scale production of biofuels. Crude oil might be very difficult to promote alternative fuels on a national scale unless crude oil prices increase too high to be affordable. Developing battery science, electricity is obtained from the solar panels and sun rays. Also included in the systems to assist the auxiliary power of shipbuilding or ship's daily use needs by this obtained energy. Therefore, some industries use solar panels for manufacturing. When looking at the solar panel for the first time, it is necessary to wait for the future in the maritime industry due to the attitude and cost of the initial setup. So, the first step is to reuse waste energy and reduce CO2 emissions. Hereby, as the amount of fuel consumed by the ship decreases, the amount of CO2 emission also decreases. In addition, ways to reduce CO2 emissions include reducing fuel costs and using alternative fuels with low or zero carbon content. For this reason, carbon emissions will be greatly reduced by burning low-emission fuel in diesel engines and sectoral profitability will increase with competitive advantage.

Power management can be achieved by ensuring that diesel engines on ships operate at optimum powers and carbon dioxide emissions can also increase when machines are operated with continuous overload. Common Rail (Powerline) working principle includes the minimum fuel for each load sent to the cylinder independently of the load the that is running the machine. This system can be used to achieve 1% energy efficiency, which system is used not only to reduce CO2 emissions, also to reduce emissions of SO2 are used.

Four types of engines are used in the manufacturing industry in the world. These motors are all equivalent engines, and which are known as IE1, IE2, IE3 and IE4. Especially E4 motors are the most efficient motors in the world and the least energy consuming. Efforts to reduce the cost of such machines are possible with the government expanding the use of IE4 engines. Also, roller bearings are generally found in automatic machines such as CNC, and their usage rates should be increased with R&D supports by the government.

Nowadays intelligent start-stop systems are widely used. Theoretically, the software is thrown into the electronics circuit of the batteries so that the parameters are protected without the need for high energy. The biggest advantage of this kaizen, the machine start-up setup time is eliminated, and the machine can be used for longer production. This system should be applied in all machines with PLC panels. Even adding start-stop batteries with the panel to low-tech machines will provide CO2 emissions, energy consumption and high profitability.

Non-insulated and high-volume environments are cooled by fans in enterprises, which causes high energy consumption and CO2 emissions. The environment cooling system design as an alternative cooling, that works by rotating cold water in the company is much cheaper and environmentally friendly.

Other Conclusions and Suggestions in the Thesis

Findings from FMOLS, DOLS and CCR models demonstrate that maritime transport, trade liberalization and industrial development are the determinants of long-term carbon emissions, just like the results of the ARDL model. It is also remarkable that the findings obtained from FMOLS, DOLS and CCR models which are described as new co-integration techniques and allowed the separation of long- and short-term relationships, consistent with the long-term results obtained from the ARDL model in Table 5. In the Long-run ARDL, if sea transport increases by 1 percent, CO2 increases by 0.3017%. If industrial

development increases a 1 percent, CO2 increases by 0.2972%. Unlike other econometric models as FMOLS, DOLS and CCR; trade liberalization has no statistically distinct effect on CO2. Long term ARDL results are like short term ARDL test findings in terms of relationships between CO2 and key economic determinants. Short-term results of ARDL estimates, reveal that the main determinants of CO2 in the short run are changed in industrial development and maritime transport at a 1% significance level. The effect of the Covid-19 outbreaks with commercial activities being closed for a long time which is affected the Chinese economy with negative. Transportation, manufacturing, trade and communication services and other top industries are suffered significantly. During the Coronavirus pandemic period, manufacturing is showing an upward trend according to the statistics for March and April of 2020 and which trend continues still in China, where suffered great commercial damage due to the Covid-19. Nowadays, China has increased the sales prices of all medical products, and then other Chinese origin products have followed this increase in prices, which will not decrease again when China covers the loss due to Covid-19. China market seized for now and most probably it will be continuing in this age. Authorities underline that: China will become the world's number one economy. Renewable energy should be encouraged to be used in transportation (sea-railway-road) by the government to reduce CO2 emissions, will become more important from now on. However, China could be the leader in overusing oil for shipping if wants to dominate the worldwide economy. Symmetrical and asymmetrical relationships between ENE, CO2, GDP, and GDP squared were not confirmed in this study for China. The EKC hypothesis was not confirmed for Australia, as the cointegration between ENE, CO2, GDP, and GDP squared was also not confirmed by the GH tests and the BH tests. In this study, causality from GDP, GDP squared, and ENE to CO2 was not found. Hypothesis 1 and hypothesis 2 were not confirmed.

Previous studies in the literature for Australia did not include a structural break and did not test the EKC hypothesis with asymmetric cointegration. Our results for the EKC hypothesis that Shahbaz et al. and Salahuddin and Khan neither confirmed the EKC hypothesis for Australia mentioned in Chapter 4 and

Marques et al. and Leal et al. confirmed the EKC hypothesis for Australia. Australia should continue its efforts to reduce oil consumption, increase renewable energy production levels and support existing market mechanisms that favor renewable energy generation over fossil fuel consumption. Australia can continue its economic growth without worrying that reducing CO2 emissions will negatively affect GDP. Politicians should increase their investment in this area, as public transport is not enough for Australian cities. Increasing use of public transport can reduce the use of passenger vehicle usage, which is beneficial for emission reduction. Financing for climate change adaptation should be sustained over the long term. Australia still depends on coal for its energy demand. Taxes on coal consumption should be increased the closure of coal plants for energy production and to support renewable energy production. After the energy sector, the transportation sector causes the second highest number of emissions. On the other hand, the Australian vehicle fleet is insufficient in terms of fuel consumption. Australia government should provide incentives to replace its inefficient vehicle fleet with fuel efficient vehicles. Taxes on fuel consumption in the transportation sector are low compared to international prices. Australia should increase taxes on fuel consumption to improve fuel efficiency in the transport sector. The taxation of fuels used for energy production should also be increased. Abandoned mines should be monitored regularly and necessary precautions should be taken because there are thousands of abandoned mines around Australia. Efforts and funding should be increased to protect biodiversity and monitoring for biodiversity conservation needs to be improved. Moreover, studies on recycling materials should be increased. Waste management should be improved due to recycling materials is necessary to benefit the industry and protect the environment. The environmental impact of agriculture is not enough monitored in Australia, but water quality and soil erosion must be improved. Majority of studies used symmetrical cointegration models, for future research directions, nonlinear cointegration models can be used for further studies in Australia. Jaforullah and King (2017) analyzed EKC for Denmark, Iceland, Canada, Finland, Norway, USA, and Sweden, the EKC relationship can only

be analyzed between CO2 and GDP for Australia by subtracting ENE from the equation.

In Chapter 5, it is revealed the long-run equilibrium link between GDP, domestic credit to the private sector (financial development) and the sum of exports and imports of goods and services in South Korea. Concordantly ADF unit root test is implemented to perform FMOLS, DOLS and CCR analysis. Considering to the results of the ADF unit root test, all variables including GDP, domestic credit to the private sector, and the sum of exports and imports of goods and services (international trade) are not stationary. Then, the first difference of the three variables was taken and the ADF unit root test was performed again to verify the stationarity structure of the series. Three variables become stationary according to the ADF unit root test results. By this way, considering to the results of FMOLS, DOLS and CCR models, there is a stable long-run relationship between the variables. Financial development (domestic credit to the private sector) affects economic growth, and this is consistent with the Johansen cointegration test and ARDL model. The empirical results show that the South Korean government should try to contribute the financial development to construct a durable financial system and triggering the Gross Domestic Product (GDP) will be beneficial or sustainable economic development. Within this scope, in order to the determined policies to be implemented, all trade barriers must be removed, an advanced logistics infrastructure and appropriate macroeconomic environment must be provided. The South Korean government should encourage the flow and use of RMB across countries and support the private sector and local companies by providing incentives so building a better state bank infrastructure and government financial system cooperation is also crucial. The establishment of a better financial system (domestic credit to the private sector) will contribute to economic growth and export volume. As a result of this study, the following policy prescriptions can be suggested; the South Korean government should contribute to the sustain of reforms by ensuring competition among institutions. The government should give the incentives to companies increase their market capacity. Also, greater financial

integration with neighboring economies for broader national interests is crucial to the state-corporate relationship. Trade barriers should be eliminated within partner economies to increase trade capacity of Asian region as the quality of products and services should be maintained, and product and service diversity should be increased. As a result, capital goods imports will be more attractive to increase production level and export volume. While determining the trade policy, the export and import trends of all partner countries should be fully evaluated.

In Chapter 6, examined the effect of China’s EXD on its EMS by taking the EKC hypothesis as its basis. The hypothesis 1, 2 and 3 are confirmed and hypothesis 4 is tested but not confirmed. Symmetric relationship between EMS and GW, Asymmetric relationship between EMS and GW and significant positive effect of EXD on EMS are confirmed for China. Although symmetric and asymmetric cointegration among the variables are confirmed but EKC relationship between GW and EMS is not confirmed by the ARDL and nonlinear ARDL models. The positive and significant effects of EXD on EMS are confirmed by ARDL and nonlinear ARDL models. The Chinese economy is still overly reliant on the heavy industries, real estate, and construction sectors. Moreover, the construction and real estate sectors contributed greatly to the company's debt. Since the Chinese government’s debt reduction policies made it difficult to borrow from domestic markets, local governments and private companies borrowed more from foreign markets and investors to invest in construction and real estate. The Chinese government has a plan to restructure the economy, known as the Made in China 2025 program due to the main target is to further develop various technological sectors and especially in the semiconductor sector. Moreover, the Chinese government also has a policy to unleash efforts to reduce foreign debt and should boost its efforts to stabilize borrowing of local governments and private companies from foreign markets and investors. The Chinese government should also continue its efforts to restructuring the economy, solve overcapacity problems in heavy

industries and stabilize the construction sector in the real estate boom in parallel.

In the last chapter, CS EKC method was investigated for Australia and China. The main findings of the study are validated for coal consumption EKC's Australia and China. The results of the study are important for understanding current policies, as China is the top country for CS and Australia is among the top 10 countries heavily dependent on CS for its energy demands. China's policies are successful for reducing CS and may be sustainable for the foreseeable future. The current market dynamics are compatible with supporting CS reduction and these market dynamics which may help current CS reduction policies to end CS in Australia in the foreseeable future. For future research methods, nonlinear cointegration models may be used for further studies in Australia and China. CS EKC studies are very limited in literature and I highly recommend the other developing and developed countries should be examined for CS EKC hypothesis.

Generally nonlinear relationships can be analyzed for the EKC hypothesis since there are still gaps in the literature for future research methods of nonlinear relationships in the EKC hypothesis. In the literature, environmental Kuznets curve of coal consumption may be analyzed for different countries and different regions by existing or new methodologies.The limitation of this study is that other protocols such as the Paris Agreement may also be analyzed.

Future work recommended are as follows:

It can be evaluated in terms of CO2 emissions by using different independent variables.

Resources can be created by doing this study for different countries.

Micro-analyses can be made by reducing the country-wide assessments to the sector.

Studies that are reduced to the sector can be evaluated as specific to the organizations at the next stage.

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CURRICULUM VITAE

Cihan Özden was born on July 07, 1986 in Bursa. In 2012, he graduated from Eastern Mediterranean University, Faculty of Engineering, and Department of Industrial Engineering. In 2013, he completed the Master of Business Administration program at Işık University. He has been working as a manager field of production and logistics in automotive companies since 2012. At the same time, he provides lean consultancy services to companies. He is married and has 3 dogs.

PLAGIARISM REPORT

Doktora Tezi 13/06/2021

ORİJİNALLİK RAPORU

%7	%4	%5	%0
BENZERLİK ENDEKSİ	İNTERNET KAYNAKLARI	YAYINLAR	ÖĞRENCİ ÖDEVLERİ

BİRİNCİL KAYNAKLAR

1	Yu Zhang, Xi Chen, Ya Wu, Chenyang Shuai, Liyin Shen. "The environmental Kuznets curve of CO2 emissions in the manufacturing and construction industries: A global empirical analysis", Environmental Impact Assessment Review, 2019 Yayın	%1
2	Muhammad Shahbaz. "Globalization–Emissions Nexus: Testing the EKC Hypothesis in Next-11 Countries", Global Business Review, 2019 Yayın	%1
3	dokumen.pub İnternet Kaynağı	%1
4	docs.neu.edu.tr İnternet Kaynağı	%1
5	Kizito Uyi Ehigiamusoe, Hooi Hooi Lean, Russell Smyth. "The moderating role of energy consumption in the carbon emissions-income nexus in middle-income countries", Applied Energy, 2020	%1