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Globalization, Energy Consumption, Environmental Degradation, in The Presence of Environmental Kuznets Curve for Developed Countries. Static and Dynamic Panel Data Approach

A dissertation presented on the partial fulfillment of the requirements of the master's degree in Quantitative Economics.

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Abstract:

The global industrialization process has led to a rapid economic growth for all countries around the world. The continued development in economic growth, and the human reliance on energy consumption is resulting in high increase of CO2 emissions. Many researchers assumed that the problem of global climate change caused by the aggravation of greenhouse gas emissions.

The specific relationship between economic growth and environmental quality has been discussed clearly by Kuznets (1955) who founded one of the theoretical foundations of the mechanics of this relationship in his paper. This research was based on the EKC theory. The main objective of this research was to investigate the existence of the EKC hypothesis in various economies categorized in developed countries.

Panel data has been used to investigate the existence of the EKC in 21 st developed countries covering the period between 1980 to 2019.

The results of the study supported the EKC hypothesis for the selected countries; the evidence of EKC is confirmed for those economies. Specifically, GDP per capita makes CO2 emissions diminished. In addition, the LGDP3 implies that the movement of CO2 emissions follows the inverted N-shaped pattern of the EKC hypothesis.

Key word: globalization, energy consumption, developed countries, CO2 emissions, The Environmental Kuznets Curve, environmental degradation.

Dedication

I dedicate this work to all my lectures, to the staff of Economics Faculty of Hamma Lakhdar University, and my family members one by one.

Acknowledgement

I wishes to express my deep gratitude to Dr. Lotfi MEKHZOUMI, the supervisor of this thesis, who provided valuable comments suggestions and guidance that enhanced the merit of this study.

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Abbreviations	Meaning
EKC	Environmental Kuznets Curve
CO2	Carbon dioxide
IMRAD	Acronym for Introduction – Method – Results – and – Discussion.
UISDR	United Nation International Strategy for Disaster Reduction
GDP	Gross domestic product
IEA	International Energy Agency
PPF	The production possibility frontier curve
BCIM	Bangladesh–China–India–Myanmar
BRI	The Belt and Road Initiative of China
{I(1)}	Integrated in the first level
{I(0)}	Integrated in the 0 level
RE	Renewable energy consumption
NR	Non-renewable energy consumption
TD	Trade openness
UR	Urbanization
PC	Energy prices
USA	United States of America
ASEAN	Association of Southeast Asian Nations
ARDL	The Autoregressive Distributed Lag
EFTA	The European Free Trade Association
EU	European Union
G7	Group of Seven countries consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.
GCC	The Cooperation Council for the Arab States of the Gulf.
Mercosur	Mercosur is an economic and political bloc comprising Argentina, Brazil, Paraguay, Uruguay, and Venezuela.
NAFTA	The North American Free Trade Agreement
OECD	The OECD is a global policy forum that promotes policies to improve the economic and social well-being of people around the world.

FIN	Financial development
IND	Industrial sector
OECD	Organization for Economic Co-operation and Development
GDP pc	GDP per capita
GI	Globalization Index
ECpc	Energy consumption per capita
POPd	Population density
CO2cp	Carbon dioxide combining power
GHG	refers to the greenhouse gas emissions
FE	Fixed effects estimator
RE	Random effects estimator
VIFs	The Variance Inflation Factors
FEM	The finite element method
BRICS	Group composed of the five major emerging countries - Brazil, Russia, India, China, and South Africa
SAARC	The South Asian Association for Regional Cooperation
OLS	Ordinary least-squares
GLS	Generalized Least Squares

INTRODUCTION

Introduction

Statement of the subject:

The Environmental Kuznets Curve (EKC) is used to graph the idea that as an economy develops rose rapidly, market forces begin to increase, economic inequality decreases, while the environment will be damaged. Therefore, the green economy has become a primer tool to achieve economic growth and development without an adverse effect on the environment. Sustainability on its part has represented as one of the most important policy goals explored in the environmental Kuznets curve (EKC) literature.

Nowadays, there is a plethora of studies and research has been conducted to support the EKC theory. These studies have used different variables and methods to estimate environmental degradation. In the current study, we have focused on three variables, which are globalization, energy consumption, and environmental degradation represented as CO2 emission.

The present research contributes to ongoing literature by studying different EKC specifications for a group of developed countries in various regions of the world over the period of 1980-2019, using long-term static and dynamic panel data methods.

Research purpose and hypotheses:

The present research attempts to use CO2 emissions as the dependent variable based on the EKC theory, which refers to the level of environmental damage. Therefore, the main objective of this research is to investigate the existence of the EKC in various economies categorized as developed countries.

The main purpose of the present research is to find answers to the following question:

- Does the environmental Kuznets Curve exist in the 21st selected developed countries?

The hypotheses:

In order to address the issue of the study, we relied on the following hypotheses:

- There is either a flat pattern or no relationship between environmental degradation and income.
- There is a monotonic increasing relationship such as the environmental degradation increases along with economic growth.
- There is a monotonic decreasing relationship between environmental deterioration and income.
- We can see the classical inverted U-shaped EKC.
- There is a U-shaped relationship between environmental degradation and income.
- There is a cubic polynomial or N-shaped relationship between environmental deterioration and income.
- There is an inverted, or opposite, N-shaped relationship between environmental degradation and economic growth.

Importance of the study:

The significance of the current study is to highlight the environmental degradation issue. Several researches haveaddressed the same issue, as the results of the importance of the environment, which is the only home that humans have, and it provides us with the air, food, and other needs.

The studies that addressed the environmental issues show the way in which countries can develop sustainable strategies to protect the environment. On its

part, this research helps to develop an understanding of how globalization and energy consumption are damaging and affecting the environment.

The present study attempts to contribute to new knowledge by introducing and analysing the EKC hypothesis. Besides, it improves student's research capabilities

Methods:

The current study has been implemented the form of the IMRAD format. In scientific writing, the IMRAD is one of the most common formats which was used in structuring the scientific researches. The IMRAD is an acronym for Introduction – Method – Results – and – Discussion.

- The object of using the IMRAD format is to show facts objectively, demonstrates actual interest, and develops a new understanding of the topic. By using this format intent to collect data from previous research to answer a specific question rather than explicitly state an argument or opinion; therefore, this format will be the most likely to achieve the purposes of the present study..
- The statistical analysis method was used in the current study, which is defined as a process that is applied to conduct scientific research, analyse data, and extract results that will facilitate the understanding of the targeted phenomena. Several mathematical and logical methods carry out data analysis process by finding out the relationships between variables and linking them to the content; hence, statistical analysis will form new important information from data that was meaningless before.
- Panel data analysis is a statistical method with a hybrid application of two different types of data, which are longitudinal/cross-sectional data and time-series data. It is widely used in social science, such as epidemiology

and econometrics to analyse twodimensions. The panel analysis usually requires collecting data over time and the same individuals, and then, a regression will be run over these two dimensions.

limitations:

Many limitations have been met during conducting this research,

- We find some difficulties to access the published article in international journals; many international articles are not free available.
- To present the literature review that interprets the research's subject, we have focused on the main concepts that are relevant in the context of the present study, as the result of luck of resources (to write the literature review.
- we faced some difficulties to complete the thesis before the deadline. because of the current situation of the pandemic Crona virus; therefore, the given time to conduct the research was was not enough.

Thesis:

The present study is organized into three major sections.

- Section one is the introduction, which provides the background and the significance of this study.
- Section two refers to Chapter one which presents the theoretical and conceptual side of the study, reviews the main variables that were used in this study, by giving the concepts definitions, theories, and approaches, links between study variables. Also reviews the related studies and the factors that affects CO2 emission levels, and describes the EKC theory.
- Section three which deals with the analytical procedural by describing the data and variables that were used in the study, highlights the methods,

discusses the main findings. In the study, the method of Panel data was used to find the link between globalization, energy consumption, and environmental degradation based on the EKC hypothesis.

- Finally, the last part of the study presents theconclusion and recommendations for future research.

Theoretical formwork

The following diagram characterizes the relationship between the study variables that was used in the study to facilitate the understanding of the research topic. :

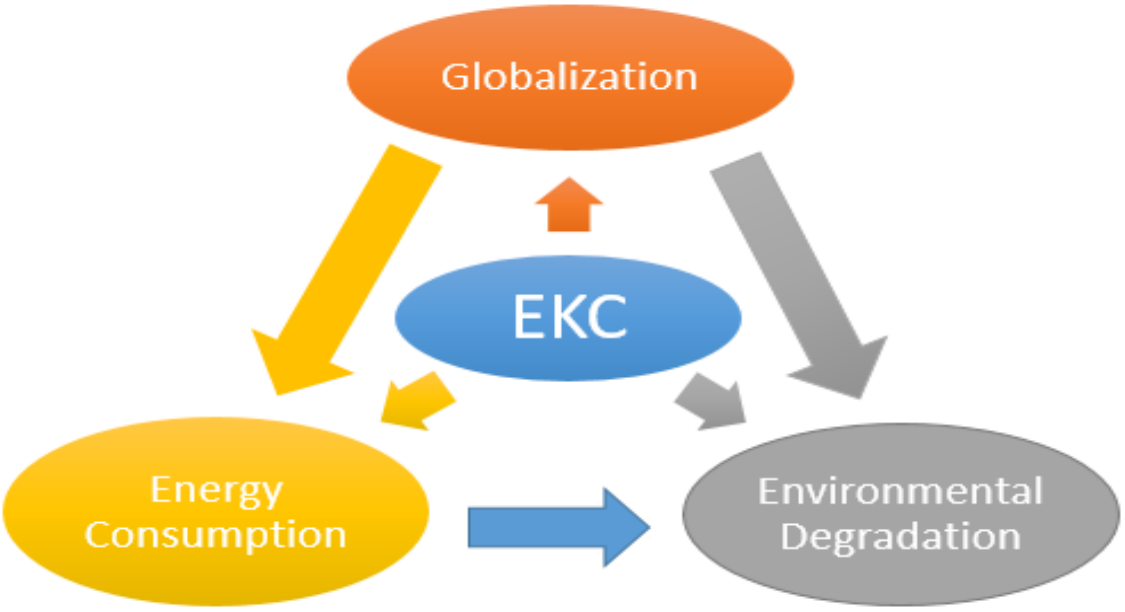


Figure1. explains the relationship between the study variables which was created by researcher

CHAPTER ONE:

Conceptual Framework and Contextual Background

Since the Industrial Revolution, manufacturing sector turns into a main driven factor of economic development in various countries. The wide use of machinery and technological inputs in the production process has brought a significant and profound change in economic activities. Although, industrial economic growth has led to an increase in environmental degradation problems. (Nutnaree Maneejuk et al, 2020)

In the late of 20th century, some countries became more connected and the world became more globalized, Therefore, globalization plays an essential role in the economy of the country, since it helps to enhance the economic development greatly depends on international trade and industrial development. However, industrialization and product activities lead to rise in energy consumption, so the level of CO2 emissions. As the result, the over-usage of non-renewable energy and globalization pushed to destroy the environmental quality.

Section one: Conceptual and theoretical framework

To understand the core topic of the present research, we have to introduce conceptual and theoretical definitions of the variables that were used in this study.

In this section, we highlight the study variables, including globalization, energy consumption, and environmental degradation. The definition of the environmental Kuznets curve (EKC), and developed countries.

1. Globalization:

Although the phenomenon of globalization is not new, it made one of the reasons for the existence of debate among scholars about when it can appear. Some scholars believe that globalization began as a phenomenon in the early human imigration, or with the conquests of Genghis Khan.However, some scholars suggested that it is more contemporary. Mean while some scholars assumed that globalization is a modern phenomenon that did not start before World War II.

The term of globalization has been used since the 80s, where some scholars believe that globalization cannot be older than the late forties of the last century, that is, in the post-war period, and the time of the emanation of the USA as the most powerful country in the world.

Globalization can be defined as the expansion of economic activities across political boundaries of nations. It is a process of economic integration and economic interdependence among nations in the world economy. It is associated not only with an increasing cross-border movement of goods, services, capitals, technologies, information, and people, but also with an organization of economic activities, which straddle national boundaries. (Shahzad, 2006).

Yalcin (2018) illustrates that globalization is an outcome of capitalist progress. As the advancement of communication, technologies and the increase in productivity necessitate states' expansion of their market territory. The decline in protective social policies, the increase in the incentives for foreign trade, and the convergence of the free-market economy.

Farhad and Mohammad, (2011) defined globalization as the process by which different economies and societies become more closely integrated, and concordant with increasing worldwide connectivity; covering a wide range of distinct political, economic, and cultural trends.

Martin et al (2018) believe that globalization, of course, is nothing new; it has been an evolving feature of world economic activity ever since the age of exploration in the 16th century and characterized many ancient systems, such as the Roman empire. However, they said that since the mid-1970s, it is known broadly as the increasing extension, interpenetration, and interdependence of production systems, corporations, markets, networks of flows across national borders.

Globalization has a huge effect on the counties economy. Today, It seems to be one of the most important factors for economics to make a change. If a country has a good or high globalization indicator, it will be a positive point for that country. It can make difference; by involving the country in the mass production economics, so globalization will help the country to enhance its economic growth.

2. Energy consumption:

Today the energy sector plays an important role in our everyday life . The importance of energy is a crucial component in economic growth as well as in any strategy to improve the quality of human life.

Teba (2021) indicated that today we are taking a closer look at the definition of the term “energy consumption“. She defined Energy consumption as "ALL" the energy that is used to perform an action, manufacture something or simply inhabit a building.

The energy sources can be divided into three main categories: fossil fuels (oil-coal-natural gas), renewable sources (Wind Energy, Hydroelectric, Ocean Energy...), and nuclear sources. In spite of the development of using the renewable energy source in today's activities, Oil and Gas are expected to be one of the most important sources of energy. (Mustafa Balat, 2005).

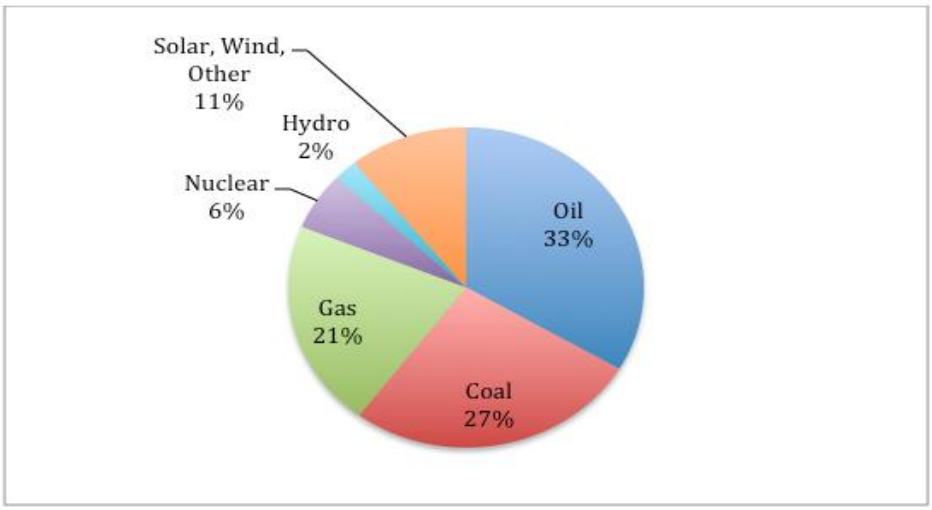


Figure 1.1: Source of global Energy 2017. (International Energy Agency (iea.org))

In figure 1.1, it can be seen clearly from the data provided that the global energy is highly dependent on fossil fuels, which accounts approximately 81% of global energy sources, followed by natural sources with only 11%.

As mentioned, energy consumption is the total energy provided and consumed by humans. Usually, it measured per year; accounting all energy utilized from defferent energy sources. Closely related to energy consumption is the concept of total primary energy supply. the figure 1.2 shows the world energy supply, such as coal, oil, and natural gas (R B Jackson et al 2019). World energy

consumption is projected to rise 28% by 2040 (oil and gas journal, 2017). It is predicted to continue as the most important source of energy for the next century.

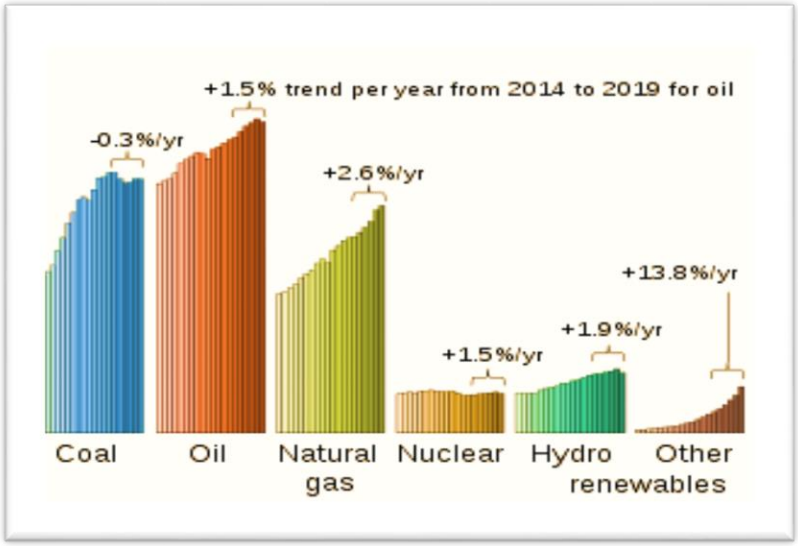


Figure 1.2: Global Energy Consumption 2019-2020. (R B Jackson et al, 2019)

3. Environmental degradation:

The Environment in terms were defined as the earth's components, which include: air, land, and water, all layers of the atmosphere, all organic matter and living organisms, and the interacting natural systems that include components referred to above. (Vianney NSANGANIRA, 2011).

Since the beginning of human activity on the planet, environmental features have been changed dramatically. These changes increased rapidly with the beginning of what is known as the Industrial Revolution, which influences the environment in general, and presented the new issue of environmental degradation.

Environmental degradation is one of the largest threats to our planet, and globly was considered as the most important issue that should be handled to protact our plant. The United Nation International Strategy for Disaster Reduction (UISDR) defines environmental degradation as "The reduction of capacity of the

environment to meet social and ecological objectives and needs" (Sawati Tyagi et al, 2014).

Neelam Garg, and Rajan Paudel (2011) asserted that environmental degradation affects our health significantly in various ways, either directly by exposing people to harmful factors, or indirectly, by disturbing life-sustaining ecosystems.

Environmental degradation constitutes systemic destruction and depletion of the earth's ecological systems, such as water resources, air, plants, and the natural soil, which are the main sources of life (Jimoh. H, 2011). It appears in many aspects of our world that it causes air pollution, water pollution, toxic pollution, deforestation, and global warming.

The major causes of environmental degradation are urbanization, industrialization, overpopulation growth, deforestation, non-renewable, and fossil energy consumption etc. (Sawati Tyagi et al, 2014).

4. The environmental Kuznets curve (EKC):

Although, economic growth should be healthy and good for the environment; many studies have shown that there is a reverse direct relationship between economic growth and environmental reduction.Many countries have realized this fact, therefore, at the least; they targeted many policies and attitudes to make sure that economic growth is compatible with improving the environment.

The specific correlation between economic growth and environmental quality has been discussed in recent literature. Kuznets (1955) founded one of the theoretical foundations of the mechanics of this relationship in his paper.

Based on this hypothesis, economic development measured usually by income per capita, and it is linked with an increase in the environmental degradation, which measured usually by the level of some form of air pollution (emissions) until a certain level. (Eyup Dogan and Roula Inglesi-Lotz, 2020)

The Environmental Kuznets Curve (EKC) hypothesis postulates an inverted-U-shaped relationship between different pollutants and per capita income, i.e., environmental pressure increased up to a certain level as income goes up; after that, it decreases. The (EKC) actually reveals how a technically specified measurement of environmental quality changes as the fortunes of a country change. (Soumyananda Dinda, 2004).

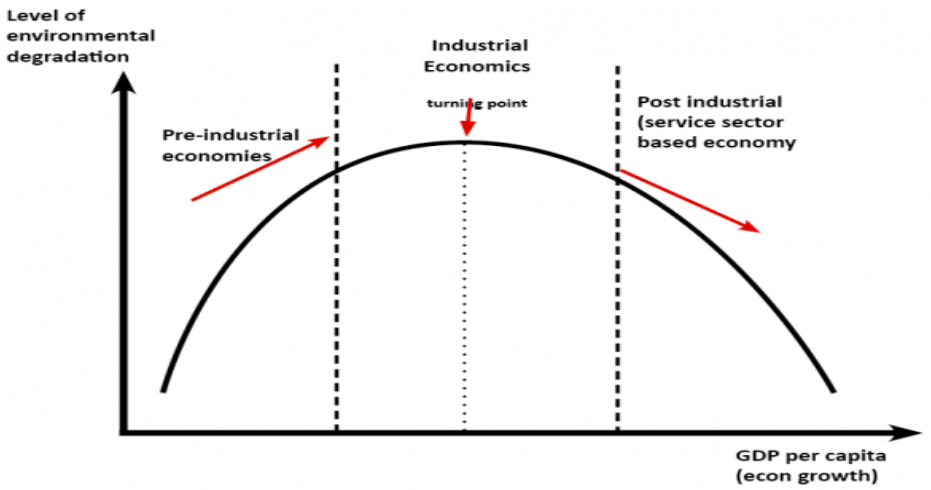


Figure1.3: Diagram explains the Environmental Kuznets Curve. (Tejvan Pettinger, 2019)

At a low level of income, pollution recession is not desirable, as individuals are using their limited income to meet their basic consumption needs, without care of the environmental issues.

Once a certain level of income is achieved, individuals begin taking into consideration the trade-offs between the environment and the quality of consumption, and environmental damage rises at a lower rate, and after a certain

point, individuals prefer improvements in environmental quality over further consumption, and environmental quality begins to improve besides economic growth (N.M.Katsoulakos et al, 2016).

5. Developed countries:

Since the second half of the 20th century, one of the remarkable phenomena in the domain of international development policy is classifications and categories of countries. This issue introduced clearly by the International Organizations in the early 1990s. (Djalita Fialho and Peter A G van Bergeijk, 2017)

According to the World Economic Situation and Prospects (WESP) report (2014), all countries are classified into one of three broad categories: developed economies, economies in transition, and developing economies.

Based on the information provided from the World Bank, classification is measured based on the Gross Domestic Product (GDP) and/or average income per citizen. Numerous countries (especially economies in transition) can be characterized in more than one category; however, for purposes of analysis, the groups have been made divided into subgroups. Within each broad category, some subgroups are defined based either on geographical location or ad hoc criteria (WESP report, 2014).

In the present research, we will focus on one category, which is developed country. In the Cambridge English Dictionary, developed country is a "country with a lot of industrial activity,where people generally have high incomes". It is also called as an industrialized country; it has a mature and advanced economy.

Furthermore, developed countries have advanced technological infrastructure, and their industrial and service sectors are quite diverse. citizens

with advanced economyusually have access to high-quality healthcare and education. This research selected the most developed countries in the world.

Section two: The relationship between globalization, energy consumption, and environmental degradation on the presence of the environmental Kuznets curve:

There are several reasons to be interested in studying the relationship between globalization, energy consumption, and environmental degradation. The three major reasons are the future energy needs, environmental pollution from carbon dioxide (CO_2) emissions, and the future of an integrated world economy. (Muhammad Shahbaz et al, 2017)

Over three decades, academics and researchers have devoted a great deal of time to studying the linkage between globalization, energy consumption, and environmental degradation. In this section, we will discuss the relationship between different variables, and attempt to find the link between them.

1. The relationship between globalization and energy consumption

Globalization's target is to benefit countries around the world by helping international trade to be more efficient, enhancing corporation competition, limiting political conflicts, and increasing human life quality.

Since the 1940s, the global economy has been rose dramatically. Various reasons helped to increase the global economy in that time; one of them is World War II. Moreover, the beginning of the 1950s, the global economy has continued to grow furiously, and practically the industrial sector faces an increase in the global demand for products.

Therefore, the globalization term has been brought up to explain the rose of global cooperation and coordination among countries, and its influence on all aspects; politically, economically, social and cultural aspects …etc.

In the economic aspect, the world GDP of the global economy has grown up significantly; the word GDP refers to the aggregate of all nation GDPs. Figure1.4 shows that world GDP has been doubled from 12.40 trillion $ in 1955 to 24.84 trillion $ in 1971, and then the world GDP has registered a great increase till 2015 with more than 108 trillion $. (Our Word in Data, 2015)

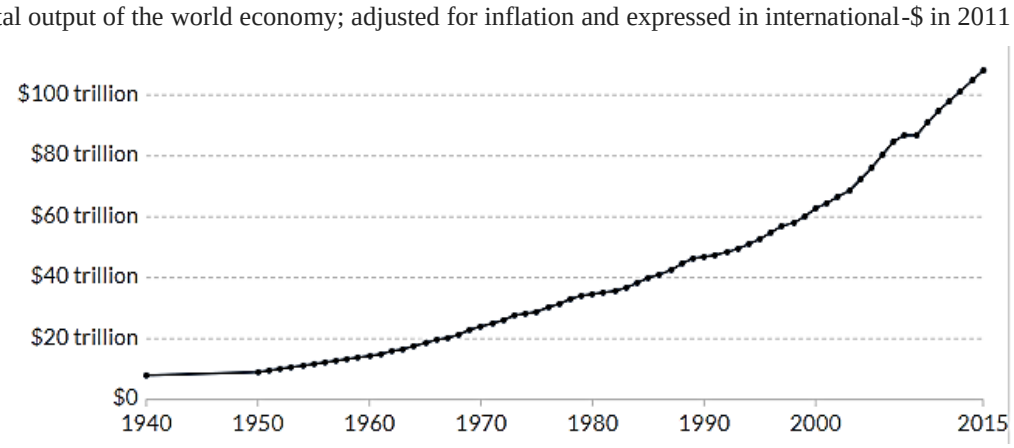
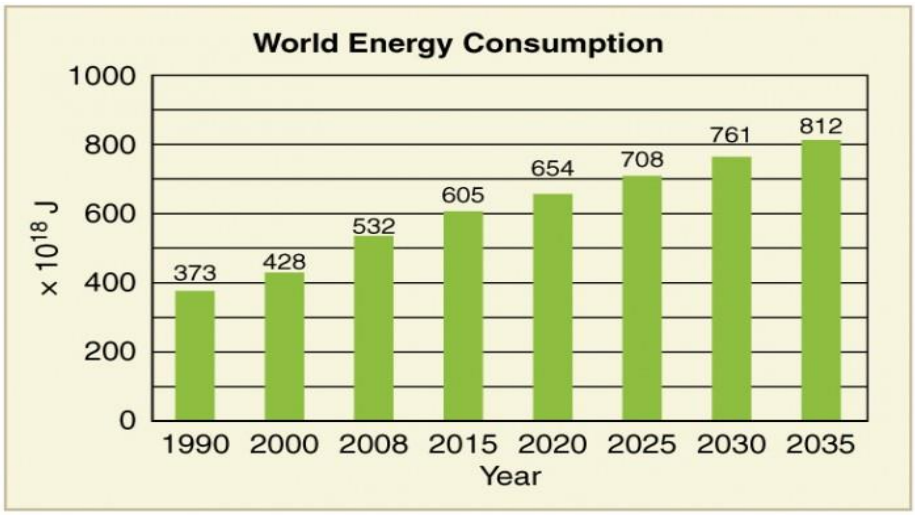


Figure1.4: World GDP from 1940 to 2015. (Our Word in Data)

Globalization has led to an era of economic and cultural integration. Also, It has driven international organizations and companies to work beyond its borders. With the advent of the 21st Century, globalization has been further fueled by rapidly advanced technology and improved communications, as a result, industrialization, transportation, and international trade become more interdependent between countries. (Today Industry Magazine, 2020)

Economic growth means an increase in real output (GDP), therefore, the increased output and consumption have driven the world energy consumption to continue rising, particularly, in developing countries. (See Figure1.5). The global

energy demand has doubled in the last 50 years and it is estimated to double again in the next 20 years.



1Figure1.5: Past and projected world energy consumption. (Based on data from U.S. Energy Information Administration, 2011).

The top five countries for energy consumption are China, the United States, India, Russia, and Japan. Figure1.6 indicates that industry and transportation are the major consumers for energy, while residential and other sectors (including commercial, public services, and agricultural sectors... etc) are Using less energy. (International Energy Agency (IEA), 2017)

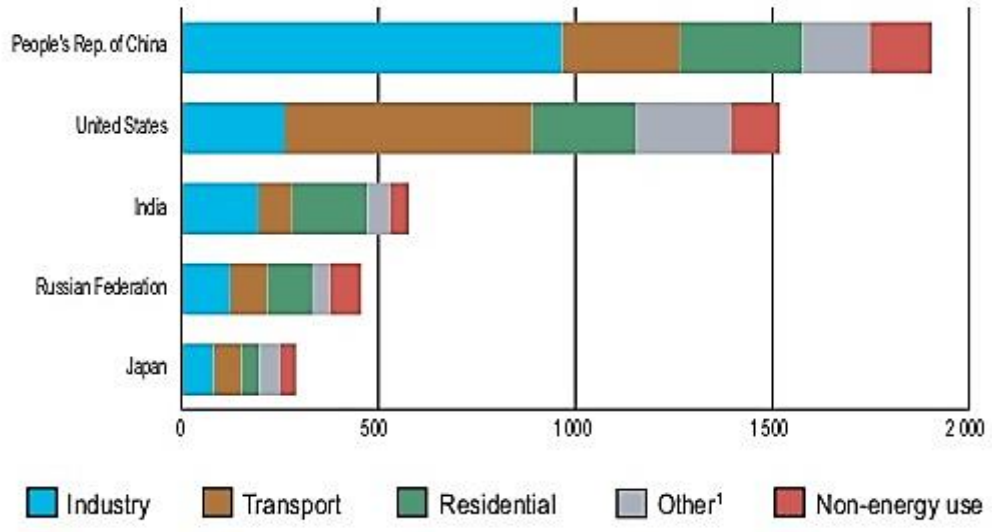


Figure1.6: The top five countries for energy consumption by sector. (International Energy Agency (IEA), 2017)

As the world becomes more globalized, total energy consumption will change; the demand and supply of energy will be more affordable. However, this change will increase or decrease depending on several elements, one of them is globalization (Amine Lahiani et al, 2018).

In the last decades, the reciprocal relationship between globalization and energy consumption has appeared strongly. Globalization has made the world into a single system, because countries nowadays are more connected to one another, throughout oil, gas resources (Buhari Dogan and Osman Deger, 2016), therefore, energy trade made globalization an embodied fact. In this sense, energy can be construed as an essential factor of globalization (Kurtz and Fustes, 2014)

There also is a huge impact of globalization on energy consumption. When energy has become a significant element for international policies as well as being a major input for production and consumption activities.

It is observed that energy diversion helps to create multinational energy cooperation, which pushed to open many energy markets that are taking place in every part of the world, leading to the globalization of the energy markets (Buhari Dogan and Osman Deger, 2016).

Amine Lahiani et al, (2018) investigated the relationship between globalization and energy consumption. The findings of the study indicate that the positively correlation between globalization energy consumption in the long term for many countries. In addition, energy consumption is strongly related to globalization in the long term. However, the influence of globalization in the short term on energy demand is sometimes limited insignificantly for highly globalized countries.

2. The relationship between globalization and environmental degradation

Globalization has a huge effect on our lifestyle. It led to rapid access to technology, improved communication, and mass production of goods. Environmental activists indicated that globalization drives to increase the consumption of products significantly, which has affected the ecological cycle. Not only increased the consumption of the product, but also leads to improve energy consumption, thereforeGlobalization increase the pressure on our environment. (Tejvan Pettinger, 2019).

Globalization and economic growth have pushed to increase consumption of non-renewable resources and industrial waste accumulation, which produced higher levels of pollution, global warming, and the potential loss of environmental habitats.

To analyze the tradeoff between non-renewable resources and consumption, the production possibility frontier curve (PPF) in Figure1.7 shows when consumption increases, the stock of non-renewable resources will decrease. For example, in the last century, rapid global economic growth has led to a decrease in the availability of natural resources such as forests (agricultural reduction/demand for wood). (Tejvan Pettinger, 2019)

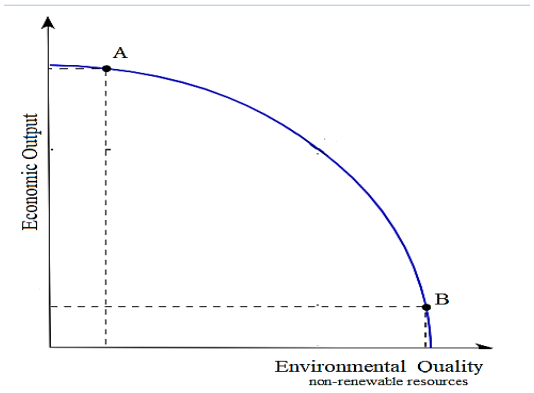


Figure1.7: PPF curve of non-renewable resources and consumption. (Tejvan Pettinger, 2019)

At one extreme, at the point A, a country would be selecting a high level of economic output but very little environmental non-renewable resources. At the other extreme, at a choice like B, a country would be selecting a high level of environmental non-renewable resources but little economic output.

Globalization also has led to an increase in transportation and cement production, which increases CO2 emissions; also, the production cycle needs CO2 emissions and subtracts pollutants.

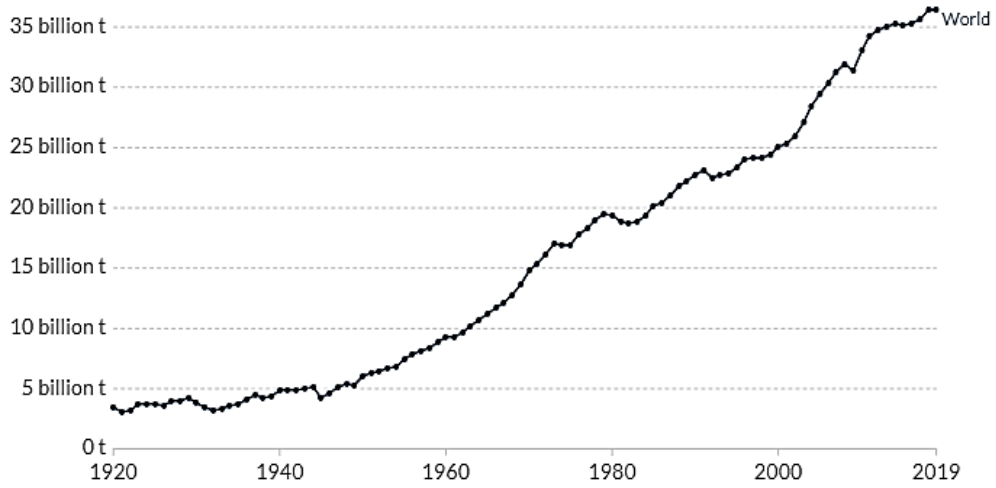


Figure 1.8: World CO2 emissions from 1920 to 2019. (Our world in data)

This chart shows the growth of global emissions from 1920 until the present. between1920and 1940, CO2 emissions were low, also, in 1950 the world-emitted gasses were just over 5 billion tons of CO2. However, in 1990, it had quadrupled to 22 billion tons. The CO2 emissions have continued to grow rapidly; nowadays, the world emits over 36 billion tons. (ourworldindata.org).

Lv and You(2018) investigated the influence of globalization on CO2 emissions between 1985 and 2013 for eighty-five countries. The results of the study indicated that economic globalization positively influences CO2 emissions; when the global economy increase, CO2 emissions increase instead. So economic globalization negatively influences environmental quality.

3. The Environmental Kuznets Curve (EKC) Hypothesis:

The Environmental Kuznets Curve (EKC) hypothesis explains an inverted U-shaped relationship between economic growth and environmental degradation (Figure: 1.9).

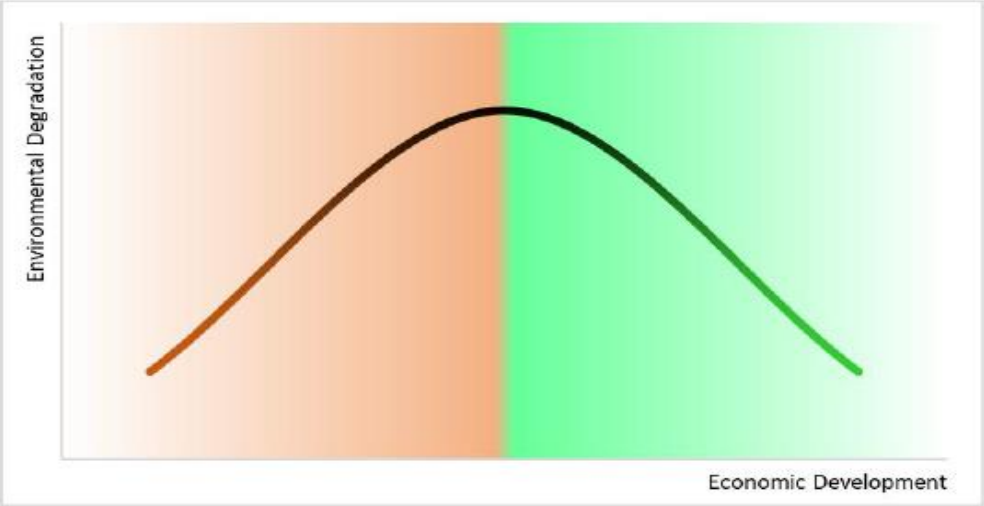


Figure1.9: The Environmental Kuznets Curve (EKC) (Nutnaree Maneejuk et al, 2020).

The environmental pressure increases in the early stages of economic growth due to the increased release of pollutants (Nutnaree Maneejuk et al, 2020).

Co2 is considered as a major greenhouse gas that has a huge effect on the environment; it was estimated at 76% of the total emission (Nutnaree Maneejuk et al, 2020). As CO2 emissions include emissions from all uses of fossil fuels for energy purposes, it is the primary gas emitted from human activities. The CO2 emissions do not only include emissions from buildings and household uses, but also industrial processes are the major factor of CO2 emissions

Numerous studies have been done to prove the existence of the EKC hypothesis. Most findings of these studies are supporting the hypothesis that the U-curve relationship between economic growth and environmental degradation exists. For instance Rahman (2020) conducted a study, using the environmental

Kuznets curve (EKC) hypothesis for the BCIM economic corridor (Bangladesh–China–India–Myanmar) under the Belt and Road Initiative (BRI) of China. (Arifur Rahman et al, 2020). Muhammad Bilal Khan et al (2021) also analyzed the relationship between globalization, energy consumption, and economic growth among selected South Asian countries. The study showed a causal association between energy consumption growth, CO2 emissions, and employed the premises of the EKC framework. Also, the study indicated that there was a relationship between GDP growth and CO2 emission, as well as bidirectional causality between economic growth and energy use.

Results show a significant impact on the CO2 emissions and destroying the level of environment regarding non-renewable energy and globalization index. However, negative and positive growth levels (GDP) and square of GDP confirm the Environmental Kuznets Curve EKC hypothesis in the region of South Asia.

However, there are also many studies that failed to approve the EKC hypothesis, as Muhammad Azam and Abdul Qayyum Khan (2016) who did not provide any evidence to support the validity of an EKC hypothesis for the countries investigated in their study.

Section three: Review of the empirical literature

1. (Nicholas Apergis, 2016)

Apergis (2016) conducted a study, using the "Environmental Kuznets curves: New evidence on both panel and country-level CO2 emissions", the author used data on per capita CO2 emissions and per capita real GDP from fifteen countries, during the period 1960 - 2013, to test the validity and authenticity of the Environmental Kuznets Curve (EKC) applying both panel-based and time-series-based approaches of cointegration. This research examined the

cointegration between per capita CO2 emissions, per capita real GDP, and the squared values of per capita real GDP.

The research results of the study showed that there was evidence from cointegration panel methodologies is mixed, it might appear due to the time dependence of the coefficients of cointegration. Moreover, time-series cointegration approaches provide strong evidence in favor of time-varying cointegration parameters. Furthermore, the results indicate that the EKC hypothesis exists in 12 out of the 15 countries. However, other three countries, the EKC hypothesis seems to be held at certain quantiles.

2. (Usama Al-Mulali and Ilhan Ozturk, 2016)

Usama Al-Mulali and Ilhan Ozturk, (2016) conducted a study to examine the effects of energy prices on pollution, and explore the existence of the environmental Kuznets curve (EKC) hypothesis in 27th advanced economies.

They have used the panel non-stationary techniques to examine the selected economies during the period between 1990and 2012, To examine the stationarity of the variables, and to identify whether the variables are integrated with the first level {I(1)} or in level 0 {I(0)}, the unit root test has been utilized.

The results of the study demonstrated three major results. Firstly, the CO2 emission, gross domestic product (GDP), renewable energy consumption(RE), non-renewable energy consumption(NR), trade openness (TD), urbanization(UR), and energy prices (PC) are cointegrated, based on the panel Kao and Fisher cointegration testes.

Secondly, the panel fully modified ordinary least square and the vector error correction Granger causality results indicate that renewable energy consumption (RE), trade openness (TD), and energy prices (PC) reduce CO2 emission, while

the gross domestic product (GDP), non-renewable energy consumption (NR), and urbanization (UR) increase it.

Also,, the study's results confirmed the inverted U-shaped relationship between gross domestic product (GDP) and CO2, which signifies the presence of the environmental Kuznets curve (EKC) hypothesis.

Overall, the authors have provided multiple policy implications to the investigated countries, to help them control and eliminate air pollution, without detriment their economic growth and development.

3. (María del P.Pablo-Romero and Josué De Jesús 2016)

María and colleagues (2016) investigated the relationship between Economic growth and energy consumption using the hypothesis of Energy-Environmental Kuznets Curve "Economic growth and energy consumption: the energy-Environmental Kuznets Curve for Latin America and the Caribbean", María .P.P and Josué .D.J The study assumed that there is an inverted-U-shape relationship between income and energy consumption.

By using panel data for 22 Latin American and Caribbean countries taking the period of 1990–2011, the results showed that the suggestedhypothesis of the Kuznets curve for energy and environment did not support the region. Per contra, the results show exponential growth with the growth of total value-added. In addition, it marked; many differences appear between the investigated economies.

4. (Muhammad Azam and Abdul Qayyum Khan, 2016)

Muhammad and colleagues (2016) conducted a study to estimate the Environmental Kuznets Curve (EKC) hypothesis for four countries from different economic categories, which are; Tanzania as a lower-income country, Guatemala

as a lower-middle-income country, China as an upper-middle-income country, and the USA as a high-income country .

Annual time-series data between 1975 and 2014 has been used to examine the cointegration for the CO2 emissions, environmental degradation as a response variable, and income, income square, energy consumption, urbanization growth rate, and trade openness as regressors.

For this empirical investigation, Johansen co-integration test is applied; the results illustrate that in all of the USA and China, there exists one co-integrating linkage among the variables. Meanwhile, in Tanzania and Guatemala, there exist two co-integrating relationships.

Furthermore, the Pearson correlation results among the variables in Tanzania, the USA, Guatemala, and China showed that energy consumption has a significant positive relation with trade openness and CO2 emissions. However, it has a significant negative relationship with economic growth in all these countries.

Moreover, the experimental results indicated that in Tanzania and China, trade openness and environmental degradation had a significant positive relationship. While in the USA and Guatemala, the correlation between environmental degradation and urbanization growth rate was significant with a negative sign.

Finally, the ordinary least square results support an EKC hypothesis for low and lower and middle-income countries. Whereas, the result of the study did not find any evidence to support the validity of an EKC hypothesis for upper, middle, ,and high-income countries during the period of the study.

5. (Seyi Saint Akadiri et al, 2019)

Seyi and colleagues (2019) attempted to examine the impact of globalization on the Environmental Kuznets curve (EKC) hypothesis for the case of tourist destination states, also the study examined the existence of an inverted U- shaped hypothesis, and interactions between globalization, tourism, and real income to show how they contributed to the CO2 emission level, for 15 selected tourism destination states during the period of 1995 to 2014. The

15 selected tourism destination states, including Bahrain, Brunei, Cuba, Cyprus, Dominican Republic, Haiti, Iceland, Indonesia, Ireland, Jamaica, Malta, Mauritius, New Zealand, Singapore, and Trinidad and Tobago, which are prioritized tourism as a means of maximizing economic growth.

The results of the study supported the EKC hypothesis for selected states. It indicated that the international tourism growth and CO2 emissions, through the channels of energy consumption, globalization, and real income, are in a long-term equilibrium relationship.

Moreover, international tourism and the squared real income have an inverse significant effect on CO2 emission levels. However, energy consumption, globalization, and real income have positive and significant effects on CO2 emission levels in the long term.

6. (Le Hoang Phong, 2019)

Le and colleagues (2019) conducted a study to evaluate the impacts of globalization, financial development, incorporating energy consumption, urbanization, and GDP per capita, on CO2 emissions with the presence of the Environmental Kuznets Curve (EKC) model for selected Asian countries.

This study utilized approximates heterogeneity panel data over the period between 1971 and 2014. The the study relied on on the Durbin-Hausman-Wu statistic tests .

The the results demonstrated that financial development, energy consumption, and urbanization pushed CO2 emissions to increase. furthermore, globalization as an aggregate measure significantly boosts CO2 emissions; its effect resulted from the economic globalization facet. Finally, the EKC hypothesis is highly supported in selected Asiancountries.

7. (Rajan Parajuli et al, 2019)

Rajan and colleagues (2019) examined the role of forests and agricultural land on CO2 emissions, using panel data from 1990 to 2014 for 86 different countries.

the study used the the framework of the Environmental Kuznets Curve (EKC) to evaluate the effects.of forests and agricultural land on CO2 emissions, using the framework of the Environmental Kuznets Curve (EKC).

The results from the dynamic panel data method showed that forests are very important to reduce CO2 emissions globally, but the effects differ from one region to another.

It was estimated with a 0.11% decline in CO2 emissions per 1% increase in the forest area global; however, it was found that the agricultural sector is a true CO2 emitter.

This paper also provides additional evidence of the roles of the forest in regulating carbon dioxide CO2 in the atmosphere, which enhances the importance of forests in global climate change policies.

8. (Arifur Rahman et al, 2020)

Arifur and colleagues (2019) examined the environmental Kuznets curve (EKC) hypothesis for member countries of the BCIM economic corridor (Bangladesh–China–India–Myanmar) under the Belt and Road Initiative (BRI) of China. Both time series and panel data are used in this paper, to investigate the relationship between CO2 emissions, GDP per capita, energy use, and trade openness.

The results of the study indicate that there are positive effects of GDP per capita and energy consumption on CO2 emissions, whereas, the effect of the squared GDP per capita is negative in the short run; however, the short-run effects do not remain valid in the long run, except for energy use. the results showed that the EKC hypothesis only exists in the short-run in the case of the panel data framework.

on The results of the Autoregressive Distributed Lag (ARDL) approach (with and without structural breaks showed that the EKC hypothesis is existing in India and China, meanwhile the EKC hypothesis holds in Bangladesh and Myanmar with disregarding breaks within the short run. The long-run estimates support the EKC hypothesis of considering and disregarding structural breaks for Bangladesh, China, and India

Moreover, the Dumitrescu and Hurlin panel non-causality tests showed that there was a unidirectional causality runs from GDP per capita to CO2 emission, squared GDP to CO2 emission, and CO2 emission to trade openness.

The authors recommend the BCIM-EC countries to do not only focus on connectivity and massive infrastructural development, but also should promise a long-range policy to cope with environmental degradation and to ensure sustainable green infrastructure.

9. (Nutnaree Maneejuk et al, 2020)

Nutnaree and colleagues (2020) attempt to examine the relationship between economic development and environmental degradation based on the Environmental Kuznets Curve (EKC) hypothesis and to measure the environmental damage, the level of CO2 emissions is used as a reflection of environmental degradation.

The investigation covered eight major international economic communities covering 44 countries across the world, consisting of ASEAN, EFTA, EU, G7, GCC, Mercosur, NAFTA, and OECD.

the Kink Regression Model was used to examine the relationship between economic growth and environmental condition, variables were used in the estimation model are; financial development (FIN), the industrial sector (IND), and urbanization (UR), CO2 emissions, and renewable energies (RN).

The finding of the study indicated that the EKC hypothesis was valid in only three out of the eight international economic communities, namely the European Union (EU), Organization for Economic Co-operation and Development (OECD), and Group of Seven (G7).

In addition, when the existence of the EKC hypothesis was investigated in an individual country, the findings illustrated that the EKC hypothesis was valid in only 09 out of the 44 countries.

CHAPTER TWO:

Static and Dynamic Analysis the Presence of Environmental Kuznets Curve in the Developed Countries: An Empirical Study

This chapter applies a quantitative research approach to conduct a cross-regional analysis for some developed countries, by using an unbalanced panel-data structure. It aims to extend the existing empirical research and provide additional insights into the complex relationship between globalization, energy consumption, and the level of CO2 emissions, which represents environmental degradation. The use of panel data is a positive development in this literature, since investigating CO2 emissions in a cross-section structure might lead to omitted variable bias and other econometric problems.

Section one: Data and Methodology

1. Data:

The panel data has a structure that contains a lot of information, due to counting observations of individual units over time. However, modeling relationships between variables with this type of database pose challenges since it produces a variance-covariance matrix that depends on time and cross-section. Using panel data reduces individual heterogeneity and co-linearity between variables because it is more reliable and stable estimates of the parameters. However, there are certain limitations to the panel data method such as the problem of design and data collection, error measurement distortions, and cross-section dependence, which is usually associated with macro data (Baltagi, 2005).

To analyze the existence of the Environmental Kuznets Curve Hypothesis of the countries was investigated, using a sample of 21st developed countries, including Australia, Austria, Belgium, Denmark, Canada, Finland, France, Germany, Hungary, Ireland, Italy, Japan, South Korea, Netherland, Norway, Portugal, Spain, Sweden, Switzerland, the USA, and the United Kingdom. The countries were chosen according to the availability of data for the variables that will be considered in the analysis. For each country, we have considered a set of indicators measuring CO2 emissions (CO2cp), GDP per capita (GDP pc), Globalization Index (GI), Energy consumption per capita (ECpc), and Population density (POPd).

In Table 2.1. describes the dependent and independent variables of the study, including their definition and sources.

Table 2.1 Description of the variables considered in the analysis.

Variable	Definition	Source
Dependent Variable		
Per capita CO2 emissions (CO2cp)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during the consumption of solid, liquid, and gas fuels and gas flaring.	International Energy Agency (IEA)
Independent variables		
GDP per capita (GDPpc)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Globalization Index (GI)	The KOF Globalization Index measures the economic, social, and political dimensions of globalization. Globalization in the economic, social, and political fields has been on the rise since the 1970s, receiving a particular boost after the end of the Cold War.	KOF Swiss Economic Institute
Energy consumption per capita (ECpc)	Energy use refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.	https://ourworldindata.org/energy-production-consumption
Population density (POPd)	Population density is midyear population divided by land area in square kilometers. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered	Food and Agriculture Organization (FAO) and World Bank

	part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases, the definition of inland water bodies includes major rivers and lakes.	population estimates.

Source: student's elaboration

The dependent variable in our study is Per capita CO2 emissions (CO2cp), which represents one of the most important indicators of environmental degradation. Data of this indicator was obtained from International Energy Agency (IEA) (Energy Agency, 2020). Our key explanatory variables are:

- GDP per capita (GDP pc) is measured by the World Bank national accounts data, and the OECD National Accounts data files.
- Globalization Index (GI) data selected from KOF Swiss Economic Institute.
- Energy consumption per capita (ECpc) data provided by our world in data website.
- Population density (POPd) data was collected from the Food and Agriculture Organization (FAO) and the World Bank population estimates.

The sources of data used in the present study are the most major sources of data, they offer data on many different Global Indexes, they are considered as official sources of data worldwide since a number of them are official websites for international and governmental institutions. The first data source is The World Bank Data, which provides data of different indexes for 189 countries members (the World Bank, 2020).

The second source of the data used in the current study is International Energy Agency (IEA). it is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to

help countries to provide secure and sustainable energy. It consists of 30 countries from all around the world (International Energy Agency,2020).

The Swiss Economic Institute (KOF) is the third source; it was established on May 16, 1938. The Institute carried out its first surveys among companies in 1955. It still provides economic surveys, data, and analysis until today.

Another source of data was used is Our World in Data; it is a scientific online publication, which focuses on large global problems such as poverty, disease, hunger, climate change, war, existential risks, and inequality. It also provides numerous economic indexes and data.

Also, we used data from the Food and Agriculture Organization (FAO). It is a specialized agency of the United Nations. It leads international efforts to defeat hunger and improve nutrition and food securityIt provides data for a different number of indexes one of them is Population density (POPd), which was used in the research as one of the independent variables.

2. Estimation Strategy:

In the existing literature, three different empirical specifications were used to analyze the EKC hypothesis (Bölük and Mert 2014; Grossman and Krueger 1995): log-linear, quadratic, or cubic form. These forms can be generalized by using other factors such as time, regional characteristics, and technical factors like external variables. These general functional forms are specified as follows:

$$CO_{2,t} = \alpha_0 + \alpha_1 \ln RGDP_t + E_t + \varepsilon_t$$

$$CO_{2,t} = \alpha_0 + \alpha_1 RGDP_t + \alpha_2 RGDP_t^2 + E_t + \varepsilon_t$$

$$lnCO_{2,t} = \alpha_0 + \alpha_1 lnRGDP_t + \alpha_2 (\ln RGDP_t)^2 + E_t + \varepsilon_t$$

$$CO_{2,t} = \alpha_0 + \alpha_1 RGDP_t + \alpha_2 RGDP_t^2 + \alpha_3 RGDP_t^3 + E_t + \varepsilon_t$$

$$lnCO_{2,t} = \alpha_0 + \alpha_1 lnRGDP_t + \alpha_2 (\ln RGDP_t)^2 + \alpha_3 (\ln RGDP_t)^3 + E_t + \varepsilon_t$$

Unlike the previous studies, there is only employed energy consumption as a control variable in a model that expresses the relationship between CO2 emissions and real income under the EKC hypothesis framework (Stern 2004; Akadiri et al. 2017). Where the existence of an inverted U-shaped framework between CO2 emissions and real income was confirmed. The current study, attempts to introduce globalization alongside energy consumption and real income as a determinant of CO2 emission level. Thus, globalization in addition to real income and energy consumption is assumed to contribute to CO2 emission levels.

The theoretical relationship between environmental degradation and economic growth is usually described as follows (Grossman and Krueger 1991; Stern 2004):

$$GHG_{it} = \alpha_{it} + \beta_1 GDPpc_{it} + \beta_2 GDPpc_{it}^2 + \beta_3 GDPpc_{it}^3 + \beta_4 Z_{it} + \varepsilon_{it}$$

Where GHG refers to the greenhouse gas emissions, that is as environmental degradation, GDPpc stands for income per capita, and Z contains all other variables that might affect environmental quality. The coefficient α_{it} measures the average environmental pressure when income has no influence, β refers to the direction and importance of the exogenous variables, and ε_{it} is the error term. Depending on the sign of the different β parameters related to income, the EKC will adopt different shapes (Álvarez-Herranz and Balsalobre Lorente 2016):

(i) If β1 = β2 = β3 =0, there will be either a flat pattern or no relationship between environmental degradation and income.
(ii) If β1 >0 and β2 = β3 = 0, there will be a monotonic increasing relationship such that environmental degradation increases along with economic growth.

(iii) If $\beta1 < 0$ and $\beta2 = \beta3 = 0$, there will be a monotonic decreasing relationship between environmental deterioration and income.

(iv) If $\beta1 > 0$ and $\beta2 < 0$ and $\beta3 = 0$, we will see the classical inverted U-shaped EKC.

(v) If $\beta1 < 0$ and $\beta2 > 0$ and $\beta3 = 0$, there will be a U-shaped relationship between environmental degradation and income.

(vi) If $\beta1 > 0$ and $\beta2 < 0$ and $\beta3 > 0$, there will be a cubic polynomial or N-shaped relationship between environmental deterioration and income.

(vii) If $\beta1 < 0$ and $\beta2 > 0$ and $\beta3 < 0$, there will be an inverted, or opposite, N-shaped relationship between environmental degradation and economic growth.

For quadratic curves and cubic curves, different combinations of coefficient symbols have different curve forms.

Table 2.2 Curve shape of the relationship between environment and income

Model	Value of βi	Forms of the curve
Model 1	$\beta1 = \beta2 = \beta3 = 0$	no
Model 2 (linear)	$\beta1 > 0, \beta2 = \beta3 = 0$	Linear monotonically increasing
Model 3 (linear)	$\beta1 < 0, \beta2 = \beta3 = 0$	linear monotonically decreasing
Model 4 (quadratic)	$\beta1 < 0, \beta2 > 0, \beta3 = 0$	U-shaped relationship
Model 5 (quadratic)	$\beta1 > 0, \beta2 < 0, \beta3 = 0$	inverted U-shaped relationship
Model 6 (cubic)	$\beta1 > 0, \beta2 < 0, \beta3 > 0$	N-type relationship
Model 7 (cubic)	$\beta1 < 0, \beta2 > 0, \beta3 < 0$	inverted N-type relationship

Source: (Chuanqi Fan and Xiaojun Zheng, 2013)

As shown in Table2.2, there are seven models for the curve, and the meanings vary from model to model, broadly speaking, linear monotonically increasing means that the environment quality deteriorates as income increases, linear monotonically decreasing means that the environmental quality improves with income increases. The U-shaped relationship means that when income levels are in the lower stages, the environment quality improves as income rises, and when the income level is at a high stage; the environment quality deteriorates as incomes rise., Moreover, inverted U-shaped relationship means that when income levels are in the lower stages, the environment quality deteriorates as incomes rise and when income levels are in the high stages, the environment quality improves as income rises. Besides, the N-type relationship is a kind of curve that explain when the income levels rise gradually, the environment quality deteriorates before further improvement, and finally, it falls into deterioration. In contrast, the inverted N-type relationship is totally opposite that as income levels raise gradually, the environment quality first improves before deterioration and at last improves.

We estimated an empirical model consisting of a relationship between CO2 emissions (CO2cp) and the following explanatory variables: income (GDP), globalization (GI), energy consumption (ECpc), and population density (POPd). The model is given by:

$$CO2cp_{it} = \alpha_{it} + \beta_1 GDPpc_{it} + \beta_2 GDPpc_{it}^2 + \beta_3 GDPpc_{it}^3 + \beta_4 GI_{it} + \beta_5 ECpc_{it} + \beta_6 POPd_{it} + \varepsilon_{it}$$

All the series are transformed into natural logarithmic form following Lean and Smyth (2010). The log-linear specification presents consistent and efficient empirical results compared to

simple linear modeling (Shahbaz et al., 2015b). The log-linear specification is modeled as follows:

$$LCO2cp_{it} = \alpha_{it} + \beta_1 LGDPpc_{it} + \beta_2 LGDPpc_{it}^2 + \beta_3 LGDPpc_{it}^3 + \beta_4 LGI_{it} + \beta_5 LECpc_{it} + \beta_6 LPOPd_{it} + \varepsilon_{it}$$

In the present study, the presence of the Environmental Kuznets Curve (EKC) hypothesis is empirically tested using a panel data set, covering 21 countries over a forty-years between 1980 and 2019. The selected empirical strategy is subject to theoretical considerations, dataset structure, and the potential econometric issues that need to be carried out in this investigation. The use of panel data is the first remedy to address some of the above-listed issues in the presence of the Environmental Kuznets Curve (EKC) in the selected developed countries. This study follows the previous research practice, which suggests that static estimators, namely fixed effects (FE) and random effects (RE) are more commonly used in panel data analysis. The suitability of the two alternative estimators is assessed on a theoretical basis, the relationship to be investigated, and the type of the data (heterogeneity; unobserved effects), and on the diagnostics tests. Random effects (RE) estimator is preferred in situations, where the unobserved country effects are assumed to be uncorrelated with the included regressors (Gujarati, 2004). On the other hand, the fixed effects (FE) estimator accounts for such correlation between the unobserved heterogeneity and explanatory variables in the model, within each cross-sectional observation, e.g., between countries. The FE rather than the RE is more frequently applied in the entrepreneurship-economic performance literature. Favoring the use of (FE), (Wooldridge J. M., 2013).

The study relies on the Hausman test to confront the decision of which is the most appropriate estimator for this investigation (Hausman, 1978). The null hypothesis states that there are no systematic differences between the two estimators, i.e., that the (RE) model is valid. A rejection of the null hypothesis suggests that the fixed effects (FE) arebeing preferred over the random effects (RE) (Baltagi, 2005).

The use of panel data methods to address unobserved heterogeneity can bring substantial gains in robustness but is not without costs. The fixed-effects identification strategy cannot be applied in all contexts. Sometimes a variable of interest is measured at only one point in time. Even where variables are measured at more frequent intervals, some are highly persistent, in which case the within-country variation is unlikely to be informative.

Given the potentially unattractive trade-off between robustness and efficiency, (Barro & Sala-i-Martin, 1997), (Temple, 1999), and (Wacziarg, 2002) all argue that the use of fixed effects in empirical growth models has to be approached with care. The price of eliminating the misleading component of the between variation – namely, the variation due to unobserved heterogeneity – is that all the between variation is lost.

There are alternative ways to reveal this point, but consider the random effects GLS estimator of the slope parameters, which will be more efficient than the within-country estimator for small T, when the random-effects assumptions are appropriate. This GLS estimator can be written as a matrix-weighted averagewithin-country estimator and the between-country estimator, which is based on averaging the data over time and then estimating a simple cross-section regression by OLS (Durlauf, Johnson, & Temple, 2005).

To address some of the above empirical issues to ensure econometric validity and statistical inference, (Hoechle, 2007) suggests using standard errors adjusted for unbalanced panel data (Driscoll & Kraay, 1998). Hoechle (2007) argues that "*Driscoll-Kraay standard errors are well-calibrated when the regression residuals are cross-sectionally dependent*". According to Driscoll & Kraay (1998), Driscoll-Kraay standard errors are robust to most of the forms of cross-sectional "spatial" and dependence. The second concern in the empirical analysis is the presence of time-invariant or slowly-moving (rarely-changing) regressors.

Section two: Results and discussion

In this section, empirical results of the relationship between CO2 emissions (CO2cp) and GDP per capita (GDP pc), Globalization Index (GI), Energy Consumption per capita (ECpc), and Population density (POPd) using static approach estimation methodologies, as was explained in the previous section.

1. Descriptive statistics:

Table 2.3 displays descriptive statistics (mean and standard deviation) of the variables that were included in the analysis. The descriptive statistics provide a summary of the sample and observations in the panel data.

Table 2.3 Description of the variables considered in the analysis.

Variable		Mean	Std. Dev.	Min	Max	Observations	
CO2cp	overall	8.946833	3.859825	2.37	20.29	N =	840
	between		3.711244	4.2845	18.27325	n =	21
	within		1.328591	4.233333	12.99783	T =	40
GDPpc	overall	38771.36	16632.45	3679.107	92556.32	N =	840
	between		14695.71	11004.89	75188.91	n =	21
	within		8409.136	12086.91	78526.32	T =	40
GDPpc2	overall	1.78e+09	1.52e+09	1.35e+07	8.57e+09	N =	840
	between		1.32e+09	1.30e+08	5.88e+09	n =	21
	within		8.03e+08	-1.74e+09	6.23e+09	T =	40
GDPpc3	overall	9.32e+13	1.28e+14	4.98e+10	7.93e+14	N =	840
	between		1.09e+14	1.63e+12	4.74e+14	n =	21
	within		7.05e+13	-2.66e+14	4.96e+14	T =	40
ECpc	overall	54069.41	23651.98	11919.27	123356.7	N =	840
	between		23342.67	23553.58	109334.8	n =	21
	within		6313.804	23361.6	79566.63	T =	40
GI	overall	78.58667	9.402616	46	91.79999	N =	840
	between		6.213983	63.8475	85.9675	n =	21
	within		7.182653	58.07167	94.43918	T =	40
POPd	overall	156.2336	143.9378	1.912448	531.8688	N =	840
	between		146.8005	2.527369	475.7618	n =	21
	within		13.01788	75.70059	212.3405	T =	40

Source: Stata/MP 16 outputs.

The dependent variable mean, CO2 emissions (CO2cp), in the developed countries under study is 8.946833, it can be observed that the mean belongs to the range between 2.37 as the minimum value and 20.29 as the maximum value of the CO2 emissions (CO2cp) worldwide.

Table 2.3 shows the GI, POPd, GDPpc, and GDPpc2 means are in the range between the minimum and the maximum values of the world countries, while the GDPpc3 and ECpc means are more than the maximum values.

Figure 2.1 shows the quadratic curve fitting diagram for environmental pollution and the per capita GDP in the developed countries.

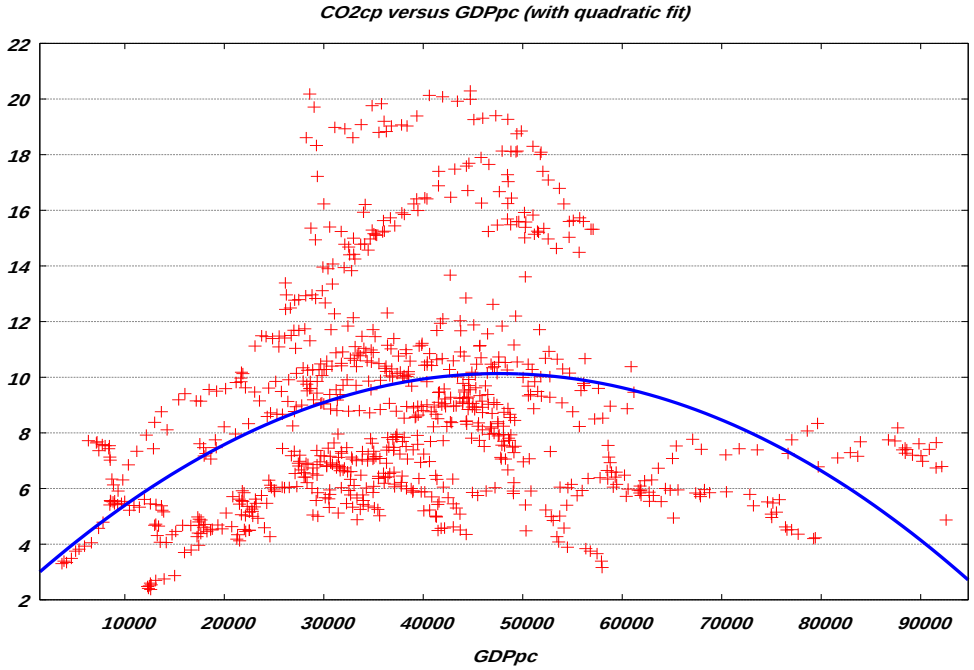


Figure 2.1: Quadratic curve Source: gretl outputs

Figure 2.2 shows the cubic curve fitting diagram for environmental pollution and the per capita GDP in the developed countries.

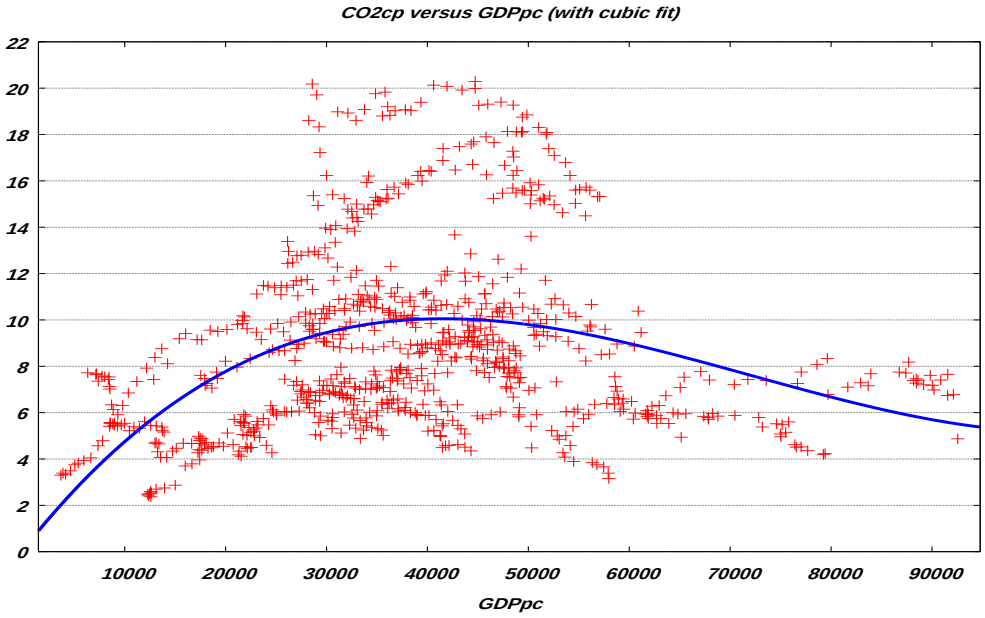


Figure 2.2: Cubic curve *Source: gretl outputs*

It can be seen from Figure 2.1 and Figure 2.2 that the quadratic curve conforms well-inverted U-shaped, meanwhile the cubic curve tends to meet the N-shaped.

The correlation matrix was performed to check whether the variables included in the specified econometric models suffer from high correlation. Table 2.4 displays the descriptive statistics of correlation among the dependent and the independent variables:

Table 2.4 correlation matrix of the variables considered in the analysis.

	LCO2cp	LGDPpc	LGI	LECpc	LPOPd
LCO2cp	1.0000				
LGDPpc	0.2870	1.0000			
LGI	0.0748	0.6824	1.0000		
LECpc	0.6773	0.6195	0.3623	1.0000	
LPOPd	-0.3817	-0.2391	-0.0171	-0.5369	1.0000

Source: Stata/MP 16 outputs.

A high correlation between ‘LGDPpc’ and ‘LGI’ (0.68), and between ‘LGDPpc’ and ‘LECpc’ (0.62) was found as it was expected.

After considering the above-outlined correlation issues, we use the variance inflation factors (VIFs) to examine the existence of the multicollinearity problem.

Table 2.5 multicollinearity test.

Variable	VIF	1/VIF
LGDPpc	2.67	0.374779
LECpc	2.19	0.455944
LGI	1.95	0.511650
LPOPd	1.48	0.675554
Mean VIF	2.07	

Source: Stata/MP 16 outputs.

The variance inflation factors (VIFs) are below 10, thus, it indicated that there are no problems of multicollinearity.

2. Estimation results :

Table 2.6 shows the results of fixed effects estimation:

Table 2.6 Fixed effects model estimation.

```
Fixed-effects (within) regression               Number of obs      =       840
Group variable: country                         Number of groups   =        21

R-sq:                                           Obs per group:
     within  = 0.8214                                         min =        40
     between = 0.3953                                         avg =      40.0
     overall = 0.4331                                         max =        40

                                                F(6,813)           =    623.39
corr(u_i, Xb)  = -0.6582                        Prob > F           =    0.0000
```

LCO2cp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LGDPpc	7.392578	3.057277	2.42	0.016	1.391492	13.39366
LGDPpc_2	-.8934338	.3128267	-2.86	0.004	-1.507477	-.2793906
LGDPpc_3	.0333913	.0106148	3.15	0.002	.0125556	.054227
LGI	.0513022	.0551933	0.93	0.353	-.0570359	.1596404
LECpc	1.319194	.026032	50.68	0.000	1.268096	1.370292
LPOPd	-.0677408	.0654041	-1.04	0.301	-.1961216	.06064
_cons	-29.90367	9.952502	-3.00	0.003	-49.4393	-10.36804
sigma_u	.4140328					
sigma_e	.07625467					
rho	.96719226	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(20, 813) = 471.10                     Prob > F = 0.0000
```

Source: Stata/MP 16 outputs.

It is evident from the outputs of the previous table that the comparison between the pooled model and the fixed effects model based on the restricted Fisher statistic (F) test, which indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis, meaning that the fixed effects model is the best. The next step is to estimate the random effects model:

Table 2.7 shows random effects of model estimation.

```
Random-effects GLS regression                   Number of obs      =       840
Group variable: country                         Number of groups   =        21

R-sq:                                           Obs per group:
     within  = 0.8209                                         min =        40
     between = 0.3851                                         avg =      40.0
     overall = 0.4391                                         max =        40

                                                Wald chi2(6)       =   3674.18
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

LCO2cp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LGDPpc	5.770498	3.026823	1.91	0.057	-.1619649	11.70296
LGDPpc_2	-.7152815	.3088452	-2.32	0.021	-1.320607	-.1099559
LGDPpc_3	.0269253	.0104437	2.58	0.010	.0064561	.0473945
LGI	.0321201	.0551337	0.58	0.560	-.0759399	.1401802
LECpc	1.304315	.0260101	50.15	0.000	1.253336	1.355294
LPOPd	.0327697	.0345166	0.95	0.342	-.0348816	.1004211
_cons	-25.21672	9.906863	-2.55	0.011	-44.63381	-5.799624
sigma_u	.27595861					
sigma_e	.07625467					
rho	.92906036	(fraction of variance due to u_i)				

Source: Stata/MP 16 outputs.

After obtaining the estimates of the random-effects model, it is required to perform a Hausman test for the comparison between the fixed effects model and the random-effects model.

Table 2.8 Hausman test .

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
LGDPpc	7.392578	5.770498	1.62208	.601495
LGDPpc_2	-.8934338	-.7152815	-.1781524	.0657512
LGDPpc_3	.0333913	.0269253	.006466	.0023941
LGI	.0513022	.0321201	.0191821	.0080064
LECpc	1.319194	1.304315	.0148788	.0037334
LPOPd	-.0677408	.0327697	-.1005105	.0562768

```
                b = consistent under Ho and Ha; obtained from xtreg
    B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

           chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =       19.25
         Prob>chi2 =      0.0017
```

Source: Stata/MP 16 outputs.

The output of the previous table shows the rejection of the null hypothesis and acceptance of the alternative hypothesis, therefore, the fixed effects model is the best. The next step is to run the diagnostic tests for the fixed-effects model.

Pesaran CD (cross-sectional dependence) test was used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in test results (also called contemporaneous correlation) (Pesaran, 2004).

Table 2.9 Pesaran cross-sectional dependence test.

```
Pesaran's test of cross sectional independence =     2.598, Pr = 0.0094

Average absolute value of the off-diagonal elements =     0.307
```

Source: Stata/MP 16 outputs.

The result of the Pesaran test indicates the acceptance of the null hypothesis, which indicates that the model is devoid of the problem of non-cross-sectional dependence.

The Modified Wald statistic was used to assess the groupwise heteroskedasticity in the residuals of a fixed-effect regression model. The modified Wald statistic is workable when the assumption of normality is violated, at least in asymptotic terms (Greene, 2000).

Table 2.10 shows the Modified Wald test for GroupWise heteroskedasticity.

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (21)  =    10618.46
Prob>chi2 =       0.0000
```

Source: Stata/MP 16 outputs.

The null is homoskedasticity (or constant variance). According to the results of the modified Wald test above, we reject the null hypothesis and accept conclude heteroskedasticity.

Many tests for serial error correlation in panel data models have been proposed in the literature. The HR-test was used to test the first-order serial

correlation in fixed effect panel data models without gaps (Born & Breitung, 2016), (Wursten, 2018).

Table 2.11 shows the HR-Born & Breitung test.

Heteroskedasticity-robust Born and Breitung (2016) HR-test as postestimation
Panelvar: country
Timevar: year

Variable	HR-stat	p-value	N	maxT	balance?
Post Estimation	0.46	0.648	21	40	balanced

Notes: Under H0, HR ~ N(0,1)
H0: No first-order serial correlation.
Ha: Some first order serial correlation.

Source: Stata/MP 16 outputs.

The null hypothesis is no serial correlation. Therefore, we fail to reject the null hypothesis and conclude the data does not have the first-order autocorrelation.

Diagnostics tests of the specified model suggest the presence of heteroscedasticity and the absence of serial correlation and cross-sectional dependency. The modified Wald test for group-wise heteroscedasticity in the fixed effects regression model indicates the presence of heteroscedasticity (p-value=0.000). The fixed effects estimator was either inconsistent, biased, or inefficient in the presence of heteroscedasticity. To illustrate this, heteroscedasticity would make the estimates inefficient and their standard errors biased. Following (Baltagi, 2005), to correct for such bias in the standard errors, robust standard errors must be used.

Table 2.12 shows the Robust standard errors of the fixed- effects model estimation.

```
Fixed-effects (within) regression               Number of obs      =       840
Group variable: country                         Number of groups   =        21

R-sq:                                           Obs per group:
     within  = 0.8214                                         min =        40
     between = 0.3953                                         avg =      40.0
     overall = 0.4331                                         max =        40

                                                F(6,20)            =    278.12
corr(u_i, Xb)  = -0.6582                        Prob > F           =    0.0000

                                (Std. Err. adjusted for 21 clusters in country)
------------------------------------------------------------------------------
             |               Robust
      LCO2cp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LGDPpc |   7.392578   10.61576     0.70   0.494    -14.7515    29.53666
    LGDPpc_2 |  -.8934338   1.090114    -0.82   0.422    -3.167372    1.380505
    LGDPpc_3 |   .0333913   .0371107     0.90   0.379    -.0440203    .1108029
         LGI |   .0513022   .1356439     0.38   0.709    -.2316459    .3342504
       LECpc |   1.319194   .0538562    24.49   0.000     1.206852    1.431536
       LPOPd |  -.0677408   .1753516    -0.39   0.703    -.4335179    .2980363
       _cons |  -29.90367   34.09879    -0.88   0.391    -101.0325    41.22515
-------------+----------------------------------------------------------------
     sigma_u |   .4140328
     sigma_e |   .07625467
         rho |   .96719226   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Source: Stata/MP 16 outputs.

The result of the robust fixed-effect model that was used to solve the heteroscedasticity problem differs from the fixed effect regression model. Although the value of the coefficient of determination remained the same, the number of statistically significant variables decreased from four to one.

GLS (Generalized Least Squares) is normally designed to produce an optimal unbiased estimator of β for the situation with heterogeneous variance. Information on GLS can be found in Greene (2018), Maddala and Lahiri (2006), Davidson and MacKinnon (1993), and Judge et al. (1985).

Table 2.13 shows the Generalized Least Squares model estimation.

```
Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   no autocorrelation

Estimated covariances      =        21          Number of obs     =       840
Estimated autocorrelations =         0          Number of groups  =        21
Estimated coefficients     =         7          Time periods      =        40
                                                Wald chi2(6)      =   5216.84
                                                Prob > chi2       =    0.0000
```

LCO2cp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LGDPpc	-40.67845	3.98373	-10.21	0.000	-48.48642	-32.87048
LGDPpc_2	4.228861	.4026767	10.50	0.000	3.439629	5.018093
LGDPpc_3	-.1459779	.013526	-10.79	0.000	-.1724883	-.1194674
LGI	-.3247525	.0529787	-6.13	0.000	-.4285888	-.2209163
LECpc	.8243242	.0152515	54.05	0.000	.7944317	.8542166
LPOPd	.0121396	.0034966	3.47	0.001	.0052864	.0189928
_cons	124.5034	13.09323	9.51	0.000	98.84119	150.1657

Source: Stata/MP 16 outputs.

The result of the Generalized Least Squares model used to solve the heteroscedasticity problem differs from the fixed-effect regression model and the robust fixed-effect model. The number of statistically significant variables re-rise to six.

The aggregate measure of globalization decelerates CO2 emissions in developed countries reached at when 1% increase in the overall KOF Globalization Index causes around 0.325% fall in LCO2. It argued that globalization, especially the economic dimension, reduces trade and investment barriers, which in turn expands economic activities and aggravates the environmental quality. The results of the study are consistent with the findings of Cole (2004), Shandra et al. (2009), Shahbaz et al. (2015b), Farhani and Ozturk (2015), Ertugrul et al. (2016), and Shahbaz et al. (2017a; 2017b) when incremental trade activities produce the scale effect that precipitates pollution. Consequently, governments play a vital role in

improving economic conditions, achieving globalization benefits, and sustainably protecting the environment.

Energy consumption (LECcp) estimates CO2 emissions with approximately 0.824% for each 1% rise. This is not dissimilar to Pao and Tsai (2010) and Haseeb et al. (2018) for BRICS countries; Jaunky (2011) for 36 high-income countries; Ozturk and Acaravci (2013) for Turkey; Shahbaz et al. (2014), Farhani and Ozturk (2015) for Tunisia; Boutabba (2014) and Shahbaz et al. (2015b) for India; Javid and Sharif (2016) for Pakistan; Dogan and Seker (2016) for OECD countries; Dogan and Turkekul (2016) for the USA; Rehman and Rashid (2017) for SAARC countries; Solarin et al. (2017) for Ghana; Shahbaz et al. (2017b) for Japan; and Phong et al. (2018) for Vietnam. The aforementioned findings recommend that the governments of those countries necessitate some energy policies for sustainable development such as: promoting effective and efficient energy use, upgrading obsolete technology towards modernity and efficiency, researching and developing renewable energy and green energy sources, and reducing the impacts of energy consumption on the environment.

The positive spillovers of the density population (LPOPd) may be explained by migration effects. The improvement of environmental quality related to economic development essentially refers to resolving pollutions rather than passing them to the younger generation or people in other places. In reality, the solution to the pollution issue may be represented by the increased capability of polluters in well-off areas to distance themselves from heavy ambient pollution caused by their consumption and polluting activities. Furthermore, distancing behavior consists of two aspects: relocating contaminated sources and moving out of areas of intensive pollution. Therefore, migration could be an important contributing factor behind the population spillover effects on neighbor emission.

Parenthetically, groups in different communities have the different ability to migrate away from polluted areas, thus the migration effects also tend to increase environmental inequality and be a driving force of the EKC. (Dinda, S, 2004)

Finally, the evidence of the EKC is confirmed in the developed economies. Specifically, GDP per capita makes CO2 emissions shrink (as evidenced by the negative coefficient of LGDPpc), while the square of GDP per capita increases CO2 emissions (as denoted by the positive coefficient of LGDP2). Meanwhile, the cubic of GDP per capita decreases CO2 emissions (as denoted by the negative coefficient of LGDP3), which implies that the movement of CO2 emissions follows the inverted N-shaped pattern of the EKC hypothesis. This result was supported by to Zheng et al. (2014), Millimet et al. (2003), and Kang et al. (2016). However, this contrasts with the results of Álvarez-Herranz and Balsalobre Lorente (2015, 2016), where estimations with FEM generate the expected N-shaped EKC.

The two turning points based on the trajectory of the EKC are approximately 1315.9 and 50121 (calculation of all turning points is based on Generalized Least Squares model and the calculation formula is

$$\mathrm{GDPpc} = \mathrm{e}^{\left(\frac{-\beta_2 \pm \sqrt{\beta_2^2 - 3\beta_1\beta_3}}{3\beta_3}\right)}$$

.

CONCLUSION

Conclusion

The global industrialization process has brought out the rapid economic growth in all countries. The continuous improvement of energy consumption, rapid economic growth lead to the rise of CO2 emissions. Therefore, the problem of global climate change was caused by the aggravation of CO2 emissions, which is threatening the survival and development of human beings and has become a worldwide concern.

To explain the relationship between CO2 emission and economic growth, various studies have been conducted throughout the last decades. Most of the latest analytical research, at the regional and global level, applied either explicitly or implicitly. One of the paradigms that focused on addressing the relationship between economic growth and CO2 emission is the EKC model. This model has linked CO2 emission to the rapid economic growth through the process of industrialization.

The systematic regional and global analysis of scientific literature, in general, has demonstrated a major impact of economic performance through the process of industrialization on the environmental degradation through the raise of CO2 emission. Most of the scientific researches based its hypothesis on the EKC model.

Main findings:

The initial results of the study contribute to the review. In the Chapter one of the theoretical and empirical literature illustrated the role of globalization in pushing up the country's economic growth, globalization makes access to high technology became more affordable, which enhances industrialization and economic development. on another hand, globalization

has impacted the increase of CO2 emission, in contrast, globalization has impacted the CO2 emission, a large number of the goods and products presented by the mass production process requires a huge consumption of energy, therefore, an increase of CO2 emission.

In the context of this study, we examined the relationship between GDP growth and CO2 emission in the 21 st developed countries over the period between 1980 and 2019. The choice of economic growth, globalization, energy consumption, and CO2 emission were guided by the measurement and definitional challenges identified, and the review of literature.

In Chapter two, Empirical results showed that the quadratic curve of GDPpc conforms well-inverted U-shaped, while the cubic curve of GDPpc tends to meet the N-shaped. In addition, a high correlation between LGDPpc and LGI, and between LGDPpc and LECpc is suspected and found. To solve this problem, we have used the variance inflation factors (VIFs) to test the existence of the multicollinearity problem. The results showed that the variance inflation factors (VIFs) are below 10, thus indicating that there are no problems of multicollinearity.

The Hausman test was applied for comparison between the fixed effects model and the random-effects model; the results show that the fixed effects model was the best.

Pesaran CD (cross-sectional dependence) test was used to test whether the residuals are correlated across entities, the result indicates the acceptance of the null hypothesis, which indicates that the model is devoid of the problem of non-cross-sectional dependence.

Conclusion

The Modified Wald statistic was used to test for group-wise heteroskedasticity in the residuals of a fixed effect regression model. According to the results of the modified Wald test, we reject the null hypothesis and conclude heteroskedasticity. Therefore, the robust fixed-effect model has been used to solve the heteroscedasticity problem that differs from the fixed effect regression model. The robust fixed-effect model reduced the number of statistically significant variables from four to one.

GLS is normally designed to produce an optimal unbiased estimator of β for the situation with heterogeneous variance, the result of the Generalized Least Squares model used to solve the heteroscedasticity problem, shows that the number of statistically significant variables re-rise to six.

The result supported the EKC hypothesis, the evidence of EKC is confirmed for developed economies. Specifically, GDP per capita makes CO2 emissions diminished. It is evidenced by the negative coefficient of LGDPpc. however, the square of GDP per capita increases CO2 emissions, which is presented by the positive coefficient of LGDP2. Meanwhile, the cubic of GDP per capita decreases CO2 emissions, which is denoted by the negative coefficient of LGDP3. The LGDP3 implies that the movement of CO2 emissions follows the inverted N-shaped pattern of the EKC hypothesis.

Policy implications

With the high energy consumption model of economic growth, many countries have become more fossil energy consumption, such as China's per capita carbon emissions is increasing rapidly. Facing such problems,

governments should make great efforts to take measures to reduce carbon emissions and advocate the development concept of "Green GDP."

Therefore, it is very important to develop a low-carbon economy and study the nexus among energy, environment, and economy. Many strategies might be adopted by countries to reduce the CO2 emission without affecting the level of economic growth, such as:

- **Carbon Tax**

A carbon tax is the amount of money is paid as a fee imposed on the burning of carbon-based fuels (coal, oil, and gas). Moreover, a carbon tax is the most important policy used to reduce and eventually eliminating the use of fossil fuels, which causes combustion, destabilizing and destroying the climate.

- **Renewable Energy**

Renewable energy is useful energy that is collected from renewable resources, which are naturally replenished on a human timescale, including carbon-neutral sources like sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy should make up at least 50% of total global electricity generation. It is advised to turn to Green Energy as a source of energy, that because it would reduce the dependence on fossil energy.

- **Transportation**

Electric vehicles should be encouraged worldwide. Therefore, Countries should produce electric vehicles, at least 50% of the new car sales globally. Which is only 1% today. Also, It was suggested to double the mass-transit utilization in cities.

- **Infrastructure**

Countries should invest more to help cities to become fully decarbonize buildings and infrastructure. Countries should decarbonize cities and upgrade their building conditions to zero- or near-zero emissions structures.

Limitations and recommendations for future research:

We can discussed the results of the current research in the light of some limitations, which perhaps influenced these findings. Firstly, the subject is new and the researcher encounter some difficulties to find resources to conduct the study as a result of limited access to scientific journals.

Secondly, difficulties to collect and treat the type of data to investigate and clarify the relationship between CO2 emission as a reflection of environmental degradation, and globalization, energy consumption, and economic growth, a larger set of panel data, particularly regarding time observations, might be more efficient.

In addition, limitations exist in the time given to conducting this research, time limitation might influence the finding.

Recommendations

We suggest to extant this kind of studies about the environmental Kuznets Curve to cover more countries around the world. Also, we urge the organizations and stakeholders to encourage this type of research to enrich and contribute to the current literature. Overall, we recommend that the developing countries to save our planet by benefiting from the advanced technology to reduce CO2 by taking serious procedures products. Furthermore, we urge the countries that have no prior experience in reducing pollution to adopt a policy by benefiting from the

successful experience of the developed countries, and taking these countries as a benchmark to guarantee their success in this field.

APPENDICES

	CO2cp	GDPpc	GI	ECpc	POPd
Australia	16.00025	43278.83	74.4625	65270.64	2.527369
Austria	7.5245	39835.71	82.85	45140.96	97.70375
Belgium	10.0855	37741.28	85.9675	64735.91	343.1633
Canada	15.609	39881.8	77.7975	109334.8	3.372844
Denmark	9.559	52009.01	84.12	41675.71	126.6735
Finland	10.34525	38328.52	80.54	63429.93	16.98244
France	5.74875	36166.13	81.12	46541.78	111.8866
Germany	10.56025	36828.35	81.39	49365.38	231.6469
Hungary	5.71725	11004.89	72.515	28682.2	113.7452
Ireland	8.698	39948.45	79.79	37251.32	57.99745
Italy	6.566	32835.57	75.3975	32544.93	196.7179
Japan	8.55175	40233.97	66.4575	42712.14	342.8914
Korea	8.0135	15417.92	63.8475	42627.08	475.7618
Netherlands	9.86525	42915.73	85.4525	61521.9	467.4196
Norway	7.03	75188.91	81.82	104388.4	12.50722
Portugal	4.2845	19058.89	73.515	23553.58	111.6562
Spain	5.69	26059.61	74.8225	32100.05	84.06226
Sweden	5.7295	44318.02	84.5975	70336.64	21.94124
Switzerland	5.59975	66953.94	84.605	46255.29	184.0507
USA	18.27325	42273.86	74.705	86684.55	30.44934
United_Kin~m	8.43225	33919.15	84.5475	41304.4	247.7475

REFERENCES:

Aisha Shahzad, (2006), What is Globalization - Historical Background, Jadavpur Journal of International Relations, 10(1), pp. 204-212.

Alexandra Soberon and Irene D'Hers, (2020), Kuznets Curve: A Dynamic Panel Data Approach, Sustainability, 11(9), p 2688.

Amine Lahiani et al, (2018), The Role of Globalization in Energy Consumption: A Quantile Cointegrating Regression. Approach, Munich Personal RePEc Archive.

Arifur Rahman et al, (2020), Evaluating the EKC Hypothesis for the BCIM-EC Member Countries under the Belt and Road Initiative, Sustainability Journal, 12(4), P. 1478.

Baltagi, B. H. (2005). Econometric Analysis of Data Panel. England: John Wiley and Sons Ltd.

Barro, R., and Sala-i-Martin, X. (1997). Technological diffusion, convergence, and growth. ournal of Economic, 2, pp. 1-26.

Betul Yalcin, (2018), what is globalization? Essay was written for the consideration of Prof. Peter A. Kemp during MSc. on Comparative Social Policy Programme at University of Oxford, 2008-2009 academic year. Published in Research-Gate website on April 2018. Visited on 01 April 2021.

Born, B., and Breitung, J. (2016). Testing for Serial Correlation in Fixed-Effects Panel Data Models, Econometric Reviews.

Buhari Dogan and Osman Deger. (2016), How Globalization and Economic Growth Affect Energy Consumption: Panel Data Analysis in the Sample of Brazil, Russia, India, China Countries, International Journal of Energy Economics and Policy, 6(4), pp. 806-813.

Cristina Teba, (2018), What does energy consumption mean? dexma Energy Intelligence. Posted on February 12, 2018. viewed on 1/04/2021.

Djalita Fialho and Peter A G van Bergeijk, (2017), The Proliferation of Developing Country Classifications, The Journal of Development Studies, 53(1), pp. 99-115.

Driscoll, J., and Kraay, A. (1998). Consistent covariance matrix estimation with spatially dependent panel data. Review of economics and statistics, 80(4), pp. 549-560.

Durlauf, S. N., Johnson, P. A., and Temple, J. R. (2005). GROWTH ECONOMETRICS. In P. Aghion, & S. N. Durlauf, Handbook of Economic Growth. 1A, pp. 555-677.

Eyup Dogan and Roula Inglesi-Lotz, (2020), The impact of economic structure to the environmental Kuznets curve (EKC) hypothesis: evidence from European countries, Environmental Science and Pollution Research, Springer Nature. https://link.springer.com/article/10.1007%2Fs11356-020-07878-2. visited on 04/04/2021.

Farhad N.H and Mohammad. R N, (2011), Globalization and Challenges; What are globalization's contemporary issues?, International Journal of Humanities and Social Science, 1(6). pp. 216-218.

Greene, W. (2000). Econometric Analysis (Vol. 4). New Jersey: Pearson Education, Inc.

Gujarati, D. (2004). Gujarati, D. West Point: United States Military Academy.

Hausman, J. A. (1978). Specification tests in econometrics. Econometrica: Journal of the econometric society, pp. 1251-1271.

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. Stata Journal, 7(3), p. 281.

International Energy Agency (IEA) report, (2017)

Jimoh, H. et al, (2011). Implications of land degradation, reclamations, and utilizations in the oil-producing areas of Nigeria: Perspectives on environmental sustainability and development. International Journal of Business & Social Science, 2(22), pp. 248-254.

Kurtz D.V and Fustes. M (2014), Globalization and energy: An anthropological perspective. Journal of Globalization Studies, 5(2), pp.19-38

Le Hoang Phong, (2019), Globalization, Financial Development, and Environmental Degradation in the Presence of Environmental Kuznets Curve: Evidence from ASEAN-5 Countries, International Journal of Energy Economics and Policy, 9(2), pp. 40-50.

María del P.Pablo-Romero and Josué De Jesús, (2016), Economic growth and energy consumption: The Energy-Environmental Kuznets Curve for Latin America and the Caribbean, Renewable and Sustainable Energy Reviews journal, Vol 60, PP. 1343-1350.

Muhammad Azam and Abdul Qayyum Khan, (2016), Testing the Environmental Kuznets Curve hypothesis: Comparative empirical study for low, lower middle, upper middle and high income countries, Renewable and Sustainable Energy Reviews Journals, vol 63, PP 556–567.

Muhammad Bilal Khan et al (2021), The effects of globalization, energy consumption and economic growth on carbon dioxide emissions in South Asian countries, Energy & Environment, Pub Date: 2021-04-04, on https://journals.sagepub.com, visited on 21/04/2021.

Muhammad Shahbaz et al, (2017), How Strong is the Causal relationship between Globalization and Energy Consumption in Developed Economies? A Country-Specific Time-Series and Panel Analysis, Munich Personal RePEc Archive.

Mustafa Balat, (2005), Usage of Energy Sources and Environmental Problems, Energy Exploration & Exploitation, 23(2), pp. 141-167.

N.M.Katsoulakos et al, (2016), Environment and Development, Metsovion Interdisciplinary Research Center, National Technical University of Athens, Athens, Greece. pp 499-569.

Nicholas Apergis, (2016), Environmental Kuznets curves: New evidence on both panel and country-level CO2 emissions, Energy Economics Journal, vol 54, pp 263–271.

Nutnaree Maneejuk et al, 2020, Does the Environmental Kuznets Curve Exist? An International Study, Sustainability 2020, 12(21), P 9117.

Our Word in Data: visited on 14/05/2021

Pesaran, M. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in Economics(0435), p. 4 8 2.

R B Jackson et al, (2019), Persistent fossil fuel growth threatens the Paris Agreement and planetary health, Environmental Research Letters, 14(12), Lett. 14 121001.

Rajan Parajuli et al, (2019) Incorporating Forests, Agriculture, and Energy Consumption in the Framework of the Environmental.

Ron Martin et al, (2018), Globalization at a critical conjuncture? Cambridge Journal of Regions, Economy, and Society, 11(1), pp. 3-16.

Seyi Saint Akadiri et al, (2019), Examining the impact of globalization in the environmental Kuznets curve hypothesis: the case of tourist destination states, Environmental Science and Pollution Research, 26(12), PP.12605-12615.

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

Swati Tyagi et al, (2014), Environmental degradation causes and consequences, European Researcher, 81(8).

Tejvan Pettinger, (2019), Environmental impact of economic growth, www.economicshelp.org, visited on 17/04/2021.

Temple, J. (1999). The new growth evidence. Journal of Economic Literature, 37(1), pp. 112–156.

The Industry Today Magazine, (2020), Impact of Globalization on Industrial Relations, visited on 14/04/2021

Wacziarg, R. (2002). Review of Easterly's The elusive quest for growth. Review of Easterly's The elusive quest for growth, 40(3), pp. 907–918.

Wooldridge, J. M. (2013). Introductory Econometrics: A modern Approach (Vol. 5). South-Western Cengage Learning.

World Bank website,

datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries, visited on 14/04/2021.

World Economic Situation and Prospects (WESP) report, (2014), United Nation. pp 143-150.

Wursten, J. (2018). Testing for serial correlation in fixed-effects panel models. Stata Journal.

You, Wanhai and Lv, Zhike, (2018), Spillover effects of economic globalization on CO2 emissions: A spatial panel approach, Energy Economics, vol 73, pp. 248-257.

Chuanqi Fan and Xiaojun Zheng (2013), An Empirical Study of the Environmental Kuznets Curve in Sichuan Province, China, Environment and Pollution. 2(3), pp 107-115.

https://ourworldindata.org/grapher/world-gdp-over-the-last-two-millennia?time=1940..2015

https://industrytoday.com/impact-of-globalization-on-industrial-relations/

https://www.ogj.com/general-interest/article/17288978/eia-world-energy-consumption-to-increase-28-by-2040. Visited on 02/04/2021