NEAR EAST UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
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GLOBAL POLITICAL ECONOMY OF ECONOMIC GROWTH DYNAMICS, ENVIRONMENTAL SUSTAINABILITY, ENERGY, TRADE AND INVESTMENT

SIMBARASHE HOVE

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GLOBAL POLITICAL ECONOMY OF ECONOMIC GROWTH DYNAMICS, ENVIRONMENTAL SUSTAINABILITY, ENERGY, TRADE AND INVESTMENT

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DEDICATION

This thesis is dedicated to my late father Vengesai Hove and the entirety of the Zimbuse family.

ABSTRACT

GLOBAL POLITICAL ECONOMY OF ECONOMIC GROWTH DYNAMICS, ENVIRONMENTAL SUSTAINABILITY, ENERGY, TRADE AND INVESTMENT.

The global political economy is in a dilemma of missing one of the important Sustainable Development Goals (SDGs), a target to achieve a gross domestic product (GDP) growth of 7% in a not too distant future and achieving environmental sustainability at the same time, and currently climate change is wreaking havoc due to ever increasing carbon emissions. The study investigated the nexus between economic growth and environmental pollutants in the global political economy, in the context of the environmental Kuznets curve (ECK) to observe the existence of an N-shaped and the inverse U-shaped relationships. The research study employed annual data for 115 global economies over the duration 2000 up to 2018 for real GDP per capita, atmospheric and land indicators, energy, trade and investment. Three indices were developed for the Global sample, Africa, Asia, Europe and the Americas, and these indices include atmospheric index, land degradation index and the environmental index, to investigate the existence of the environmental Kuznets curve. A special case of 24 emerging economies over the duration 2000 to 2017 was included to investigate the environmental Kuznets curve using single atmospheric indicators such as carbon dioxide emissions, fossil fuel energy consumption and nitrous oxide emission. The study made use of an improved panel system generalized method of moments (GMM) technique, to be specific, the Arellano and Bover (1995), Blundell and Bond (1998) dynamic panel technique so as to ensure robust findings. The findings suggested the existence of the environmental Kuznets curve with respect to global atmospheric index (GAI), global environmental index (GEI), African land degradation index (AFLI) and also European land degradation index (EULI). An inverse N-shaped pattern was observed with respect to the Americas environmental index (AMEI). Findings for our special case of emerging economies revealed the environmental Kuznets curve with respect to nitrous oxide emissions, while a U-shaped pattern was observed with respect to

carbon dioxide emissions and fossil fuel energy consumption. Robust public policy and regulatory interventions were recommended for global authorities to promote a healthy and sustainable environment while achieving sustainable economic growth and development of the global political economy.

Key words: Political economy, Economic growth, Environmental sustainability, Energy, Trade, Investment, Environmental Kuznets curve, Sustainable development.

ÖZ

GLOBAL POLITICAL ECONOMY OF ECONOMIC GROWTH DYNAMICS, ENVIRONMENTAL SUSTAINABILITY, ENERGY, TRADE AND INVESTMENT.

Küresel politik ekonomi, çok uzak olmayan bir gelecekte% 7'lik bir gayri safi yurtiçi hasıla (GSYİH) büyümesi ve aynı zamanda çevresel sürdürülebilirliğe ulaşma hedefi olan önemli Sürdürülebilir Kalkınma Hedeflerinden (SDG'ler) birinin eksikliğinin bir ikileminde. ve şu anda iklim değişikliği, gittikçe artan karbon salınımlarından dolayı büyük hasara yol açıyor. Çalışma, N-şekilli ve ters U-şekilli ilişkilerin varlığını gözlemlemek için çevresel Kuznets eğrisi (ECK) bağlamında, küresel politik ekonomideki ekonomik büyüme ile çevresel kirleticiler arasındaki bağlantıyı araştırdı. Araştırma çalışması, kişi başına reel GSYİH, atmosferik ve arazi göstergeleri, enerji, ticaret ve yatırım için 2000 yılına kadar 2018 yılına kadar 115 küresel ekonomi için yıllık verileri kullandı. Global örnek, Afrika, Asya, Avrupa ve Amerika için üç endeks geliştirilmiştir ve bu endeksler, çevresel Kuznets eğrisinin varlığını araştırmak için atmosferik endeks, arazi bozulma endeksi ve çevre endeksini içermektedir. Çevresel Kuznets eğrisini, karbondioksit emisyonları, fosil yakıt enerji tüketimi ve azot oksit emisyonu gibi tek atmosferik göstergeler kullanarak araştırmak için 2000-2017 yılları arasında ortaya çıkan 24 ekonomiden oluşan özel bir vaka dahil edildi. Çalışmada, sağlam bulgular elde etmek için, geliştirilmiş panel sistemi genelleştirilmiş momentler (GMM) tekniğinin, spesifik olması için, Arellano ve Bover (1995), Blundell ve Bond (1998) dinamik panel tekniğinden yararlanılmıştır. Bulgular, küresel Kuznets eğrisinin, küresel atmosfer indeksi (GAI), global çevre endeksi (GEI), Afrika arazi bozulma endeksi (AFLI) ve ayrıca Avrupa arazi bozulma endeksi (EULI) açısından olduğunu göstermiştir. Amerika'nın çevre endeksine (AMEI) göre N şeklinde ters bir desen gözlendi. Özel gelişmekte olan ekonomilerimize ilişkin bulgular, çevresel Kuznets eğrilerinin azot oksit emisyonları ile ilgili eğrilerini ortaya çıkarırken, karbondioksit emisyonları ve fosil yakıt enerji tüketimi ile ilgili U şeklinde bir patern gözlemlenmiştir. Küresel makamlara, sürdürülebilir ekonomik büyüme ve küresel politik ekonominin gelişmesini sağlarken, sağlıklı ve sürdürülebilir

bir çevrenin desteklenmesi için güçlü kamu politikası ve düzenleyici müdahaleler önerildi.

Anahtar kelimeler: Politik ekonomi, Ekonomik büyüme, Çevresel sürdürülebilirlik, Enerji, Ticaret, Yatırım, Çevresel Kuznets eğrisi, Sürdürülebilir kalkınma.

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ABBREVATIONS

AFEI	African Environmental Index
AfCFTA	African Continental Free Trade Area
AFLI	African Land degradation Index
AIDS	Acquired Immune Deficiency Syndrome
ALH	Arable Land in Hectares
ASAI	Asian Atmospheric Index
ASEI	Asian Environmental Index
ASLI	Asian Land degradation Index
AMAI	American Atmospheric Index
AMEI	American Environmental Index
AMLI	American Land degradation Index
AOSIS	Alliance of Small Island States
ARDL	Autoregressive Distributed Lag
BIS	Bank of International Settlement
BP	British Petroleum
CDE	Carbon Dioxide Emissions
CIS	Commonwealth of Independent States
CKC	Carbon Dioxide Kuznets Curve
CO2	Carbon dioxide emissions
PCA	Principal Component Analysis
DCP	Domestic Credit provided by financial sector
DOLS	Dynamic Ordinary Least Squares
EBAFOS	Ecosystems Based Adaptation for Food Security Assembly
ECB	European Central Bank
ECK	Environmental Kuznets Curve
ECLAC	Economic Commission for Latin America and the Caribbean
EEU	GDP per unit of energy use
EGS	Exports of goods and services
EMBI	Emerging Market Bond Index
EPC	Electric Power Consumption

EU	European Union
EUAI	European Union Atmospheric Index
EUEI	European Union Environmental Index
EULI	European Union Land degradation Index
FAL	Forest Area
FDI	Foreign Direct Investment
FE	Fixed Effects
FFC	Fossil Fuel Energy Consumption
FGDs	Focus Group Discussion
GAI	Global Atmospheric Index
GEI	Global Environmental Index
G20	Group of 20
GDP	Gross Domestic Product
GDP2	Gross Domestic Product Squared
GDP3	Gross Domestic Product Cubed
GLI	Global Land degradation Index
GMI	Global Moran's Index
GMM	Generalized Method of Moments
GMPMI	Global Manufacturing Purchasing Managers' Index
HIV	Human Immune Virus
ICAO	International Civil Aviation Organization
ICT	Information Communication Technology
ICV	Industry value added including construction
IEA	International Energy Agency
IGS	Imports of goods and services
IIF	Institute of International Finance
IMF	International Monetary Fund
IMO	International Maritime Organization
IVA	Industry Value Added
LNG	Liquefied Natural Gas
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MEK	Methane Emissions

NAFTA	North America Free Trade Area
NDC	Nationally Determined Contributions
NOT	Nitrous Oxide Emissions
OECD	Organization of Economic Cooperation and Development
OGE	Other Greenhouse Gas Emissions
OLS	Ordinary Least Squares
OPEC	Organization of Petroleum Exporting Countries
PCA	Permanent Cropland Area
PDOLS	Pooled Dynamic Ordinary Least Squares
PV	Photovoltaic
RE	Random Effects
RKC	Railways Kuznets Curve
SDGs	Sustainable Development Goals
SDM	Spatial Durbin Model
SEM	Spatial Error Model
SLM	Spatial Lag Model
TFP	Total Fisheries Production
TNR	Total Natural Resources Rents
TRS	Travel Services
TSP	Transport Service
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDSEA	United Nations Department of Social Economic Affairs
UNFCCCP	United Nations Framework Convention on Climate Change Parties
UNGA	United Nations General Assembly
UNWTO	United Nations World Tourism Organization
VECM	Vector Error Correction Model
WB	World Bank
WDI	World Development Indicators

INTRODUCTION

The republic of global political economy is concerned with analysis of political economies around the globe without regard to their differences in terms of development, geographical location, regional groupings etc. The term 'political economy' is understood from a variety of perspectives, however, in this thesis the term will be restricted to the application of both economic models and econometric techniques in providing practical solutions to the global climate change issues. This will be done with governmentality lenses on economic growth dynamics, environmental sustainability, energy, trade and investment in a way that will unleash robust public policy and regulatory responses for global sustainability.

Background

The global economy have been tormented by a plethora of economic crises like the 2008-2009 global financial crisis, 2010-2012 European debt crisis and also the 2014-2016 global commodities realignment era. The end of these crises have ushered in new life to the global economy which was forced to its death bed by these avenging crises and this gave impetus for public policies to be realigned in lieu with social, economic and environmental aspects of sustainability, UN (2018). The UN also noted that in 2017, the global economy posted 3.0% of growth, in 2016 it stood at 2.4% and this marked the highest ever recorded from 2011; further growth in 2018 and 2019 was envisioned to remain at around 3%. The growth of the global economy in the past few years was linked to strengthening growth in developed economies but East and South Asia are regarded as too dynamic; while Argentina, Russia, Brazil and Nigeria significantly contributed to global economic growth for 2016 and 2017. However in some parts of the world, economies are yet to realize sustainable growth as inequalities are visible on different countries and regions around the world. A strong global macroeconomic outlook breeds favorable conditions for investment due to reduced volatilities on financial assets, reduced weakness of banking systems and recovery of commodities sectors of the global

economy. On the contrary, global trade strengthened for the year 2017 amid strong demand for imports from East Asia due to conducive public policy interventions in this region and imports of capital goods improved in advanced states due to stable investment conditions. Trade restrictions and wars pose great uncertainty on global trade and this is aggravated by the decision by the UK and Northern Ireland to dump the European Union and the renegotiation of North American Free Trade Agreement with the United States of America. Climate change and the degradation of the environment need to be addressed as an urgent phenomenon because rapid global economy growth is normally plagued with a multiplicity of environmental costs in the form of pollutants. The shift towards sustainable energy is progressing at a gradual pace globally, with China being the “big brother” investor in renewable energy; while energy shortages are common in Africa. Notwithstanding all these challenges and opportunities confronting the global political economy, there is need to escalate environmental sustainability growth initiatives by way of unleashing robust public policies and regulatory initiatives.

Statement Of The Problem

Climate change and environmental degradation became a global issue and have drawn the attentions of development partners, governments, policy makers, investors and academia; although the shocks from the Global Financial Crisis (GFC) of 2008-2009 seemingly dormant, there is a ‘time bomb’ of uncertainties lumbering on the horizon; the global economy is on a dilemma of missing one of the important Sustainable Development Goals (SDGs) , a target to achieve a GDP growth of a minimum of 7% in a not too distant future and achieving environmental sustainability at the same time and only a handful of developing economies will be able to meet the GDP growth target, hence affecting the global political economy to meeting the overall growth target and also climate change is wreaking havoc on the global economy since emissions are increasing and the Paris Agreement excluded shipping and aviation emissions which have since accelerated unabated from 2013.

Aim And Objectives Of The Study

This research study will be aiming at unmasking global political economy dynamics of economic growth, environmental sustainability, energy, trade and investment with a view to unleashing robust public policy and regulatory interventions for sustainable development. Other specific objectives include to:

a. make an investigation on the nexus between the dynamics of economic growth and environmental pollution in a global political economy;

b. empirically examine the relationships between trade and environmental pollution in a global political economy;

c. explore the environment-energy nexus in a global political economy perspective.

d. investigate the impact of institutions supporting economic growth and development for the global political economy; and

e. reveal the nature of causalities which are existing among economic growth, environmental pollutants, energy, trade and investment for the global political economy so as to develop robust public policy and regulatory interventions

Significances Of Study

This research study will broaden the scope for public policy reorientation in the global political economy across the domains of sustainable economic growth, environmental sustainability, energy, trade and investment. The major contributions of the study being to examine dynamics of global political economy in the environmental Kuznets curve context, specifically the cubic polynomial function using environmental indexes, in the process considering the Sustainable Development Goal target of a minimum 7% global growth as a lead. The study will consider atmospheric indicators, land indicators and freshwater indicators in the global political economy environmental Kuznets curve analysis and these indicators will be put together in an index form, except for our special case study for emerging economies. To the best of my

knowledge, this will be the unique contribution of this work since there is no available study which employed these environmental factors together as indexes calculated using principal component analysis (PCA), especially in the environmental Kuznets curve context and also consider some special case for emerging economies in perspective of global political economy.

Research Study Questions

The research study sought answers to the questions:

(a) Does Environmental Kuznets Curve (EKC) hold in the Global Political Economy (GPE)?

(b) Is there any relationships between trade and environmental pollutants for the global political economy?

(c) What is the nexus between environmental pollutants and energy in the context of global political economy?

(d) Are institutions and the financial system in the global political economy strong enough to support Sustainable Development Goals?

(e) Do we have any causality relationship between economic growth, environmental pollution, energy, trade and investment in the global political economy?

Hypothesis

The study will test three alternative hypothesis given below:

- **H_1**: The Environmental Kuznets Curve is significant in the Global Political Economy.
- **H_1**: There is significant dynamic relationships between economic growth, environmental pollutants, energy, trade and investment in the global political economy.

- **H_1**: The causality relations between economic growth, environmental pollutants, energy, trade and investment are significant.

Limitations And Delimitations

The research study only considered the nexus that exist on economic growth dynamics, environmental sustainability, energy, trade and investment in a global political economy perspective. The study considered data from the year 2000 up to 2018. However, since the study considered all economies which are members of the United Nations (UN), some countries had no relevant data for our selected variables. Such countries were eliminated from our selected sample and only 115 countries composed our sample, therefore the researcher included only economies which had the data availability for a reasonable period of time. In the same vain, the generalizability of the findings of this study may be jeopardised by too many missing values in some countries but the researcher considered a multiplicity of interventions on a case by case basis, including interpolation and extrapolation to fill the missing values. This was done in a way that could not make the study loose its traction of appealing to the global political economy audience. Another issue was on obtaining data for recent years, though the various data series was somewhat balanced, there was no recent update of data for the period 2019 on the World Development Indicator series, however this could not jeopardise our findings since our variables have a long series dating back to the year 2000.

Summary

In this chapter we presented the background to the research study, a statement of the problem, aims and objectives of the research study, significance of the research study, research questions, hypothesis and limitations as well as delimitations of the research study. Chapter 2 reviews Literature relating to economic growth dynamics, environmental sustainability, energy, trade and investment in a global political economy perspective.

CHAPTER 1

REVIEW OF RELATED LITERATURE

1.0 Introduction

This chapter provides related literatures for economic growth, environmental sustainability, energy, trade and investment at a global scale. The first part will provide an overview of the global political economy. Economic growth issues to be considered include its definition, theories, models, determinants, measures, costs and benefits. Environmental sustainability is defined, its determinants explained, while its linkages with economic growth is unearthed and finally its benefits. Energy issues include sources, uses, global energy demand, energy investments and the future of energy. Trade is defined, imports and exports explained, travel and transport services are considered. In addition the chapter will give attention to investment, considering its definition, foreign direct investment and domestic credit as an investment. The chapter also provides some empirical evidences on Environmental Kuznets Curve before it closes.

1.1 Overview Of The Global Political Economy

The United Nations (UN.2019) have noted the need to put in place sound public policy interventions as a matter of urgency to arrest uncertainty to the global economy and create conditions to achieve sustainable growth and development. Authorities should arrest short-range uncertainties related to financial dynamics and growing trade wars, however, concurrently supporting economic, environmental and social sustainability in the future. The UN (2019)

further noted that sound policy initiatives are a possibility when global policy making is multilateral, long-range and cooperative across the domains of fighting climatic changes, financial sustainability, sustainable production operation processes, as well as addressing inequalities across the globe. In 2017 and 2018, the majority of world economies have witnessed an acceleration of their growth trajectories with developed countries growing by about 2.2%, while other countries have approached their growth potential and the rates of unemployment in developed states approached their bottoms UN (2019). The developing territories of Eastern and Southern Asian countries displayed a strong growth position, growing at 5.8% and 5.6% respectively, while countries exporting commodities such as fuel are on a gradual recovery but price related risks and the impact of the commodities crisis of 2014 and 2015 pose significant pressure on fiscal as well as external positions, hence leaving economies trapped in debt (UN 2019). The UN (2018) noted that economic benefits which were recently realized in the global economy were not equally distributed across regions and countries, with some economies not yet realized sustainable growth. In addition, long-range global economic growth potential is still licking wounds caused by depressed investments and reduced productivity due to the global financial crisis. According to the UN (2018), rapid global economic growth calls for taking cognizance of marriage to the sustainability of the environment due to the recurrence of shocks associated with weather, hence the need to adapt to climatic changes and curb the degradation of the environment. The global body also noted that the adoption of sustainable energy is still gradual, with renewable energy sources claiming above half of new power capacity and is providing a meagre 11% of power generated globally. The prospects of the global economy are still exposed to the risks associated with the uncertainty of policies, hence putting global trade, aid for development, climate related targets and the movement of people in jeopardy, as well as delaying improvements in investment and productivity in the global economy (UN 2018). Therefore, policies should be reoriented so as to usher in some progress along socially and environmentally related initiatives and also improve the prospects of long-range sustainable growth and development.

1.1.1 Political Economy Business Cycles

According to Alt and Lassen (2006) in Cao et al (2019), global political business cycles are caused by elections in democratic societies when political entities seek reelection into government through both expansionary fiscal and monetary policy interventions. Drazen (2000) alluded that political business cycles are not only in mature democratic societies but also in societies in transitional democracy and autocrats too. Guo (2009) in Cao et al (2019) argued that authoritarian societies like China, national political party secretaries fast-track spending by governments at a time in their careers when political party committees at higher levels are set to make decisions related to personnel issues. Further, Cao et al (2019) revealed that the incentives structure is very important for political players and in China studies have given attention to the political tournaments theory, a system of cadre evaluation. Cao et al (2019) alluded that Li and Zhou (2005) and Chen et al (2005) employed a theory of yardstick competition adopted from organizational economics to make explanations about economic growth in China. Political cadres in a locality are encouraged to take part in “tournament-style” with other political actors from other districts for promotion to next levels. Maskin et al (2000), alluded that in order for these political actors to increase their promotional chances, they are encouraged to develop economies in their local territories. However, Cao et al (2019) lamented that “political tournaments theory” is plagued with a plethora of critics for example, economic performance of local political actors is an internal issue. Jia et al (2015) decried that political actors with close relationships with high profile leaders are allocated territories which have high economic growth prospects. Furthermore, Holmstrom and Milgrom (1991) lamented the breaking of political tournaments as a result of a multiplicity of duties to perform and O’Brien and Li (1999) mooted that policy priorities should be included into a single and complete index so as to avoid selective implementation of national projects for the benefit of political leaders. As Guo (2009) pointed out, accelerated government expenditure on huge projects is very costly and in most cases not sustainable, therefore political actors should be careful when scheduling those projects during their tenure in positions.

1.1.2 Environmental Effects Of Political Economy Business Cycles

Cao et al (2019) have indicated that political leaders improve their performance when their tenure is about to end. They do this through increasing the gross domestic product (GDP) for their respective areas and also massive investments in political achievement projects which pays off within the shortest period. Policy interventions which make it possible for the achievement of these objectives include expanding government expenditure in local territories through massive infrastructural related investments. These massive investments are normally associated with massive negative environmental externalities for example construction of buildings and roads triggers both land degradation and air pollution. As a result of scale effect, faster economic growth as a function of government expenditure results in increased overall pollution in an economy. According to Cao et al (2019) environmental pollution from infrastructural development and expansion of the economy is not avoidable in developing economies. Therefore, sound environmental regulatory initiatives and enforcement thereof are an integral policy stance.

1.2.1 Definition Of Economic Growth

Economic growth can be defined in a multiplicity of ways, however the definitions are not divorced from each other as one could imagine. According to Raisova and Durcova (2014), economic growth entails some increase in capacity of the economy to make goods and services, comparing from one time period to the other. Haller (2012) defined economic growth as an increment of the national income per person and associated it with analysis, in a quantitative way, with a focus to determine relationships between endogenous variables.

1.2.2 Theories Of Economic Growth

There are a multiplicity of economic growth theories, however this study will delve into four theories that is the Lewis's, Kuznets's, Rostow's and Schumpeters's theories of growth. According to Pietak (2014), Arthur Lewis (1954) developed a model to deal with the challenges by developing countries who have the abundance of labor force. Lewis is believed to have been a classical economist although he differed with them in terms of identification of economic problems and the techniques to solve them. In his model, Lewis (1954) proposed a model to support massive savings in the short-range and maintain a low level of lifestyle. These savings accumulated in the short-range will be channeled towards capital accumulation in the long-range and help boost economic growth. Therefore, according to Pietak (2014), the model presented by Lewis calls for large income disparities in the short-range and a movement towards income equality in the long-range. In 1955, Simon Kuznets provided a theory of economic growth which provided support to Lewis's theory. According to Kuznets (1955), during early stages of growth of the economy, income disparities are visible, but during later stages of economic growth income differences are narrowed. This scenario is widely known as the Kuznets's curve, and it have gained a lot of empirical support. In the Kuznets curve context, at the early stages as labor force advances from Agricultural sectors to the Industrial sectors, income disparities are wider. Due to the increase in the availability of factors of production in the Industrial sector, long-range income disparities will begin to narrow. In 1976, Simon Kuznets observed a positive relationship between economic growth dynamics and the rate of growth of the urban population, Pietak (2014). Another important economic growth theory was presented by Walt Rostow in 1960. According to Rostow (1960) the growth of the economy takes place in stages, that is traditional society, preconditions to take-off, take-off, drive to maturity and age of high mass consumption. In a traditional society, the economy is based on labor intensive subsistence agricultural activities, low level of trading and technological development is backward. The preconditions to take-off exhibit an economy which starts developing its manufacturing and the focus of economic activities shift to resemble a national and/or international posture as

opposed to a regional posture. Pietak (2014) alluded that, Rostow (1960) mooted that developing countries have a challenge reaching the take-off stage due to what he called the “Vicious Circle of Poverty” created over the years. In the take-off stage, the economy starts to industrialize and workers as well as institutions will be concentrated around a particular industry, however this does not last long. The drive to maturity stage prolongs for some time and is characterized by a rise in the standards of living, technical progress. It is during the drive to maturity stage when the economy grows and diversifies. Another stage of development which Rostow noted is the period of high mass consumption, where it is believed the majority of Western countries are, especially the United States of America and known as a developed stage. This stage is the capitalist stage, in which mass production and consumerism dominate economic activities and the country’s economy performs well. According to Rostow, the transition of an economy from agriculture to industrial economy would cascade to economic growth across the whole economy. The final economic growth theory to be reviewed in this section was developed by Joseph Schumpeter in 1934. According to Schumpeter (1934), the accumulation of capital is not the main driving force for economic growth as was propounded by the classical economists, however he attached great importance to the notion of “entrepreneur-innovator” and labeled it the “hero of development”, Pietak (2014). Schumpeter believed that the development of an economy rests in the innovativeness and creativity of its entrepreneurs, and further noted that the growth of the economy is unbalanced due to what he called the nature of the ‘jump’. In his theory, Schumpeter (1934) assumed the primacy of market competition, market efficiency and private property rights so as to drive innovation, however, he lamented the lack of these conditions in economies which have no democracy. Therefore this have rendered his theory of economic growth applicable to countries which have democracy and have economically developed systems.

1.2.3 Models Of Economic Growth

Pietak (2014) noted that economic growth models employ some simplifications relating to the rate of depreciation of capital and population growth by treating them as external variables. Using the rate of savings, economic growth models can be put into two categories, that is those which treat it as external such as the Harod-Domar model and those which consider it internal such as Kaldor-Pasinetti. Economic growth models may also be classified as short-range and long-range. This section considers the Harod-Domar (1939, 1946), Pasinetti-Kaldor (1962, 1963), Uzawa (1963) and the Ramsey-Cass-Koopmans (1928, 1965, 1965) models. Harrod-Domar (1939, 1946) developed an economic growth model which envisioned sustainable economic growth through modification of the short-range Keynesian model. Harrod and Domar alluded that economic growth is sustainable in the case that actual rate of growth, guaranteed growth rate and the natural growth rate are equal. According to Harrod (1939), if this is obtaining in an economy, it becomes a 'golden age' where labor and capital are fully employed, however this depends on the equilibrium with saving which are also dependent on capitalist households and investments. This situation is however an impossibility in the real world. The rate of savings is determined outside the model and it is the same with population growth which depends on natural dynamics. The Harrod-Domar economic growth model makes an assumption of a constant ratio of labor to capital, hence ruling out factor substitution, however reinforcing the impossibilities of balancing the three economic growth rates. Therefore in this regard, an economic growth model suggested by Harrod and Domar is plugged with two major problems, firstly it is not possible to realize economic growth at the warranted level in a capitalist economy at a full employment level. The other problem associated with the Harrod-Domar economic growth model exposed the unsustainable nature of economic growth through its attempt to find an ever changing equilibrium position in an economy. Another interesting economic growth model was presented by Pissinetti-Kaldor (1962, 1963), in which the duo argued by considering the apportionment of income into wages and profits into their economic growth models and mooted the possibility of economic growth in the event that labor is fully employed. The duo made

emphasis on a constant ratio of capital, however, they discarded the assumption of a constant rate of savings in an economy, and instead asserted that savings rates differ with different social groupings and noted that capitalists save more than employees. The internalization of the nature of savings in their models helped to trace the way to sustainable economic development. A two sector economic growth model was presented in 1960 by Hirofumi Uzawa, a Japanese economist in which one produces consumer goods and the other one produces capital goods. Uzawa (1960), lamented that stability of the model is achieved when the ratio of capital to labor in the sector responsible for the production of consumer goods is larger than that in the sector producing capital goods. The Ramsey and Cass and Koopmans (1928, 1965, 1965) model of economic growth was devised as an improvement to the Ramsey (1928) economic growth model which sought to confront an issue with desired savings level. The results obtaining in the Ramsey-Cass-Koopmans model are related to the results found in the Solow-Swam economic growth model.

1.2.4 The Determinants Of Economic Growth

There are many economic growth determinants which have attracted empirical support, however in this study attention will be focused on investment, human capital, technology, economic policies, foreign direct investment, institutional framework, political factors, demographic trends and social as well as cultural factors. Song et al (2019) applied the open endogenous economic growth model in their investigation of China's panel data for the provinces and the results revealed negative nonlinear U-shaped pattern. Using generalized methods of moments (GMM), Asongu and Odhiambo (2019) revealed that mobile phone and internet use moderated Foreign Direct Investment (FDI), leading to some positive impact on gross domestic product (GDP), real Gross Domestic Product and Gross Domestic Product per capita. According to Alvarado et al (2017), Foreign Direct Investment has a positive effect on growth of the economy in developed economies. Empirical results found by Cieslik and Goczek (2017) revealed that corruption negatively affects economic

growth by reducing investment and this is due to its ability to cause uncertainty in an economy. According to Prskawets et al (2007) the ageing of people in an economy is expected to put more pressure on social security interventions and the growth of the economy will have some correlation with the age structure inherent in a particular country. Pelinescu (2015) alluded that the European Union 2020 growth strategy may not be attained without skills, knowledge and value of people (human capital). Therefore a good educational and training system, complimented with innovations in the manufacturing sector, industry and massive research and development are paramount in driving economic growth. Acemoglu and Robinson (2008) put forth their argument that differences in economic institutions across countries contributes to prosperity disparities across countries and to resolve these disparities there is need for institutional reforms. However, the duo lamented that political processes have more influence on economic institutions and these rely on political institutions and how political power is distributed in country, making it difficult to make institutional reforms.

1.2.5 Economic Growth Dynamics

In this section we trace the growth trends of the Global economy, African countries, Asian countries, European countries, the Americas and Emerging economies with a view to lay bare the nature of economic growth dynamics over the years. The global economy has been marred by a chain of wide spread economic challenges for example the global financial crisis which wreaked havoc between 2008 and 2009, the European debt crisis which took tall between 2010 and 2012 and the 2014-2016 commodity realignments, (UN 2018). The end of these crises and the subsequent subsidence of shocks associated with them have seen the strengthening of the global economy and this prompted policy reorientation towards long-range sustainability principles across social, environmental and economic dimensions. In the year 2017, the global economy is believed to have realized a 3.0% growth, a notable increase from 2.4% realized in 2016 and this is the highest growth rate ever experienced since the year 2011. In 2018 and 2019, the global economic growth prospect

was projected to remain stable at 3.0%. The United Nations (2018) estimated that the United States of America grew by 2.2% in 2017, a steady growth of 2.1% in 2018 and 2019 projections. According to the United Nations, this growth trajectory for the United States of America was a turning point from the previous meagre 1.5% growth realized in 2016. The Canadian economy is estimated to have grown by 3% in 2017, making Canada one of the fasted growing developed economy, however due to the desired policy stance by Canadian authorities to adjust consumer spending in lieu with incomes, growth of the economy was envisioned to hover between 2.2% and 2.3 for both 2018 and 2019. Further, the United Nations (2018) alluded that the Japanese economy soared to levels which were beyond expectations to 1.7% in 2017 due to sound macroeconomic policies which have stimulated domestic demand. However, this growth momentum is expected to subside 1.2% and 1.0% for 2018 and 2019 respectively. The Australian and New Zealand economies have attained strong growth performance of 2.8% and 2.5% respectively for 2017; with 2018 projections of 3% and 2.9% in the same order. According to the UN (2018) this is realized at the foundation of favorable fiscal policies in both countries. The United Nations have hinted that European economic activities are robust and in 2018 growth was forecasted at 2.1% amid expansionary monetary policies influencing business investments and construction sector activities. The decisions of the European Central Bank (ECB) of tapering the buying of assets and a subsequent halt in balance sheet growth will dampen growth, resulting in a projected slide to 1.9% for the year 2019. The robustness of growth in Europe was possible because of the contributions from a number of countries. In Spain, economic growth was envisioned to be 2.6% for 2018 and 2.4% for the year 2019 amid strong domestic private consumption, capital investment in machinery and construction and tourism. These factors were also envisioned to propel growth in Ireland which is believed to be 2.8% in 2018 and 3.1% for 2019. However, Italy was envisioned as the sick-man of the region with growth at 1.4% in 2018 and 1.1% for the year 2019. This poor trajectory in Italy was due to slowing employment growth and political uncertainties which have chocked the growth of private consumption, aggravated by an ill public investment and poor credit

access from banks which will negatively impact fixed investment. The growth of the economy in the United Kingdom of Great Britain and Northern Ireland was projected to be slow at 1.4% for the duration 2018 and 2019. More so, the UN (2018) noted that economic activities in the Commonwealth of Independent States (CIS) was fast due to growth in the economy of Russian Federation after some years of economic slide. The United Nations mooted that Belarus was coming out of a recession and economic growth accelerating, in Kazakhstan, Armenia, Kyrgyzstan and Uzbekistan economic indicators were robust. Overly, economic growth in the region was rendered unchanged in 2016, with projections of 2.2% for the year 2017, with an acceleration of 2.3% in 2018 and 2.4% for the 2019 year. Strong domestic demand, coupled with economic improvements in the European Union is aiding economic activities in the South-Eastern Europe anchored on investments in infrastructure especially in Montenegro, UN (2018). Albanian economic growth is anchored on private consumption due to an increase in employment levels and also wages, while Serbia has faced a bad winter which have damaged transportation links and dampened activities in the construction sector and to make matters worse agricultural harvests were marred. As if that is not enough, domestic political uncertainties have disturbed private consumption and business investments in the then Yugoslav Republic of Macedonia. Therefore, notwithstanding the foregoing, South-Eastern Europe had a 2.9% growth in 2016, 2.5% in 2017 and in 2018 the region was expected to spring to 3.2% growth per year. Economic growth in the African region was projected to reach 3.5% in 2018 and in 2019 it was envisioned to hit 3.7%; however, if we exclude Libya, Africa is expected to growth 3.3% and 3.5% in 2018 and 2019 in that order. This is supported by the resumption of oil extraction in Angola, Nigeria and Angola, as well as the rebound of South Africa, Egypt and Nigeria who are Africa's giant economies. Economic growth outlook for East Asia in the short-range was envisioned to be robust and was aided by accommodative monetary policies, complimented with expansionary fiscal policy interventions. Against this backdrop, economic growth in 2017 was believed to have reached 5.9% in East Asia and was projected to remain steady at 5.7% in 2018 and 5.6% in 2019. However, the United Nations (2018)

lamented that East Asia is plagued with a lot of geopolitical uncertainty and unsustainable debt levels. South Asia was envisioned to remain steady and favorable in terms of its economic prospects due to sound private consumption and robust macroeconomic interventions. Economic growth in South Asia was projected to firm to 6.3% for the year 2018 and in 2019 be envisioned to record 7.0%, this follows a growth from 6.3% for year 2017. Furthermore, Western Asia's economic prospects were envisioned to remain mixed due to both geopolitical issues and developments in the oil market, UN (2018). Economic growth in Western Asia was believed to have been slow at estimates of 1.9% in the year 2017 and this snail recovery pace is believed to have persisted in 2018 to 2.3% and 2.7% in 2019. Latin America and the Caribbean territories faced good economic prospects and the region was set for another fertile period and growth was envisioned to have been 1.0% in 2017, with projected 2.0% in 2018 and 2.5% in 2019. These growth rates were believed to be the greatest ever posted since 2013, United Nations (2018).

1.3 Environmental Sustainability Indicators

According to Sarkodie and Strezov (2019b), based on past studies, environmental sustainability indicators incorporate atmospheric indicators, land indicators, coasts, seas, oceans, and also biodiversity and fresh-water indicators. These environmental sustainability indicators are shown in Box 1 shown in Appendix 25.

1.3.1 Atmospheric Environmental Sustainability Indicators

Atmospheric environmental sustainability indicators considers priority air pollutants and greenhouse gas emissions. As noted by Sarkodie and Strezov (2019b) greenhouse gases includes carbon-dioxide emissions, methane emissions, nitrous-oxide emissions, sulfur-hexafluoride, hydro-fluorocarbons and per-fluorocarbons. Sarkodie and Strezov (2019b) noted that carbon dioxide emission is mostly used in studies due to its large contribution to global anthropogenic greenhouse gas emissions. According to DiSano (2002) in Sarkodie and Strezov (2019b), the sources of carbon dioxide emissions

include agriculture, forests, energy, land-use and also industrial sectors. On other hand, priority air-pollutants includes sulfur-dioxide, lead, nitrogen-dioxide, nitrogen-monoxide, carbon-monoxide, volatile-organic compounds such as benzene and ambient concentrations of particulate matter such as PM_{10}, $PM_{2.5}$, and black smoke. Therefore an improved air quality will promote sustainable human life but this is possible if the world can do away with these atmospheric environmental indicators.

1.3.2 Land Environmental Sustainability Indicators

Sarkodie and Strezov (2019b) indicated that land environmental sustainability indicators incorporate land-area affected by desertification, arable and permanent cropland, changes in land-use, land degradations, area under organic farming, usage of agricultural pesticides, efficiency of fertilizer usage, area of forests under sustainable management, forest trees damaged by defoliation and proportion of land-area covered by forests. According to DiSano (2002) in Sarkodie and Strezov (2019b), continued deterioration in forest area coupled with some degree of defoliation indicates bad and/or poor forest management techniques and forest healthy that are important in poverty alleviation, reducing the degradation of natural resources and ensuring biodiversity. The duo further noted DiSano (2002) who lamented that land use status gives details on land resource change due to sound land-policy planning and management and also extent of the degradation of land and also impact of the desertification have ripple effects on sustainable development and agriculture. Therefore it is clearly apparent that the degradation of land and desertification leads to poverty, particularly in emerging and developing countries which are predominantly agricultural based. Furthermore, Owusu et al (2016) in Sarkodie and Strezov (2019b) made an allusion that massive fertilizer usage may result in loss of some essential nutrients from the soil and this may lead to eutrophication of water sources, soil acidification and nitrates contaminations of sources of water. Sarkodie and Strezov (2019b) further stressed that, although the use of fertilizers increases productivity, too much use leads to both health and environmental concerns. In the same vein, Owusu

and Asumandu-Sarkodie (2016), in Sarkodie and Strezov (2019b) further reiterated that excessive usage of fertilizers may damage ground water quality and aquifers due to the process of leaching.

1.3.3 Freshwater Environmental Sustainability Indicators

The UN (2015) and DiSano (2002), according to Sarkodie and Strezov (2019b) noted that freshwater environmental sustainability indicators include waste water treatment, biological oxygen demand in water sources, total-water resources, and intensity of water-use per economic activity and availability of fecal-coliforms in fresh water sources. The extraction of total renewable water resource so as to satisfy demand for water gives details on the scarcity of water and its vulnerabilities to shortages, Sarkodie and Strezov (2019b). The duo also noted that the scarcity of water normally impacts sustainability through putting pressure on regional economic and developmental initiatives, thereby leading to massive losses to biodiversity. In the same vein, the duo alluded that DiSano (2002) lamented that economic pressure on water resources testifies the improvement in collaborative water resource management techniques. The UN (2015) in Sarkodie and Strezov (2019b) elaborated that the quality of microbial in water resources, waste water treatment methods and the quantity of biological oxygen demand in water resources are critical so as to foster a reduction in morbidity and mortality of aquatic and terrestrial habitants, whose damaging effects will hinder sustainable economic growth and development.

1.3.4 Coasts, Seas, Oceans And Biodiversity Environmental Sustainability Indicators

According to Sarkodie and Strezov (2019b), this environmental sustainability indicator considers quality of recreation water and its beauties, proportion of fish-stocks in safe-biological limits, proportions of people who live in coastal areas, share of terrestrial-area protected per ecological territory, the index of marine trophic, area of coral-reef ecosystem and proportion of live-cover, share of marine area under protection, abundances of special species, status

of species, sound management of area under protection and the reproduction of habitats. The duo also pointed that vulnerabilities due to sea-level rise and associated dangers to coast areas may be subjected to quantification so as to get an understanding of sources of pressure to coastal ecosystems. Sarkodie and Strezov (2019b) lamented that violating recreational water quality standards breeds both economic and health challenges for both tourism and coastal dwellers. Based on the foregoing, it becomes important for authorities to protect marine areas so as to enhance biodiversity, cultural heritage, recreation, and improved ecosystems' diversity DiSano (2002) in Sarkodie and Strezov (2019b).

1.4 Energy

According to BP (2019), energy demand is envisioned to rise due to increased prosperity in developing countries. However, notwithstanding the ballooning global energy demand, more than half of the global population by 2040 will be dwelling in economies where per capita energy consumption remain low, a signal for the need for more energy. The IEA (2018) have noted that global energy consumption have nearly doubled the mean growth rate from 2010 mainly due to a robust global economic outlook, coupled with increased energy needs for heating and cooling. The quantity demanded for most fuels have gone up, with natural gas leading, followed by solar and wind which have realized double digit growth. An increased demand for electricity constituted about more than half of total global energy needs and energy efficiency revealed a mixed performance. In this subsection we consider sources of energy and their trends, global energy demand, energy production trends, regional energy trends and energy efficiency issues.

1.4.1 Global Energy Sources And Demand Trends

The major sources of global energy include oil, natural gas, coal, renewables and electricity. The IEA (2018) have noted a rise in the demand of oil by 1.3 percent due to strengthening United States of America economy and the initiation of petrochemical projects have pushed demand upwards and this have neutralized the slowing growth for the demand of gasoline. This demand growth was witnessed more in China and the United States of America, however in Korea and Japan there was a demand fall and in Europe it remained unchanged. The BP (2019) noted that the demand of oil including other liquid fuels witnessed some growth for the first part of its outlook but later it leveled, and the United States of America was leading production of liquid fuels, but the OPEC took over production increase following the United States of America's decrease. According to the IEA (2018), the consumption of natural gas increased by about 4.6 percent, this being the largest increase since 2010 when the demand for gas was emerging from shocks from the Global Financial Crisis of 2008-2009. This was a second series of strengthening demand from 3 percent in 2017 which was moved by substitution from coal and the general growth of energy demand. The shifting from coal consumption to the consumption of gas have constituted more than a fifth of the total increase in the demand of gas and the United States of America and China occupied the first and second lead respectively. According to the BP (2019), the growth in the consumption of natural gas is robust and is aided by wide ranging demand and its availability supported by liquefied natural gas (LNG) expansion. In the case of the demand for coal, the IEA (2018) alluded that it grew for the second consecutive year, however it is declining in importance in the global energy mix. In 2017, the 0.7 percent rise was notably lower compared to 4.5 percent yearly rise over the duration 2000 up to 2010. The BP (2019) alluded that the global consumption of coal remain widely unchanged, while decrease in OECD and Chinese consumption offsetting with increases in India and Other Asia. Although the proportion of coal in the generation of electricity and primary energy demand continue decreasing at a slow pace, it continues to dominate as electricity source and largest second source of primary energy. According to the BP (2019), the

fastest growing source of energy is renewable energy, with its contribution being half of the global energy supply growth and has the potential to be the largest power source by 2040. The IEA (2018) mooted that renewables rose by 4 percent which is about a quarter of the growth in energy demand globally, with the power sector leading because renewables based electricity generation accelerating in this decade. Furthermore, the IEA (2019) noted that hydropower, wind and solar PV constituted about one-third each, whilst the rest was from bioenergy. It was also noted that renewable accounted for about 45 percent of global growth of electricity generation and currently it constitutes about 25 percent to the global output of power. The BP (2019) pointed that global electrification continues and about three quarters of primary energy growth being constituted by the power sector, while the IEA (2018) observed that the demand of electricity peaked by 4 percent, a double acceleration of total energy demand and this is believed to be the fastest ever since 2010. The largest proportions of energy demand was accounted for by renewables and nuclear power; moreover, electricity generation from coal-gas-powered power plants recorded a considerable increase and this contributed to a rise of carbon-dioxide emissions to 2.5 percent from this sector.

1.4.2 Global Energy Efficiency And Carbon Dioxide Emissions

According to the IEA (2018), global energy efficiency is improving, while the intensity of global primary energy fell by 1.3 percent; however this could not match improvements realized in recent past periods. Notwithstanding that the efficiency of energy globally was considered a reliable source for abatement of carbon-dioxide emission for some energy sectors, year 2018 became the third in a series whereby global energy efficiency decreased. On the other hand, the BP (2019) noted that carbon dioxide emissions are increasing and this shows that there is need for global policy authorities to deploy robust public policy interventions in order to realize a low carbon global political economy. The British Petroleum considered a multiplicity of possible options in its Outlook, such as “more energy”, “less carbon” and also the consequences associated with rising trade wars.

1.4.3 Regional Energy Trends

In its outlook, the BP (2019) noted the global energy transition in global energy demand in which developing economies have an increasing role as a major market for the consumption of energy. It further noted that in the1990s, the OECD constituted about two thirds of global energy demand, while developing economies accounts for just a third. However, this could be changed by 2040 when non OECD economies are expected to toll more than two thirds of global energy demand. According to the BP (2019), the major rise in global energy demand is mostly in developing Asia for example in India, China and Other Asian economies where the standards of living are improving and wealth is rising thereby promoting some increase of per capita consumption of energy. The BP (2019) further lamented that the transitioning of China to sustainable economic growth trajectory will catapult India's status to being the fastest growth market with potential to absorb more than a quarter of global energy demand. Notwithstanding that, China will double India by 2040, retaining its position as the global leader of energy demand by market size. On the other hand, energy demand in Africa is still small compared to its size and in 2040 it is expected that Africa will constitute one quarter of global population, however its energy demand remains a meagre 6 percent of global energy demand.

1.5 Trade

In this subsection, trade dimensions will take the form of international commodities trade, international services trade, international energy trade as well as international transport and the environment. However, this will consider both importations and exportations of both goods and services in context of global political economy in a way that will contextualize the relevance of trade in our research study.

1.5.1 Global Commodities Trade And Regional Trends

The UN (2018) have observed that global trade improved in 2017, posting about 3.7% for the year and this was following a weaker trajectory observed in 2016, in which the volumes of trade globally were lower at 2.2% following the crisis. This was at the backdrop of improved global industrial output coupled with a strong Global Manufacturing Purchasing Managers' Index (GMPMI) to its 6 year high level. A significant gain in momentum for global air freight and container shipping was witnessed in the year 2017 due to strong exports and strong commodity prices, especially for crude oil and metals, UN (2018). Furthermore, an improvement of global trade anchored on sound investment in a number of global economies which have consequently boosted capital and intermediate goods trade. It is believed that the fastest merchandise trade growth was realized in the first 8 months of the 2017 following the crisis. The differences in import demand was observable between different regions, with Asia contributing 60% growth in world merchandise importations due to robust domestic demand throughout the region which was further complimented by sound policies in a multiplicity of countries and also China. In the developed European-Union (EU), United States of America and Japan, the importation of capital goods increased due to lucrative investment opportunities. In the developing territories, Latin America witnessed a modest improvement in the demand for imports due to the emergency of big economies such as Brazil and Argentina from a recession, UN (2018). The UN (2018) also noted that the demand for imports from the Middle East and Africa followed a continued nose dive, an indication of weak commodity revenues, weak national currencies, complimented with poor investment activities. The global political entity (United Nations, 2018) further lamented that investment remain dampened in a number of OPEC (Organization of Petroleum Exporting Countries) countries reduced oil production and fiscal consolidations as well as regional political uncertainty. According to the UN (2018), there was a wide spread improvement in global export of merchandise due to strengthening investment activity in developed countries and some developing countries like China. An improvement in trading of electrical and electronic merchandise improved exports in emerging Asian economies and this revealed that the region is

closely linked to global industrial value chains. Further, exports from the USA were supported to some extent by the weak dollar. Global trade is expected to continue on a sound footing, growing 3.5% in the year 2018 and 2019 is expected to reach 3.6%, however, this trajectory will depend on strong growth and investment circumstances of the global political economy.

1.5.2 Global Trade In Services And Regional Trends

The prospects for the growth of global trade can be strengthened by trade in services, UN (2018). Global exportation of services for the duration 2005 and 2016 was greater than the exportation of goods in monetary value and this prompted an increase in the proportion of services in overall global exports, considering both developed countries and developing countries and services trade have shown some stability as compared to trade in merchandise. The global exportation of services emerged in 2016 to post an improved growth trajectory after it fell in 2015, however on the other hand the value of exportation of goods realized a decline. The importation and exportation of services continues to be dominated by developed countries, with 50% of global exportation being dominated by top 10 exporters in 2016 and this revealed that global trade in services is plagued with a plethora of inequalities. According to the United Nations (2018), trading in services has the potential of supporting economic growth and development initiatives for developing economies. The exportation of services in developing countries increased sharply in the decade ago and this was revealed in improved proportion of exports of services from developing countries from a low of 23% in the year 2005 to a high of 29% by the year 2016. Categorically, the larger proportion of global exportation of services from developing countries was dominated by travel services, transport services and construction services and these concentrate on high value addition services. However, an improved telecommunications and ICT, financial services and other business related services exportation was in lieu of prospects to diversify developing countries' economic profiles, UN (2018).

1.5.3 Global Energy Trade And Regional Trends

The differences in regional consumption and production trends of energy contributes to changing patterns of global energy trade, BP (2019). According to the British Petroleum, there exists different patterns of the energy balances (the difference between energy consumption and energy production) between the Americas and Asia, but 20 years ago they were both small net importers of energy. An accelerating United States of America tight oil and shale gas accounts for the rise in total energy exportation from the Americas and the Americas are expected to be the ultimate energy exporter to the whole global economy. The BP (2019) further lamented that, compared to the acceleration of the demand for energy in Asia, where China, India and Other Asia, strengthens the position of Asia as the biggest market for importations of energy. Implications of trade wars and rising energy security issues could jeopardize global energy flows. A weak energy consumption growth positions Russia and other Commonwealth Independent States (CIS) to boost their proportions of global energy exportation, however the total exportations of energy from Africa and the Middle East will remain stable.

1.5.4 Global Transport And The Environment

The United Nations (2018) mooted that the volumes of global transportation is envisioned to balloon in the future year due to strengthening global trade. Although it reflects a healthy global economy, there are some environmental externalities associated therewith due to increases in emissions of carbon dioxide. According to UNCTAD (2017b) in UN (2018), global shipping which is responsible for more than 80% of global trade volumes and global aviation which is responsible for tourism growth, of which according to the UNWTO (2017) 55% come from air. The global political entity also noted that net emissions from shipping and aviation reached 4% of total global emissions. The IEA (2017) made long-range forecasts which suggested that in the coming 25 years, about 30% of the increase in global oil demand will originate from shipping and aviation sources. According to the UN (2018), global aviation and shipping emissions were not included in the Paris Agreement because it only

focused on emissions which are domestically produced and global emissions are not incorporated in the Nationally Determined Contributions (NDC) framework which only consider domestic actions and targets. This simply means that, notwithstanding the fact that the calculation of emissions is done as part of the stock of Greenhouse-gas under UNFCCCP (United Nations Framework Convention on Climate Change Parties), they are not part of the domestic sum and are thus separately reported.

1.6 Global Investment Trends

Globally there have been significant improvements in the financial conditions in the year 2017 due to improved prospects for the global political economy and an accommodating United States of America monetary policy transition, UN (2018). This was reinforced by reduced financial risks for the majority of major global assets which have nosedived recently, complimented with major improvements in global bank lending and also gains in the equities markets in both emerging and developing countries. However, the UN (2018) lamented that such conditions are an indication of increasing propensity for risks by investors and this could be due to mispricing of risks, leading to abrupt equities markets reaction. On the other hand, promising prospects for the global financial system and liquidity conditions which are supported by strengthening global trade is helping global investment recovery and global political economic growth.

1.6.1 Portfolio Investments

According to the UN (2018), improvements in capital investments for emerging countries in 2017 was a result of portfolio investments, especially debt and searching for better yields escalated portfolio investments to about 350 billion dollars for the year 2017, following a paltry 163 billion dollars in the prior year. Substantial investments in emerging economies contributed to massive improvements for the EMBI (Emerging Market Bond Index) for the period 2017. The IMF (2017a) and the BIS (2017a) in UN (2018), voiced that the issuing of bonds in countries such as India, China, Mexico, Turkey, Colombia and

Indonesia have gathered some momentum and there was also a visible improvements in countries which export oil on their issuance of sovereign bonds. Furthermore, the IIF (2017) in UN (2018) revealed that moderately higher and increasing interest rates differential, complimented with promising inflation outlook, contributed to the improvement of the demand for local currency bonds for Russia, Brazil and India. On the other hand, investments in equities for Latin America and Asian economies in Brazil, Thailand, India and the Republic of Korea. More so, the IIF (2017) and BIS (2017a) in UN (2018), observed that equity market valuations in emerging markets were lucrative compared to developed market valuations and this was signaled by cyclical adjustments in PE ratios (price to earnings ratios).

1.6.2 Bank Investments

Bank lending across the borders to developing economies has been risky and depressed in the recent past years because huge global banking institutions in Europe were struggling to reduce their debt levels, UN (2018). The fall in bank financing across the borders performed a big part in the collapse of the whole private financial investments after the great recession of 2008-2009. According to Lund et al (2017) in UN (2018), over the duration January 2007 up to the period December 2016, banking institutions reduced assets by about 2 trillion dollars in the global political economy and of this amount, half was from banks from Europe. However, this have strengthened credit creation by a multiplicity of banking institutions from big emerging countries, an indication of increased importance of lending from South to South, UN (2018).

1.6.3 Foreign Direct Investment

According to UN (2018), foreign direct investments (FDI) continue to be more stable, while the UNCTAD (2017c) alluded that developing economies will experience an improvement in foreign direct investments for the entirety of the year 2017 mainly because of a promising global economic growth outlook, improved global trade and increased profits in corporate entities. These promising foreign direct investment prospects have been experienced in

developing territories, particularly Asia and large FDI destinations like China, Indonesia and India have escalated their policy endeavors to lure foreign direct investments. The UN (2018) further noted that Africa is also set to attract more foreign direct investments in the short-range, primarily due to strengthening prices of commodities such as metals and the recent continental integration. However, according to the global political entity (United Nations), Latin America experienced significant declines in foreign direct investments in the recent past years because of low prices of commodities and poor economic prospects in developed economies. Foreign direct investment outlook is envisioned to be depressed in the short-range, ECLA (2017), for instance Central America and Mexico are at the verge of a massive policy risk in the USA and the NAFTA renegotiations. In the same vein, Africa was envisioned to witness a drop in foreign direct investments for the year 2016 due to slowing growth prospect emanating from volatile security and political circumstances in a multiplicity of countries.

1.7 Empirical Evidence Of The Environmental Kuznets Curve

A multiplicity of literature on environmental Kuznets curve exists and this section will consider some of it with a view to provide an empirical understanding of the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment. Azizalrahman and Hasyimi (2019) developed a model of urban growth on carbon-dioxide emissions by targeting its sources in urban territories such as industry, commerce and residential. The duo performed some comparisons for lower middle, upper middle and high income economies and major indicators of carbon dioxide emissions in each sub-group, under environmental Kuznets curve contexts were employed. The results revealed existence of the inverse U-shaped pattern with respect to carbon-dioxide emissions and per-capita GDP, as well as linear marriage with respect to urbanization. Based on these findings, the duo provided specific policy recommendations for each sub-group of countries. Hove and Trugut (2019) investigated the Environmental Kuznets curve for 24 emerging countries using national-scale economic indicators and

environmental pollutants. Their findings revealed an inverse U-shaped pattern with respect to nitrous oxide emission and real GDP per-capita and also U-shaped pattern with respect to carbon dioxide emissions and fossil-fuel energy consumption. The duo suggested public policy interventions aimed at reducing environmental pollution and promoting sustainable economic growth trajectory around the globe. Shabani and Shahnazi (2019) alluded that information-communication-technology (ICT) impacts the consumption of energy and carbon-dioxide emissions differently across sectors of the economy, however, past studies could not address issues of sectorial concerns with it. To this end, the duo made an investigation of short-range and long-range causal relations in the case of the consumption of energy, real GDP per-capita, carbon dioxide emissions and information-communication-technology in Iranian economic sectors. These researchers employed DOLS in order to determine the long-range relations and the VECM was employed to determine the causality relationships among the variables. The finding suggested presence of environmental Kuznets curve in the Iranian economic sectors and policy recommendations were provided based on causality results. Aydin et al (2019) conducted an empirical investigation of the non-linear effects of growth of the economy on the ecological footprint for 26 European Union countries. The study employed a new panel smooth transition regression technique and the findings did not support presence of the Environmental Kuznets curve since inverse U-shaped pattern could not be observed. The improvement of the performance of the Chinese economy was enhanced by the political leadership which loosened environmental regulatory instruments in a way which favored the reduction of production costs and also attraction of entities from other territories, Cao et al (2019). Liu et al (2019) applied the Gini coefficient and the Global Moran's Index (GMI) to make estimations of inequalities of income on spatial and non-spatial position by employing data for 403 cities. This was performed in the environmental Kuznets curve context and an investigation was done to determine the impact of the distribution of income within 30 provinces in China have impacted the emission of carbon-dioxide emissions in the province. Their findings suggested that the growth of income in China increased the duration of the research study and the inverted U-shape pattern

was observed with respect to income growth and the emission of carbon dioxide, hence supporting the Environmental Kuznets curve in the Chinese provinces. Wang et al (2019) made some investigations of the sea-water Environmental Kuznets curve for Chinese coastal territories and unveiled that these territories possess differing sea-water qualities at various environmental Kuznets curve stages. These researchers then suggested an array of measures designed to make improvement on the existing policies to resolve environmental quality of coastal waters in these territories. In their study, Kibria et al (2019) investigated the share of fossil fuel in the energy profile and incomes for 151 nations; the findings of which revealed the environmental Kuznets curve. However, this trio lamented that, although these findings suggested presence of environmental Kuznets curve, they are responsive to the model specification. The trio further pointed that findings from non-parametric specification provided the evidence of the energy mix environmental Kuznets curve. According to Ding et al (2019), Beijing, Tianjin and Habei territories of China have been polluted by $PM_{2.5}$ and their research study targeted an investigation of the marriage between the growth of the economy and air pollution. Empirical findings from their study revealed that the presence of inverse U-shape pattern was relevant, the turning position for environmental Kuznets curve occurred after some time with respect to spatial effects but that was not the case with non-spatial technique and turning positions of the environmental Kuznets curve normally occur in post-industrial phase. The researchers further lamented that other territories in Beijing, Tianjin and Habei which attained the post-industrial phase have not realized the environmental Kuznets curve turning position. These researchers then made a suggestion that there is a potential of arresting air pollution and called for policy collaborations on regional governance in a bid to manage air pollution. Pao and Chen (2019) found the environmental Kuznets curve for G20 economies and it was also revealed that a positive elasticity with respect to emissions and consumption of fossil-fuel energy holds and a negative inelasticity with respect to renewable-energy consumption, hydroelectricity consumption and nuclear-energy consumption holds. Gui et al (2019) lamented that solid wastes from municipalities have become a pollution

menace in cities and a multiplicity of studies have been carried, however on a small scale. The trio pointed that little has been done to investigate the spatial dependence on municipality solid waste on a larger scale by employing data from cities and this resulted in biased results. The findings from their study suggested that the inverse U-shape purported in the environmental Kuznets curve could not be supported in Chinese cities and this according to the trio afforded new perspectives in the planning of cities and protection of the environment in the face of dangerous social and environmental dilemmas. The findings also suggested that Chinese cities have spatial convergence and dependence syndrome of municipality solid waste. According to Hao et al (2019), forest natural resources are an integral component in Chinese sustainability economic development endeavors and in not too distant past, it has been of great concern in a bid to foster responsible use of forest resources. These researchers have empirically proved that rapid growth of the economy would increase the output of timber and afforestation area before it subsequently nose dive after a turning point is realized. Such findings suggested a transition in China's quest to achieve sustainable economic growth and environmental health simultaneously. Zhang et al (2019) alluded that the biggest carbon dioxide emitter is China due to its massive agricultural activities, hence the need to make an understanding of the marriage between the emissions of carbon-dioxide, consumption of energy and growing of the economy in agro areas in China. The findings from their research study indicated that environmental Kuznets curve was valid in agro areas of China, in addition the consumption of energy in these territories revealed short-range and long-range negative impacts on agricultural emissions of carbon dioxide. Therefore, based on these findings, public policy interventions were suggested to foster sustainable agricultural development in the Chinese agro territories. Shahbaz et al (2019) made an investigation of the relationship with respect to economic growth and the degradation of an environment in the Vietnamese economy and revealed the N-shaped relationship. Such a result exposed existence of environmental Kuznets curve and this require policy authorities to give their attention to long-range environment and economy wide interventions. Gorus and Aslan (2019) made an investigation on effect of

economic determinants on degradation for the environment in the MENA economies and found that the environmental Kuznets curve was partially supported. It was also exposed by this duo that foreign direct investments and the use of energy escalated environmental pollution in most MENA economies. Hassan and Aslan (2019) investigated the railways Kuznets curve in the high incomes economies using a generalized method of moment and found that a U-shaped pattern was relevant with respect to emissions of carbon-dioxide and methane emission. However, results with respect to nitrous oxide emissions revealed the presence of inverse U-shape pattern, an indication of existence of RKC. Dyrstad et al (2019) made an analysis as to what extent does production of electricity from non-fossils can make a replacement of fossil-based production of electricity in OECD economies. The findings from their study unveiled that, economies that possess lower fossils based production of electricity indicated the presence for the Environmental Kuznets curve relation. In the same vein, the findings suggested that the European Union Emissions Trading System, coupled with economy specific policy interventions impacted on the production of electricity in the desired way. Ouyang et al (2019) revealed inverse U-shape relation with respect to air pollutions and urban growth for 30 OECD economies for the duration 1998-2015 and made recommendations for studies in the future to explore more on regulated $PM_{2.5}$ and expose the causality relationships between the development of the economy and the pollution of air. Kim et al (2019) considered the marriage existing between the quality of the environmental and trade as an of controversy and in their study, the findings suggested that the environmental Kuznets curve was relevant with respect to the whole sample and also developed and developing economies' sub-samples. Based on these finding, the researchers concluded that the benefits of trade accrue mostly to developed economies, however hurting developing economies during their trade with advanced income counterparties due to massive carbon dioxide emissions. According to Shahbaz et al (2019), the relationship existing with respect to the growth of economy and the emissions of carbon-dioxide resembles an inverse U-pattern and N-pattern, however Foreign Direct Investment and growth of economy revealed N-shape pattern with respect to

MENA economies. Therefore, this trio provided policy recommendations for authorities to craft robust energy and trade policy interventions which promotes cleaner production operation processes so as to simultaneously achieve sustainable development goals and environmental sustainability. Table 1 below shows a robust compilation of empirical evidence for environmental Kuznets curve hypothesis.

Table 1: Empirical evidence of the environmental Kuznets curve

Authors and Year	**Country**	**Period**	**Methodology**	**Findings**
Azizalraman and Hasyimi (2019)	Lower middle, Upper middle, High income	1973-2013	ARDL	Inverse U-shape and linear relation with urbanization
Hove and Tursoy (2019)	24 Emerging	2000-2017	Panel GMM	U-shaped pattern with respect to carbon-dioxide emissions and fossil-fuel consumption. Inverse U-shape for nitrous oxide emissions.
Shabani and Shahnazi (2019)	Iran	2002-2013	DOLS	Inverse U-shaped relationship in all sectors.

Aydin et al (2019)	26 European Union (EU)	1990-2013	Panel smooth transition regression (PSTR)	No environmental Kuznets curve between ecological footprint and economic development.
Cao et al (2019)	China	2002-2010	Random and Fixed Effects models	Inverse U-shaped relationship.
Liu et al (2019)	China	1996-2014	Gini coefficient and Global Moran's Index	Income growth increased carbon dioxide emissions, U-shaped pattern
Wang et al (2019)	China	2001-2016	Principal Component Analysis (CPA), Multiple logistic model	Chinese coastal territories revealed different sea-water quality at differing stage of the ECK.
Kibria et al (2019)	151 Countries	1971-2013	Pooled OLS, Fixed-Effects and Random Effects techniques	The polynomial relation with respect to fossil fuel share and real income was observed (EMEKC).

Ding et al (2019)	China	1998-2016	Spatial Durbin Model (SDM)	Inverse U-shaped relationship.
Pao and Chen (2019)	G20	1991-2016	Panel VECM	Carbon dioxide Kuznets curve exists (CKC), Positive elasticity between emissions and fossil fuel, negative inelasticity with respect to renewable-energy, hydroelectricity and nuclear-energy.
Gui et al (2019)	285 Chinese cities	2006-2015	Spatial-lag model (SLM) and Spatial-error model (SEM).	Environmental Kuznets curve was not supported, spatial dependence and convergence was revealed among Chinese cities.
Hao et al (2019)	China	2002-2015	GMM technique	Environmental Kuznets curve was supported

				with respect to forest resources.
Zhang et al (2019)	China	1996-2015	ARDL, VECM	The findings supported the environmental Kuznets curve.
Shahbaz et al (2019)	Vietnam	1974-2016	ARDL, VECM	An N-shape environmental Kuznets curve was relevant.
Gorus and Aslan (2019)	MENA	1980-2013	PDOLS	Partial support for the environmental Kuznets curve.
Hassan and Nosheen (2019)	37 High-income economies	1990-2017	GMM	U-pattern in the case of carbon-dioxide emissions and methane emissions, inverse U-pattern with respect to nitrous oxide emissions.
Dyrstad et al (2019)	OECD	1980-2014	Fixed Effects (FE) models	Environmental Kuznets curve was relevant with respect to economies with low level of

				fossil fuel consumption.
Ouyang et al (2019)	OECD	1998-2015	Panel Threshold model	Inverse U-shape relation with respect to air pollution and urbanization.
Kim et al (2019)	North North, North South, South North and South South.	1960-2013	Quantile Regression	Environmental Kuznets curve was observed with respect to the whole sample and also developed and developing economies
Shahbaz et al (2019)	Middle East and North Africa	1990-2015	GMM	N-pattern with respect to foreign direct investment and Inverse U-pattern and N-pattern with respect to economic growth.

Source: Author compilation based on robust literature reviews

1.8. Chapter Summary

Chapter 2 delved into the review of related literature to our study, in the process considering an overview of the global political economy, political economy business cycles and their environmental effects. Economic growth was defined in this chapter and also theories of economic growth, models of economic growth, determinants of economic growth and economic growth dynamics. This chapter was further engrossed into environmental sustainability indicators, in the same vein considering land environmental indicators, fresh water environmental indicators and coasts, seas, oceans and biodiversity environmental indicators. Literature relating to energy also formed part of our related literature, wherein global energy sources and demand, global energy efficiency and carbon dioxide emissions as well as regional energy trends were given due attention. As if that was not enough, Chapter 2 also considered literature on trade, where issues relating to global commodities trade and regional trends, global trade in services and regional trends and global energy trade and regional trends were the subject matter. It could not be enough without considering global transport and the environment, before we delved into global investment trends where portfolio investments, bank investments and foreign direct investments were robustly reviewed. The chapter closed by doing justice to empirical evidence of the environmental Kuznets curve. In Chapter 2, we will consider global climate change conventions.

CHAPTER 2

GLOBAL CLIMATE CHANGE CONVENTIONS

2.0 Introduction

This chapter provides more literature on global agreements to fight climate change ever since the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) on 9th of May 1992. In this vein, this chapter will do justice to the overview of the UNFCCC, the Kyoto Protocol and the Paris Agreement. It is also in this chapter where Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs) and Ecosystem Based Adaptation for Food Security (EBAFOSA) will be considered before it is closed.

2.1 Overview Of The UNFCCC

In June 1992 at the Earth Summit held in Brazil's Rio de Janeiro, global leaders crafted an environmental treaty known as the United Nations Framework Convention on Climate Change (UNFCCC) or simply the Framework Convention on Climate Change (FCCC), UNFCCC (1992). The major objective of the Convention was to stabilize the concentrations of greenhouse gases in the atmosphere to levels which could counter anthropogenic perils on the climatic system. This objective was supposed to be realized in such a time that would make it possible for ecosystems to self-adapt to climatic changes, in the process guaranteeing food security and sustainable economic development. The parties to the Convention agreed to craft periodic updates and publication of greenhouse gases stocks according to their sources and removals by sinks through employing techniques that are agreeable at the Conference of Parties. The parties also agreed to craft, employ, publish and make regular updates on national and regional interventions to promote

adaptation to climate changes. The Convention also required parties to promote and coordinate in developing, use and spreading, as well as sharing of technology, best practices and techniques which help in controlling, reducing and/or preventing greenhouse gas emissions from sectors such as agriculture, forestry, energy, industry, waste management and transport. In the same vein, the Convention mandated parties to uphold sustainable management and cooperation in conserving and enhancing sinks and reservoirs of all greenhouse gases such as biomass, oceans, forests and also marine, coastal and terrestrial territories. In the Convention, parties were also required to enhance cooperation in the quest of enhancing climate change adaptation and also craft clear and comprehensive roadmaps for the management of coasts, agriculture and water resources, and protecting and rehabilitation of areas, especially in Africa, under the threats of droughts, floods and desertification. Furthermore, the Convention called for parties to consider climate change in their environmental, social and economic policy initiatives and craft relevant techniques for assessing impact; crafted and nationally determined with an eye to reduce hazards to the economy, public health and environmental health so as to foster climate change adaptation and/or mitigation. The 1992 Convention also made a call to the parties to support and collaborate in research, systemic observations and development of data storages on climate systems and designed to advance the understanding, reduction, and removal of challenges associated with causes, effects, scale and timing of climatic changes and also socio-economic impacts of these interventions. The FCCC treaty further mandated parties to support and collaborate on total, transparent and quick sharing of scientific, technical, technological, legal, and socio-economic information on climate change and climate systems and also the effect of various response initiatives on social and economic dimensions. The Convention also required parties to support and collaborate on the dimensions of education, training and creating public awareness on climate change issues and foster greater or broader participation in these initiatives and also consider non-governmental entities. Finally, the parties in the Convention were encouraged to participate at the Conference of Parties and provide information related to implementation.

However, the United Nations Framework Convention on Climate Change (UNFCCC) could not provide specific targets of greenhouse gas emissions and contributions from the parties, but it gave way for the possibilities for its review through Protocols.

According to Sands (1992), the United Nations Framework Convention on Climate Change (UNFCCC) was a reactive approach to the growing empirical evidence which pointed to the surge in perils associated with an ever increasing greenhouse gases in the atmosphere. These greenhouse gases are a threat due to their potential to cause temperature increases on a global scale, with effects of leading to the unsustainable consequences such as rise in sea levels, desertification, hurricanes, droughts, cyclones and also bleaching of coral reefs. Greene (2000) described the UNFCCC as a tool to be used by governments to deal with the dangers associated with global warming. Obergassel et al (2015) lamented that the UNFCCC was born after 25 years of climatic diplomacy among UN members and this was the first time to ever witness such an action under the international law to foster climate action by all parties. A research study conducted by Tompkins and Amundsen (2008) described the way the United Nations Framework Convention on Climate Change is being implemented at national level, the findings revealed that although a multiplicity of people witnessed some changes at national level in the form of research and planning, very few people have witnessed some climate change initiative at their locality. On the other hand, Ashe et al (1999) noted that the Alliance of Small Island States (AOSIS) had crafted 12 points to base their negotiation at the UNFCCC, however only 10 were accepted. The trio noted that, due to their vulnerability to climate change, AOSIS members were put in discomfort due to the failure of the UNFCCC to the absents of specific targets and/or time for the realization of meaningful reduction of greenhouse gases by developed countries; absence of a dedicated financial plan for supporting climate adaptation responses and the lack of clear mechanisms for implementing coastal zone management initiatives.

2.2 The Kyoto Protocol

The Kyoto protocol, signed on the eleventh of December 1997 in Kyoto, Japan extends the dictates of the United Nations Framework Convention on Climate Change that was signed in 1992 in Rio de Janeiro in Brazil. The protocol came into force on the sixteenth of February 2005 and it has a total of 192 parties, however Canada withdrew in December 2012. The Parties to the Kyoto Protocol, in a bid to meet their greenhouse gas emission limits and commitments to reduce them have agreed to craft policies and other initiatives in lieu with their national status-quo and coordinate with other parties in order to strengthen their national and combined policy interventions. The parties have further committed to uphold limitations and reductions of greenhouse gases which are not under the purview of the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO). Further, the parties to the Kyoto Protocol agreed to put in place policy initiatives that will reduce the hazards, including harmful impacts of climatic changes, impacts on global trade, socio-economic and environmental impacts on other countries, particularly developing countries. In addition, the parties to the Kyoto Protocol shall allow the Conference of the Parties to make a decision on the need to coordinate policies, however this should follow circumstance of individual parties and associated effects.

The IGBP Terrestrial Carbon Working Group (1998) noted that commendable milestones were achieved by the Kyoto Protocol when it included terrestrial sources of carbon dioxide and sinks into a framework which is legally binding and its effectiveness can be realized by crafting a robust carbon budget. O'Neill and Oppenheimer (2002) mooted that if we consider the relationships with respect to emissions, climatic changes and effects, the Kyoto Protocol is an icebreaker to leverage on to deal with the dangers to the degradation of coral reefs, breaking of the Western Antarctic Ice Sheets and closure of access to oceans. Reilly et al (1999) alluded that in the Kyoto Protocol, reduction of emissions of greenhouse gases is based on the limits of carbon dioxide equivalent and this measure is arrived at by calculating index of the potential

to cause global warming of each greenhouse gas. These researchers suggested that under strict policies, employing the potentials of global warming obtained by an integrated global-systems technique in the Kyoto Protocol way will result in significantly high climate change mitigation using a multiplicity of gases than would be possibly under carbon dioxide only techniques, hence reiterating the use of global warming potentials' weakness as a political tool. Barret (1998) considered the political economy of the Kyoto Protocol and lamented that although it sought to enhance cost effectiveness, the protocol have evidenced that it is too costly. The researcher further noted that, the Kyoto Protocol is on a dilemma of not meeting its promises of reducing emissions due to a multiplicity of reasons, some of which include the possibility of emissions relocating to territories that are not mandated to stay within the confinements of prescribed limits and/or simply because the trading mechanisms will be under the control of the protocol. Furthermore, the researcher noted that the Kyoto Protocol does not prevent the parties from complying with its conditions but it only partially prevents non-participation by the parties. Manne and Richels (1999) observed that the United States of America will incur large abatement costs in the short-term and international trading of rights to emit is key to bringing these costs down and a multiplicity of factors will determine these costs. These factors include the number of traders in this market, the slope of each trader's additional cost and compliance by buyers to the terms of the rights purchased. The duo further lashed that, only and only if the set emissions target goes below 550ppmv, otherwise the Kyoto Protocol will render self not consistent with long-range objective to stabilize the concentration of greenhouse gas emissions. A research study by Copeland and Taylor (2005) revealed that in an open global economy: one sided reduction of emissions by developed countries in the North may lead to self-serving reduction of emissions by the developing South who are not constrained to emit; the rules on how emissions are allocated should be simple for example same reduction targets should be in place since they are proving to be the best even if international trade of emission permits is not in place; and international trading of emissions permits make parties involved poorer and leads to further increase of global greenhouse gas emissions.

2.3 The Paris Agreement (Accord de Paris)

The Paris Agreement was a culmination of negotiations between 196 countries held in Le Bourget, Paris in France at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC). The Agreement was reached by consensus on the twelfth of December 2015 as a global initiative to fight greenhouse gas emissions through fostering mitigation, adaptation and financing. The Paris Agreement aimed at strengthening global initiatives against the dangers of climatic changes, in view of sustainable development and attempts to do away with poverty through: restricting global temperatures to 1.5℃ increase above that before the industrial era, with an aim to reduce vulnerabilities due to climatic changes; strengthening adaptation and enhancing resilience to climatic changes, as well as reducing the emissions of greenhouse gases in ways that will not put the production of food in jeopardy; and fostering the flow of financial resources consistent with the dictates of achieving low emission of greenhouse gas and the realization of climate resilient development of the global economy. The implementation of the Kyoto Protocol was envisioned to ensure equity and commonality of different responsibilities and capabilities in line with circumstances of different countries.

Falkner (2016) hailed the Paris Agreement as a ground breaker in global climate policy by upholding the role of national politics in climatic change and affording countries an opportunity to determine their own climate mitigation targets. On the contrary, Clemencon (2016) lashed that the Paris Agreement deserves in the trash, an indication that the agreement was as good as not being crafted, further noting that there is terrifying evidence of global warming and the possibility of achieving below 2 ℃ was very remote. The researcher further lamented that the Paris Agreement could not provide the roadmap as to how the ambitious objective could be achieved. In the same vein, Dimitrov (2016) characterized the Paris Agreement as a political achievement in climatic negotiations and diplomatic issues and it provided important takeaways for the academia. According to Peters et al (2017), pledges that

were made at the Paris Agreement were not enough for global temperatures to be restricted to levels 2℃ below the period before the industrial era. Further, these researchers have castigated the lack of clarity with respect to the Paris goal, global stock take and enlargement of the ambitious nationally determined contributions (NDCs). Hale (2016) alluded that the climate summit held in Paris in 2015 have strengthened climate issues from being merely regulatory to becoming catalytic as well as facilitative. The researcher noted the intergovernmental regime embraced climate action by both sub-state and non-state climate actors and the agreement also brought climate transition initiatives to the core. Du Pont et al (2017) lashed that targets to provide guidance to parties to the Paris Agreement to speed-up climate desire, financing and supporting on equality basis are very important, however these are not yet revealing in the Paris Agreement. Bodansky (2016) used legal lenses to characterize the Paris Agreement as being within the dictates of the Vienna Convention regarding the Law of Treaties, however the researcher noted that the agreement is a mixed bag of binding and non-binding provisions with regards to mitigation and financing by the parties.

2.4 Revisiting Millennium Development Goals (MDGs)

The millennium development goals (MDGs) were agreed upon by 191 member states of the United Nation (UN), in the year 2000 and were supposed to be achieved by the year 2015. These MDGs include to: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and women empowerment; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases; ensure environmental sustainability; and develop a global partnership for development.

2.4.1 Eradicate Extreme Poverty And Hunger

According to Bhat (2013a), the MDGs were a reflection of the globe's dedication to fighting poverty in all its facets, however this goal is being threatened by a slow-down of the global economy, food insecurity and climatic changes. The researcher noted that Millennium Development Goals (MDGs)

provided a yardstick to the global commitment to end poverty although the goals were too ambitious and achieving them require greater commitment by individual countries. The researcher further noted significant progress towards their attainment in a multiplicity of countries and pinned hope on improving quality of life for millions of people globally.

2.4.2 Achieve Universal Primary Education

Bhat (2013b) recognized the importance of education as a tool to fight extreme poverty and inequalities, strengthening health and social well-being, and providing a stronger foundation for sustainable economic growth and development. The researcher further noted that education is critical in the realization of democracies and the establishment of strong global economies, however this realization is plagued with a plethora of hurdles. According to Arends and Winnaar (2016), the target of the millennium development goal number two is to make sure that by the end of the year 2015, children, both girls and boys around the globe will have to undergo and complete a primary education course.

2.4.3 Promote Gender Equality And Women Empowerment

Labucay and Stations (2016) alluded that the empowerment of women politically translates to improved economic opportunities for them, thereby leading to both human and economic development. The duo also indicated that politically empowering women is normally measured on a broader level with their representation in both the government and legislature. According to McCann (2013), women parliamentarians globally are less than one in every five and the quota system is used voluntarily or legally in more than half of global countries as a way to increase women participation in political activities.

2.4.4 Reduce Child Mortality

Hoekstra et al (2006) mooted that efforts to administer measles vaccinations globally for the previous five years have culminated into tremendous reduction of deaths from measles for children under the age of 5 years. These researchers observed that such a reductions contributes significantly to the millennium development goal number four, a goal to reduce the deaths of children under the age of 5 by as much as two thirds by the year 2015. Appunni and Hamisi (2013) also reiterated that, the millennium development goal number 4 (MDG4) targeted to reduce the deaths of children under the age of five years from ninety three per one thousand births in the year 1990 to thirty one per one thousand births in 2015. This could be realized through increasing number of one year old under immunization against diseases such as measles, diphtheria and BCG.

2.4.5 Improve Maternal Health

Gupta and Gupta (2016) alluded that the millennium development goal number five deal with two simultaneous goals that is: to achieve a maternal deaths by seventy five percentage and achieving universal accessibility of reproductive health facilities. The duo noted that significant progress have been made this far, however the goal is still miles from being achieved. WHO (2003) conducted a workshop in Manila that focused on reducing maternal related deaths where participants were drawn from 7 countries and they agreed that all mothers and new-born babies have the right to survive from pregnancy and childbirth and it is the responsibility of all stakeholders to ensure their survival.

2.4.6 Combat HIV/AIDS, Malaria And Other Diseases

The prevalence of HIV/AIDS and nutritional deficiencies in developing territories is a major stumbling block towards the achievement of the United Nations MDGs and robust initiatives to fight HIV is still needed, Colecraft (2008). In the same vein, the researcher noted the need for concerted efforts to make nutritional improvements specifically targeting vulnerable people living with HIV/AIDS. Lenssen et al (2008) observed the ever growing narrative that

public health related challenges have become too complex to the extent that more resources are required and this cannot be done by countries and other parties concerned and this have put the realization of MDGs in jeopardy. Initiatives to achieving the millennium development goals (MDGs) should incorporate robust and wide ranging efforts so as to deal with main health related challenges and these efforts include sound allocation of resources and mobilization, considering an array of disease inter-linkages, Alban and Andersen (2007).

2.4.7 Ensure Environmental Sustainability

Akpor and Muchie (2010), there is a multiplicity of strategies which have been deployed for the purpose of achieving the millennium development goal of ensuring environmental sustainability (MDG7) and these have been done at both national and international level. The duo mentioned that there are mainly two techniques that can be employed to remove pollutants from wastewater that is biological and chemical methods. In the same vein, the duo indicated that biological waste water treatment techniques are mostly regarded over chemical techniques. Bauer et al (2012) upheld that the sustainability of the economy depends on environmental sustainability and global environmental changes have brought firms to the realization that focusing on shareholder value only is a threat to the firm's long-range viability.

2.4.8 Develop A Global Partnership For Development.

According to Barnes and Brown (2011), the word partnership is prevalent when it comes to issues relating to participative global governmentality and it reflects a pledge for the millennium development goals (MDGs). The duo also alluded that the ideal of global partnerships is unclear and how this idea should promote a transition from theory to praxis. Caliari (2014) investigated the standard and verifiable effects of the millennium development goal to develop a global partnership for development's selection of benchmarks on the rights of human beings. The researcher noted that the MDG 8's benchmarks could

not have any significant effect on principles for the promotion of human rights, however it was not good for existing partnerships to promote human rights.

2.5 A Look At Sustainable Development Goals (SDGs)

In 2015, the member states of the United Nations crafted the Agenda 2030, which is a roadmap to achieve prosperity and peace for both people and the planet, today and tomorrow. At the core of the agenda there are seventeen (17) sustainable development goals (SDGs) and these goals presented an emergency call for global economies (both developed and developing) to collaborate. These goals include: no poverty; zero hunger; good health and wellbeing; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequality; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; and partnerships for the goals, UN (2019). According to the United Nations (2019), sustainable development goals (SDGs) were a culmination of hard work by global economies and the United Nations, particularly the United Nations Department of Social and Economic Affairs (UNDSEA).

2.5.1 No Poverty

The alleviation of global poverty calls for robust interventions since about 1.2 billion people are languishing in the poverty cycle and there is need for the intervention of development support at community, country and global levels Yeates (2014a). The researcher further observed that there is great potential, yet it remain untapped for regional groupings of countries to enhance social investments as a way to foster the elimination of global poverty and this requires massive backing from the United Nations, and the World Bank as well as other development entities. Yeates (2014b) mooted that the political economy of the New South American Regionalism (NSAR) was far from being a true reflection of what is generally thought of it, a reflection of big developmental projects. The researcher investigated the development

initiatives of the New South American Regionalism in the context of a dynamic global order, in the process affording due attention to issues relating to regionalism; economic and social developments; regional integration; defense; intelligence and organized crime.

2.5.2 Zero Hunger

According to Nabarro (2016), notwithstanding the complexity and interconnectedness of the foundations of poverty and hunger, the Agenda 2030 provides the highest possibility of a zero hunger and this can be realized through partnerships; leveraging on technological innovations and also mainstreaming equity and justice in all initiatives. Konefal (2018) concluded that there are some weaknesses in issues relating to agricultural sustainability since there are a multiplicity of differences with respect to social innovations; technology; expertise; democracy; markets; nature and change itself. Further, governmentality issues and institutionalizations were considered and it was apparent that governance moderates sustainability.

2.5.3 Good Health and Wellbeing

Dadzie et al (2016) voiced that the development of human beings is premised on good health and wellbeing, further identifying the primacy of interpersonal techniques like focus group discussions (FGDs); below the line and above the line strategies to enhance good health and wellbeing. Fernandez (2019) noted UN (2015a) to reinforce the role of role of the SDG 3 in enhancing good health and wellbeing of all the people around the globe and further highlighting that a multiplicity of issues are at stake when it comes to health issues, including both economic and environmental sustainability issues. In the same vein Ridgway (2018) looked on the health of old people and identified two dimensions with which they are perceived: that they are resource parasites, hence have no value; and that they are social assets. However, the researcher could not hold on to allude that a large demographic of the elderly is fraught with a plethora of mixed bag of issues.

2.5.4 Quality Education

Nazar et al (2018) forwarded that provision of best minds is the best thing to be done by any government and with the setting in of sustainable development goals (SDGs), it is important to set benchmarks for tracking progress in lieu with the new development agenda. Gillies (2010) have alluded that quality management (QM) models are awash in the European education systems and this have refocused education and to adjust it in lieu with business models in a way that will enhance human development. Furthermore, Anangisye (2010) further alluded in a study conducted in Tanzania that, the market model of education is the way to go if the aspirations of quality education has to be attained.

2.5.5 Gender Equality

Deere (2018) observed that the achievement of gender equality as enshrined in the Agenda 2030 sustainable development goals has 9 targets and they focus on the primary causes of inequalities of gender such as issues of unequal accessibility to resources by women. According to Esquivel and Sweetman (2016), have positioned that the Agenda 2030 affords global economies a road map to the attainment of sustainable development across the social, economic and environmental domains. Rosche (2016) hailed the Agenda 2030 and the culmination of sustainable development goals (SDGs) as being a culmination of broader participation of the civic society as opposed to how the millennial development goals (MDGs) were crafted.

2.5.6 Clean Water And Sanitation

Although water is an important public health asset, its uses need to be balanced since they are competing, robust surface water and ground water management need to be deployed, Powers (2019). Furthermore, the limited supply of physical water, which was normally experienced in arid and desert territories is now a global phenomenon wreaking havoc in big cities and poor communities. Therefore, since water has greater importance as a global commodity, existing property rights should be scrutinized, challenging

democratic control of natural resources should be prioritized and the sovereignty of countries is being put to test in transnational and continental waters. According to von Hirschhausen (2017), lamented that, although there is some progress towards the attainment of the SDG to provide access to clean water, about 800 million people globally face severe shortages of access to clean water for drinking purposes.

2.5.7 Affordable And Clean Energy

Development and every life aspect rely on the use of energy and this makes significant contribution to the attainment of sustainable development goals (SDGs); however, the distribution of energy resources is not equal globally thereby leading to poverty and wealth inequalities. Furthermore, energy use is the major source of anthropogenic emissions and associated challenges, Bruce (2018). Barua et al (2012), has it that renewable energy is growing in importance due to the ever expanding global market for cleaner sources of energy and this is expected to continue up to 2035 if the global economy could meet its pledge and boost investment.

2.5.8 Decent Work And Economic Growth

There are heterogeneous forms through which decent work manifests itself in both economic and social dimensions, and in modern days, it has become more relevant in modelling both society and business at large, Ferraro et al (2016). According to Soares Oliveira (2018) there have been issues with the operations of retailers and to this end they faced some boycotts and tough criticism due to their poor workmanship and scandalous human rights practices. These issues could be addressed by the implementation of social responsibility initiatives in host countries and such interventions are in lieu with the dictates of sustainable development goals (SDGs) of the United Nations, specifically the eight goal which addresses decent work and economic growth.

2.5.9 Industry, Innovation And Infrastructure

Roy (2019) alluded that sustainable development goals (SDGs) of the United Nations are a roadmap that leads to prosperous, conflict free and a sustainable global future and this cannot be realized without improving the standard of living. However, the researcher noted with concern that coastal dwellers are faced with massive threats to such a realization in the context of goal number nine of the SDGs. Lesnikova and Schmidtova (2019) made an allusion that driving the growth and development of an economy require massive investments in innovative initiatives. Wahab et al (2016) mentioned the then United Nations Secretary General Ban Ki as having alluded to the primacy of innovations in both science and technology as the major ingredients to the attainment of SDGs.

2.5.10 Reduced Inequality

Oliveira (2018) suggested that equality of benefits and challenges associated with development between the current and future generations is not a guarantee of a better life for the generations to come further into the future. Furthermore, the researcher suggested an intergenerational sufficientarian position as the sole technique to make sure future generations benefits from the realization of sustainable development goals (SDGs).

2.5.11 Sustainable Cities And Communities

Guneralp (2015) lamented that urbanization globally will be punctuated with challenges related to sustainability, the use of energy and emissions of greenhouse gases. The reason being that expansion of urban territories in the form of residence and business centers, as well as infrastructural developments demand large quantities of raw materials such as wood, concrete, bricks, mortar and steel. However, as if that is not enough, the built environment rely on energy for maintenance and operationalization. Greyling et al (2016) observed that cities in South Africa aim at issues of sustainability from policy and strategic lenses, in the process alluding that the transformation of cities is rooted in the rhetoric of policies and their deployment.

2.5.12 Responsible Consumption And Production

Sznida (2018) provided a step-by-step narration of how the European Union did as a way to make the realization of the sustainable development goal number 12 (SDG12) a reality and this included the crafting of Secular Economy Package, initiatives to minimize wastage of food across the whole value chain, and interventions for attaining efficiency in the use of renewable energy.

2.5.13 Climate Action

Robinson et al (2006) observed the existence of a multiplicity of relations with respect to climate change and sustainable developmental issues and lamented the inadequacy of literature relating to climatic change. The available pieces of literature concentrate mainly on viewing sustainability developments from the perspective of climate change, instead of viewing climate change in the perspective of sustainable development. Further, there is too little praxis to make attempts of marrying these twin issues in real world setups. Shindell et al (2017) hailed the Paris Agreement which was a culmination of the UNFCCC for closely marrying global long-range climatic and short-range poverty alleviation and developmental initiatives. The researchers called for urgent interventions, but however noted the possibility of a multiplicity of channels through which long-range targets could be realized. Janetos et al (2012) envisioned a bootstrap relation in available research studies with respect to development and climate change issues. It was also noted by these researchers that, although there are a multiplicity of initiatives to marry climate action into developmental projects, there is a lot that need to be done with respect to exposing possible synergistic benefits and costs thereof.

2.5.14 Life Below Water

Singh et al (2018) posits that the attainment of sustainable development goals is associated with a multiplicity of socio-economic and ecological effects which are interlinked. In this regard, a framework was crafted as a way of integrating available understanding from both experts and literature to investigate the marriage between one sustainable development goal and another. To be

specific these researchers directed their lenses on life below water goal (SDG14) and its target, in the process relating it to other sustainable development goals. It was found that the “life below water” goal make significant contributions to the realization of other sustainable development goals. In the same spirit, Knott and Neis (2017) lamented that the damaging nature of intensive salmon aquaculture and individual transferable quotas (ITQs) on both the natural and marine space users have not received the due attention it deserves in financialization and fisheries context. Keen et al (2018) observed that governments and agencies regionally in the Pacific are bolstering their pledges to foster sustainability of ocean management by putting in place robust public and private policy interventions. According to Blanchad et al (2017) global food security, livelihoods and nutrition rely to a large extent on aquaculture and fisheries production; but terrestrial and marine ecosystems and food production are separated under sustainable development goals. In order to ensure sustainability in satisfying the increasing global demand for fish, the marriages of goals with respect to aquaculture, agriculture and fisheries should be afforded due attention.

2.5.15 Life On Land

According to Angelov et al (2019), the production of honey in large quantity and excessive use of pesticides threatens the global bee populations with extinction and this has the potential to spillover to the global botanical system. Although there are a multiplicity of micro sanctuaries of bees around the globe, there is little understanding on this initiative and it is therefore appropriate to educate people on bee keeping so that they can preserve and rehabilitate them due to their importance in pollinating crops globally. The conclusion therefore is account for the global bee population since they are the lifeblood of all botanical systems and they also help foster the health of forests and farms. According to Solorzano and Fleischman (2018), there are many reasons for differing effectiveness of protected territories with respect to the attainment of goals for the conservation of nature; however little has been done along this. The duo then argues that institutional development is though neglected

notwithstanding that it forms the foundation of protected territories. Sant'Anna and Young (2010) demonstrated the marriage with respect to deforestation and conflicts in the Amazonia territory, in the process lamenting that violent land acquisition leads to massive deforestation.

2.5.16 Peace, Justice And Strong Institutions

Ginting and Anzela (2019) made a clarity that sustainable development goals (SDGs) are equipped with five major tenants such as planet, people, peace, prosperity and partnerships, and these principles straddle across the dimensions of environment, social and economic. The duo also hailed the Peace is Possible initiative in Indonesia for its inclusiveness of all stakeholders, however in the spirit of attaining sustainable development goals.

2.5.17 Partnerships For The Goals

According to Glasbergen (2007) partnerships represent marriages of a multiplicity of parties in a society, with each standing in for some interests bringing in different hopes, claims and also expectations, being characterized by its own weaknesses and strengths. These characteristics of partnerships are well articulated in a multiplicity of writings and this being the source of their strengths in the realization of sustainable development goals. Graham et al (2018) pointed that Agenda 2030 have been under looked for its enthusiasm and narrowness, and cumbersome sense which is alike to a call for working together globally. However, this message has the possibility to foster significant achievements by 2013 and it is believed that the strength of SDGs is embedded in partnerships for development goal (SDG17).

2.6 Ecosystem Based Adaptation For Food Security Assembly (EBAFOSA)

According to to Munang and Mgendi (2017), the United Nations Environment supports sustainability practices by encouraging sound policies and practices through provisioning of technical and other support services for African states

implementing the provisions of the Paris Agreement to foster the resolve for social and economic issues such as unemployment, food insecurity and economic growth in general. The duo propounded that, ecosystems based adaptation for food security assembly (EBAFOSA) is an intervention to promote agricultural industrialization, supported by the United Nations Environment with the backing of African Union (AU), state actors, non-state actors as well as private sector players. The essence of ecosystem based adaptation for food security incorporates techniques employed in agriculture designed to foster conservation and sustainability by way of integrating land management, living and water resources. Reid (2011) described ecosystem based approaches to adaptation (EBA) as techniques which combine both biodiversity and ecosystems into initiatives to adapt to climatic changes. Mercer et al (2012) alluded that EBA techniques employs internal and external based understanding of an ecosystem for the identification of climatic changes adaptability initiatives.

2.7 Chapter Summary

This chapter delved into an overview of the United Nations Framework Climate Convention on Climate Change (UNFCCC), the Kyoto Protocol, Paris Agreement, Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). The chapter also closed by taking a quick look at Ecosystem Based Adaptation for Food Security Assembly (EBAFOSA). Chapter 3 will present the theoretical framework of our research study and is the next chapter.

CHAPTER 3

THEORETICAL FRAMEWORK

3.0 Introduction

In this chapter, the researcher presents the 'theoretical framework' of the research study. It is in this chapter where the expected relationships among the variables is being dealt with and also the justification for the variables used in the study.

3.1 The Environmental Kuznets Curve (EKC) Theory

Sarkodie and Strezov (2019) mooted that the Kuznets curve originated from the work of Kuznets (1955) who mooted the presence of inverted U-shape relation between per capita income and inequalities of income. This relationship is formed when income per person at initial stages of growth of economy increase and some income disparities adopts a similar pattern, and start to fall after reaching a certain stage (turning-point) in later stages of economic development. Kuznets (1955) alluded that early stages of growth of incomes is associated with an unequal distribution of income, however as economic activities increase in their productivity, the distribution of income gravitates to equality. Grossman and Kruger (1991) familiarized the environmental Kuznets curve in their seminary work which found that the deterioration of the environment and per-capita incomes reveal some inverse U-shape relation as noted by Kuznets (1955). Panayotou (1993) coined the term, 'Environmental Kuznets curve' after Grossman and Kruger (1991) found the existence of an inverted U-shaped pattern with respect to atmospheric

indicators (Suphur-dioxide and smoke) and per-capita income. Further, Panayotou (1993) examined the relations with respect to degradation of the environment and per capita income with an attempt to validate it and the results exposed an inverse U-shape pattern. According to Panayotou (1993), policy related distortions related to the carbon subsidies, subsidies on energy, protectionism tendencies, under-pricing of natural resources and also the failure of markets impacts on the slope of the inverted U-shaped marriage. Further to that, Sarkodie and Strezov (2019) have identified the elasticity of income, scales, compositions, techniques effect and global trade as factors which influence the inverse U-shape pattern with respect to environmental degradation and the levels of income for an economy.

3.1.1 The Elasticity Of Income Of Environmental Quality

Sarkodie and Strezov (2019) define the incomes elasticity for environmental quality as responsiveness of quality of environment to changes in income in an economy. The duo noted that individuals in a country prefer high living standards and are willing to pay for a clean environment as their incomes grow. According to Baldwin (1995), at high income levels, people opt for quality than quantity and are more environmentally conscious, therefore, call for better environmental services and this brings changes to the structure of an economy and consequently an improvement of the environmental quality. However, on the other hand, societies which are worse off are less environmentally conscious and their major concern is quantity instead of quality. According to Sarkodie and Strezov (2019a), the need for quantity leads to unconscious extraction of natural resources and breaking of laws regulating the environment as well as industrial standards in the quest to attract industry polluters from the first world.

3.1.2 The Scales, Compositions And Techniques Effect

Grossman and Krueger (1991) pointed out that the relations with respect to degradation of the environment and growth for the economy evolves in three main stages that is scales, compositions and techniques effect. Under the scales effect, development for the economy has a negative relationship with the environment, an indication that as output grows, exploitation of natural resources will also be increasing thereby leading to the environmental degradations. Further, development for an economy under scale effect requires a high energy consumption mainly from fossil fuel sources of energy because they are relatively cheap and is readily available when compared to renewable energy sources. Edenhofe et al (2011), Owusu and Asumadu (2016) have noted that reliance on the consumption of fossil fuel energy in industry production operation processes leads to the reduction of costs and helps in mass production of goods and services so as to satisfy the ever increasing demand, however this will lead to industrial linked environmental emissions. Sarkodie and Strezov (2018a) alluded that composition effects is a stage where the relationships with respect to economic development and the environment can either be positive and/or negative based on structural economic shifts. Therefore the degradation of the environment normally increases as the growth of the economy increases, emanating from the shift of the agricultural economy to an industrial operation processes which consume more energy and also carbon intensive. In the same vein, due to the contraction of pollution intensive industrial establishments and the service industries develop, the degradation of the environment will fall. According to Dinda (2004) and Sarkodie and Strezov (2018b), under the technique effect, the relationships with respect to economic development and the environment is positive. The quality of an environment improves as developed countries have a high propensity to fund Researches and also Developments, thereby replacing pollution intensive and old technology with clean and complex technology as well as strong regulatory and industrial standards, leading to a quality environment.

3.1.3 International Trade

The environmental Kuznets curve can be well explained by trade policy as one of the important factors (Sarkodie and Strezov 2019). Due to the liberalization of trade, economies are able to specialize in economic sectors where they are competitively strong. According to Grossman and Krueger (1991), in the event that environmentally related regulatory frameworks are weak in a sector the country has competitive advantage, then liberalization of trading may result in environmental damage because every economy will be specializing in a sector having weaker environmentally related regulatory frameworks and avoid industrial production in sectors having higher pollution abatement costs. Therefore, the overall levels of pollution will be determined by the nature of pollution intensive industries and also the regulatory framework in place. Strezov and Sarkodie (2019) revealed that the liberalization of trade through the composition effect is responsible for the pollution hypothesis, although free trade may provide the benefits of employment creation, skills enhancement and also boosting of incomes, hence leading to a clean environment. Further, Sarkodie and Strezov (2019) have made a claim that Foreign Direct Investments leads to a transfer of innovations, research and development, as well as cleaner and state of the art technologies from developed economies to developing economies, in the process replacing old technology and this will reduce pollution levels.

3.2 Theoretical Model

The research study will employ the environmental Kuznets curve hypothesis in its theoretical modeling process as alluded by Sarkodie and Strezov (2019). Although existing studies apply different techniques on the environmental Kuznets curve hypothesis, most of them adopt a similar specification of the model. Therefore to this end, the study will employ panel data series to investigate the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment. The reduced form environmental Kuznets curve hypothesis model is thus presented as:

$$E_{i,t} = \alpha_{i,t} + \beta_1 y_{i,t} + \beta_2 y^2{}_{i,t} + \beta_3 y^3{}_{i,t} + \beta_4 X_{i,t} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

In equation (1) above, α represent the constant term E shows environmental indicators, y; y^2 and, y^3 shows economic growth (income levels), square and cubic polynomial of economic growth respectively, X being other factors which affect the environment, $\beta's$ being the coefficients estimations of independent variables, ε representing the error term or the disturbance across cross sections i over the time t. The theoretical specification presented in equation (1) above, the marriage with respect to environmental deterioration and growth of the economy could be:

a) $\beta_1 = \beta_2 = \beta_2 = 0$, if no relationship with respect to environmental deterioration and growth of the economy.

b) $\beta_1 > 0$; $\beta_2 = \beta_3 = 0$, when there is existence of positive-monotonic relationship with respect to environmental deterioration and growth of the economy.

c) $\beta_1 < 0$; $\beta_2 = \beta_3 = 0$, when there is a negative monotonic relation with respect to environmental deterioration and growth of the economy.

d) $\beta_1 > 0$; $\beta_2 < 0$; $\beta_3 = 0$, when there is inverse U-shaped relation with respect to environmental deterioration and growth of the economy.

e) $\beta_1 < 0$; $\beta_2 > 0$; $\beta_3 = 0$, when there is a U-shape relation with respect environmental deterioration and growth of the economy.

f) $\beta_1 > 0$; $\beta_2 < 0$; $\beta_3 > 0$, when there is N-shaped relation with respect to environmental deterioration and growth of economy.

g) $\beta_1 < 0$; $\beta_2 > 0$; $\beta_3 < 0$, if there is inverse N-shape relation with respect to environmental deterioration and growth of the economy.

Therefore, Environmental Kuznets curve hypothesis becomes valid when, $\beta_1 > 0$; $\beta_2 < 0$; $\beta_3 = 0$, resulting in positive-negative relation or inverse U-shape pattern and when $\beta_1 < 0$; $\beta_2 > 0$; $\beta_3 < 0$, resulting in positive-negative-positive or N-shape pattern.

3.3 Chapter Summary

In this chapter we provided theoretical framework for the research study, in which the income elasticity of environmental quality was explained. The chapter also considered scales, compositions and techniques effect as major factors that explain the environmental Kuznets curve in an economy. It is also in this chapter where the role of international trade have been considered explicitly in the context of environmental Kuznets curve and the theoretical model thereof. Chapter 4 will present the methodology of this study and it is the next chapter.

CHAPTER 4

METHODOLOGY

4.0 Introduction

Our aim in this chapter being to explicitly give an explanation of the research design and methodology thereof. In this section we will first restate our research questions so as to vigorously elucidate what the researchers intend to achieve in this research study. It is also appropriate to venture into the targeted population, the size of our main sample as well as sub-samples, sample designing, data collection and data analysis etc.

4.1 Research Questions

Our research study seek to provide solutions to the research questions:

(a) Does Environmental Kuznets Curve (EKC) hold in the Global Political Economy (GPE)?

(b) Is there any relationships between trade and environmental pollutants for the global political economy?

(c) What is the nexus between environmental pollutants and energy in the context of global political economy?

(d) Are institutions and the financial system in the global political economy strong enough to support Sustainable Development Goals?

(e) Do we have any causality relationship between economic growth, environmental pollution, energy, trade and investment in the global political economy?

4.2 Research Design

Mouton (2007) lamented that research designs provide some glue to hold the research project together and shows major parts of a research project, that is samples, groups, programs and also techniques employed and demonstrate how they work together so as to provide solutions to research questions. Rowley (2003) added that research designs logically marry data to be gathered and findings expected to the research questions of the study. The research study will employ a case study design. As mooted by O'Leary (2010), case study is technique to study some social element using detailed descriptions as well as analysis of one situation or case, for example, robust study of individuals, settings, groups, episodes or events. As such, case study research design delves into depth since it require the researcher to dig and dig deeper. Saunders et al (2016) employed a definition used by Yin (2014) to define case study as an in-depth investigation of a subject of phenomenon in its natural setting. This trio also alluded that a "CASE", in case study research may be persons, groups, organisations, associations, change processes, events etc. The trio also mentioned Flyvberg (2011) who lamented that selecting the case to investigate and crafting demarcations for the study is important for case study research. As such a case study seeks an understanding of some dynamics inherent in a topic within a certain setup and/or context, (Eisenhardt 1989, Eisenhardt and Graebner 2007). Saunders et al (2016) further alluded that understanding some dynamics of a topic relates to some relationships between subjects in a case and its context. According to O'Leary (2010), there is a propensity to delve into details, dig into contexts and really get a handle on sound experience of the individuals, events, communities, groups and/or organisations you are exploring. This has an objective to go deeper into what is generally practicable with other techniques such as large scale survey research. Further, case study may make it possible for researchers to burst

into both quantitative and/or qualitative territories, O'Leary (2010). Yin (2014) in Saunders et al (2016) also voiced and made a distinction between four case study research techniques basing on two major categories such as single-case versus multiple-cases and holistic-case versus embedded-case. In regard to this, a single-case research study is appropriate in situation that seek to consider a critical case or else a unique case. Saunders et al (2016) also pointed that a single case may be chosen deliberately because of its appropriateness or due to its ability to provide a chance to observe a situation which a few have considered before. Notwithstanding all this, what is important is for a researcher to decide an actual case. A multiple case study is also another dimension available for consideration by researchers, the rationale being to observe the replicability of findings across cases. According to Saunders et al (2016), cases will be selected with care with similar results being predicted from each case and according to Yin (2014), in Saunders et al (2016), it is called, "literal replication". In other sets of cases, they are selected when factor specific context is different and some effect of this difference is of expected results made by the researcher. This according to Yin (2014) is called theoretical replication. Saunders et al (2016) alluded that Yin's holistic versus embedded cases is a unit of analysis. In this case the researcher chooses a single organisation as a case, then when a research study is concerned with the organisation as a whole, then it becomes a holistic-case study. On the contrary, when researchers choose an organisation and then decides to consider a multiplicity of logical subunits within the same entity, for example departments and work groups, this will demand multiple units of analysis, hence making the research study an embedded case study. Based on the foregoing, it is clear that our study on the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment will qualify as an embedded case study. This is because the study will consider 115 economies around the globe which were candidate economies from a global population of countries. These global countries will then be sub divided into various groups such as Africa, Asia, Europe and the Americas. This will effectively make our cases 5 that is the Global case, African case, European case and the Americas case. However, in order to get a hand to understanding

the Environmental Kuznets curve based on traditional approaches to it, the research study have also considered a special case of Emerging economies around the globe by considering atmospheric indicators only. However, this does not take away the qualities of our study as a multiple case.

4.3 Research Philosophy

Saunders et al (2016), alluded that a research philosophy is used in relation to a myriad of assumptions and beliefs about knowledge development. Burrell and Morgan (1979), in Saunders et al (2016) alluded that a researcher makes a multiplicity of these types of assumptions whether consciously or unconsciously throughout the research study. Such assumptions incorporates epistemological assumption, ontological assumption and axiological assumption. Saunders et al (2016) defined ontology assumption as that which talk about the nature of reality. Burrell and Morgan (2016) alluded to epistemological assumptions as concerns about knowledge that is what makes valid, legitimate and acceptable gnostic and how it could be communicated to others. Whereas, axiology relates to importance of ethics and values throughout the research study process. Crotty (1998) mooted in Saunders et al (2016) that the above assumptions mould the understanding of research questions, methods to be employed and the interpretation of results. This study will therefore be informed by positivism approach. According to Delanty (2005), positivism considers that scientific knowledge can be verified positively as opposed to dogmatism, speculations and superstitions; thus positivistic knowledge is rooted in sure and certain foundations. Saunders et al (2016) alluded to positivism as being a philosophical position of natural scientists and involves employing observable social realties so as to be able to make generalisations which are law-like. According to the trio, positivism leads to unambiguous and accurate knowledge and is credited to Francis Bacon, Auguste Comte and the Vienna Circle. Denicolo and Becker (2012), lamented that in a positivist technique, one should incorporate in its design some predetermined measurable variables in which some will be independent while the effect on some dependent variables will be observable. To this end, this is

exactly what this research study seeks to achieve. The study will investigate the environmental Kuznets curve by collecting data on environmental variables as well as economic variables and then manipulate it in a positivistic way. This approach will be considered the gold standard in examining the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment.

4.4 Research Population

The study considered all economies around the globe, however only 115 qualified to be part of the research study due to the availability of data for our intended variables so as to be able to provide practical solutions to our research questions. These 115 global economies were further subdivided into their various regional groupings such as 29 African economies, 29 Asian economies, 34 European economies and 22 the Americas. Our research study included a separate special case study for 24 emerging economies. The reason for the categorisation of countries as above was to contextualise the study on the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment. This was done in a way that could enhance robust practical policy recommendations for specific groups of countries due to regional specific macroeconomic dynamics. In this vein it was also made possible to identify the main regional source of environmental damage in the global political economy.

4.5 Data Collection and Sorting Techniques

The research study used data retrieved from World Development Indicators (WDI) of the World Bank (WB) (2019) for the global economies. The collection of data was done for environmental pollutants like atmospheric indicators and land related indicators, and economic variables. Atmospheric pollutants such as carbon-dioxide emission, methane emission, nitrous-oxide emission, PM2.5 air pollution and other greenhouse gas emissions were collected, while land indicators included arable land, forest area, permanent cropland, total fisheries production and total natural resources rents. Both atmospheric

indicators and land indicators were further developed into atmospheric indices and land degradation indices respectively by using principal component analysis (PCA). A third index was developed by combining atmospheric index and land degradation index, also using principal component analysis to achieve this. In figures 1, 2, and 3 below we show the Principal Component Analysis (PCA) proportions of each indicator in our indices:

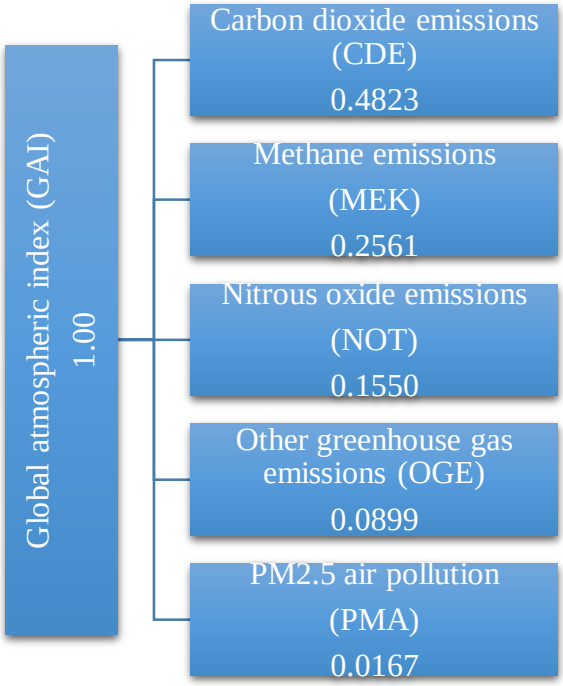

Figure 1: Proportions of atmospheric indicators

The PCA proportins of atmospheric indicators, land indicators, atmosphiric indices and land degradation indices for African economies, Asian economies, European economies and the Americas given in in figures 4, 5, 6…….. and 15 in Apendices 7, 8, 9 …… and 18 respectively. To make it possible to investigete the impact of economic variables on environmental variables, the research study deployed GDP per-capita (constant 2010 US$) (GDP), a square of GDP per-capita (GDP2), a cubic polynomial function of GDP per-capita (GDP3), GDP per unit of energy use (PPP$ per Kilogram of oil equivalent) (EEU), importations of goods and services (constant 2010 US$) (IGS), exportations of goods and services (constant 2010 US$) (EGS), industry (icluding construction) value added (constant 2010 US$) (ICV),

Foreign Direct Investment net-inflows (% of GDP) (FDI), Domestic Credit provided by financial sector (% of GDP) (DCP) and renewable enrgy consumption (% of total energy consumption).

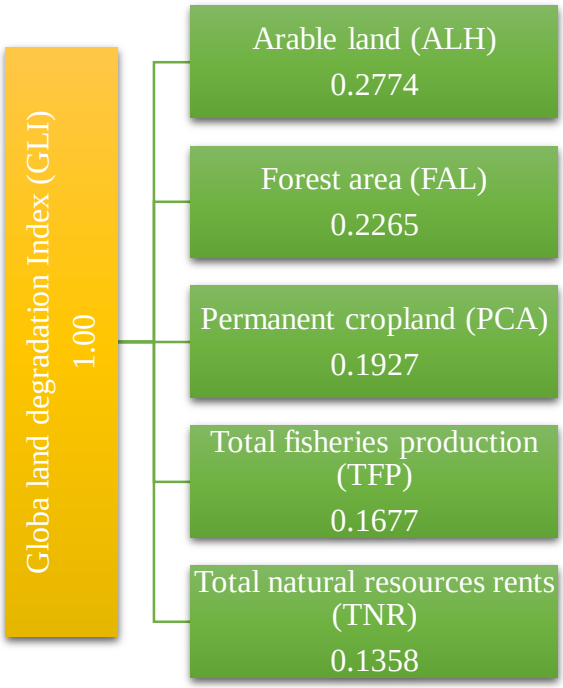

Figure 2: Proportion of land indicators

The variables for our special case of 24 emerging countries included carbon-dioxide emissions (metric tones per-capita) (CO2), fossil-fuel energy consumption (% of total energy consumption) (FFC), nitrous-oxide emissions (thousand metric tons per-capita) (NOE), GDP per capita (Constant 2010 US$) (GDP), the square of GDP per capita (GDP2), industry value (including construction) added (constant 2010 US$) (IVA), Domestic Credit provided by financial sector (as a % of GDP) (DCF), travel services (% of commercial services exports) (TRS), transport services (% of commercial services exports) (TSP), Renewable energy consumption (% of total energy consumption) (REC) and electric power consumption (kWh per capita) (EPC). These variable have been identified as important in understanding the macroeconomic dynamics in emerging economies and were collected with a view to address issues related to the choice of data in the environmental Kuznets curve

context. The data was retrieved from World Developmemt Indicators (WDI) of the World Bank (2018) and had some missing values making the panels unbalanced.

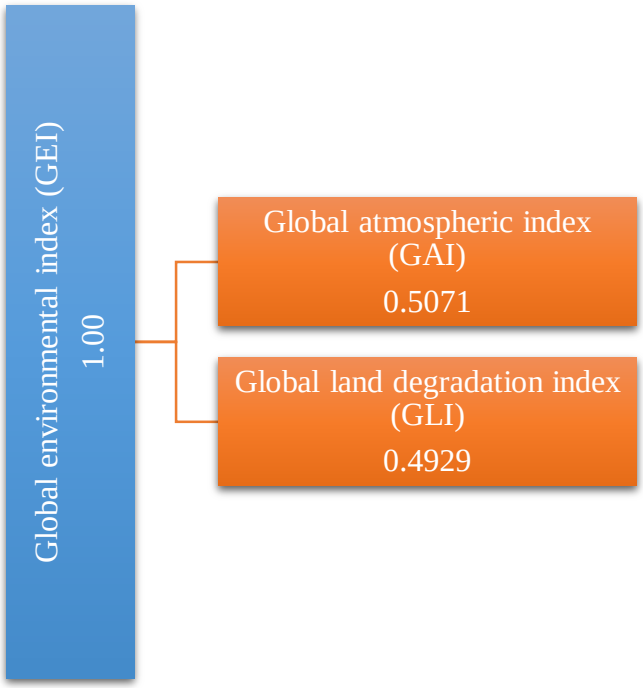

Figure 3: Proportions of global atmospheric index and global land degradation index.

4.6. Empirical Model

The research study employed two main empirical techniques in a way that provide robust results and allow for sound policy recommendations. The first estimation technique was a dynamic system since it incorporated the lag of dependent variable and dependent variables had the potential of joint endogeneity due to their possible correlation with the disturbance term. The second technique was adopted for use in crafting robust policy recommendations. Therefore in order to make efficient and consistent estimates, the Generalised Method of Moments (GMM), panel data technique was deployed, particularly the Arellano and Bover (1995); Blundell and Bond (1998) econometric technique was used. The Dumitrescu-Hurlin (2012) technique was employed for causality analysis with a view to unleash sound

public policy and regulatory interventions. The methodology structuring employed in the research study is graphically presented as figure 16:

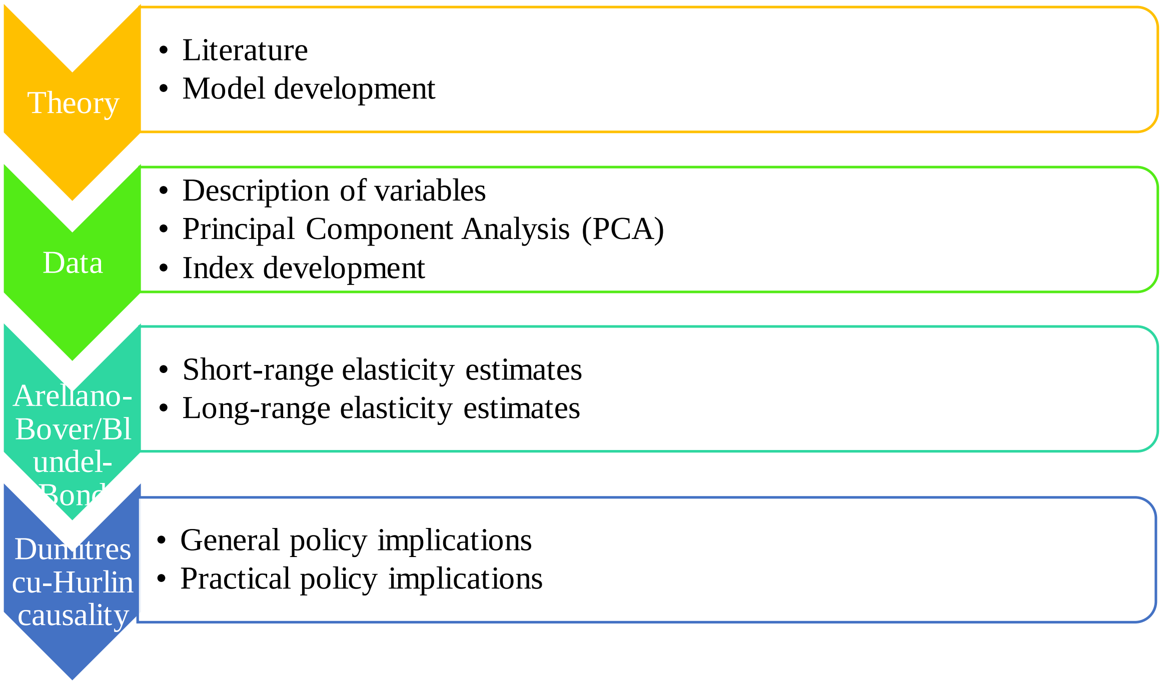

Figure 16: Methodological structure

4.6.1 Panel Generalised Method Of Moment (GMM) Estimation

According to Poveda (2011), the system GMM estimator employs regression equations for both levels and differenced variables each with associated specific instruments. Therefore, following Hove and Turgut (2019), the study employed the Arellano-Bover (1995)/Blundell-Bond (1998) econometric technique. The following equation provides its general form as:

$$x_{it} = \emptyset x_{i,t-1} + {y^a}_{it}\beta + \varphi_i + \varepsilon_{i,t} \text{ .... (2)}$$

Some unobserved country-specific effects are eliminated by making a re-specification of equation 2 above as below:

$$x_{i,t} - x_{i,t-1} = \emptyset\left(x_{i,t-1} - x_{i,t-2}\right) + \beta\left(y_{i,t} - y_{i,t-1}\right) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \text{............... (3)}$$

The specification in equation 3 above is meant to use the instruments selection for two main reasons according to Poveda (2011). The initial problem is to do away with endogeneity of the independent variables (y), which takes the form of correlations with respect to independent factors and a disturbance term. A

second issue being that, a new disturbance term $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$ becomes correlated to a new lag of dependent factor, $(x_{i,t-1} - x_{i,t-2})$. According to Poveda (2011), such a specification allows for the possibility of simultaneity and reversed causal relations are accommodated rather than making an assumption of the existence of no correlation between the dependent and the disturbance term at all lags and leads (strict exogeneity). Therefore, the assumption of weak exogeneity has more flexibility and was adopted, with the notion that current dependent factors become influenced by their past and current values of dependent factor, whoever, future disturbances have no influence on them. The following moment conditions are relevant under assumptions that the disturbance term has no serial correlation and that the independent variables have weak exogeneity:

$$E\left[x_{i,t-z}\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \;\; \forall\, z \geq 2; t = 3, \ldots, T \quad \ldots\ldots (4)$$

$$E\left[y_{i,t-z}\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \;\; \forall\, z \geq 2; t = 3, \ldots, T \quad \ldots\ldots (5)$$

A system Generalised Method of Moments (GMM) rely on moment conditions in equation (4) and (5) above. Poveda (2011), noted that though the System GMM is asymptotically consistent, it is plagued with a plethora of little asymptotic precision and enormous bias under conditions of small samples of data and this could be dealt with by incorporating levels regression equations. As mooted by Blundell-Bond (1997), and Alonso-Borrego-Arellano (1999) in Poveda (2011) that in the event that the lag of dependent variables and independent variables exist over some time, lag of level factors become weak-instruments of a differenced equation. This will therefore consequently impact on both small sample and asymptotic robustness of differenced estimators. Further, Griliches and Hausman (1986) noted in Poveda (2011) that the simple differenced estimator is marred by errors relating to measurement since differencing aggravates bias because variable errors decrease the ratio of signal to noise. According to Poveda (2011), the Arellano and Bover (1995) system GMM technique reduces the likely bias and lack of precision inherent in the traditional differenced estimator of Blundell and Bond (1997). Up to this stage, the country specific factors still exist, however it can be managed by instrumental variables. Sufficient instruments for level equations becomes the

lags of differenced variables subject to the assumption that, though the levels of independent variables are correlated with country specific effects, there should not be some correlations with respect to the differenced variables and country specific-effects. The above assumption draws from the stationary process presents below as:

$E[x_{i,t+p}\varphi_i] = E[x_{i,t+q}\varphi_i]$ and $E[y_{i,t+p}\varphi_i] = [x_{i,t+q}\varphi_i]\ \forall\ p\ and\ q$…….. (6)

Therefore, more moment conditions for this portion of the system will be represented as below:

$E[(x_{i,t-z} - x_{i,t-z-1}) \cdot (\varphi_i + \varepsilon_{i,t})] = 0$ for $z = 1$ …….. (7)

$E[(y_{i,t-z} - y_{i,t-z-1}) \cdot (\varphi_i + \varepsilon_{i,t})] = 0$ for $z = 1$ …….. (8)

If we apply some moment conditions in equations (7) and (8), as well as follow Arellano-Bond (1991) and also Arellano-Bover (1995), the technique employs the Generalised Method of Moments (GMM) estimator to craft a robust estimation of variables in question. Poveda (2011) further alluded that the weighting matrix in a GMM estimator could be some symmetric, positive and obvious matrix, where a robust GMM technique becomes achievable through application of an adjustment matrix correspondent with some variance-covariance of moment conditions. Therefore in the research study, a system Generalised Method of Moments (GMM) is adopted in a way that will make it possible to deal with weaknesses inherent in previous studies which employed fixed as well as random effects linear techniques. As noted by Joshi and Beck (2018), in Hove and Turgut (2019), these techniques make use of linear models which could be ordinary least-squares or else generalised least-square estimations. Further these techniques have drawn critics on the basis of bearing the problems associated with endogeneity and heteroskedasticity, leading to less robust and unreliable estimates under dynamic situations, Carson (2009) and Lee et al (2010) in Hove and Turgut (2019). In this regard, this study makes a unique methodological contribution by addressing these concerns through employing Arellano-Bover (1995)/Blundell-Bond (1998) techniques as being explicated in this foregoing.

4.6.1.1 Empirical Models For Global Economies

Since this study examined the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment in the environmental Kuznets curve context, the reduced form of an improved Arellano-Bover/ Blundell-Bond (1995;1998) is given as shown below:

$$\Delta GAI_{i,t} = \beta_i \Delta GAI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (9)$$

$$\Delta GLI_{i,t} = \beta_i \Delta GLI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (10)$$

$$\Delta GEI_{i,t} = \beta_i \Delta GEI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (11)$$

Where GAI is Global atmospheric index, GAI_{t-1} represents the first lag of Global atmospheric index, GLI represents Global land degradation index, GLI_{t-1} being the first lag of Global land degradation index, GEI is Global environmental index, GEI_{t-1} is for the first lag of Global environmental index, GDPC being real GDP per-capita, $GDPC^2$ shows square of real GDP per-capita, $GDPC^3$ being a cubic polynomial function of real GDP per-capita, ICV represent industry value added including construction, EEU is GDP per unit of energy use, REC shows renewable energy consumption, IGS is importations of goods and services, EGS representing exportations of goods and services, FDI is Foreign Direct Investments, DCP is the Domestic Credit provided by financial sector, ε shows the disturbance or error term and Δ represents first difference operator. The same representation in equations is done below for Africa, Asia, Europe and the Americas.

4.6.1.2 Empirical Models For African Economies

The reduced form of an improved Arellano-Bover/ Blundell-Bond (1995;1998) for African economies is given as shown below:

$$\Delta AFAI_{i,t} = \beta_i \Delta AFAI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (12)$$

$$\Delta AFLI_{i,t} = \beta_i \Delta AFLI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (13)$$

$$\Delta AFEI_{i,t} = \beta_i \Delta AFEI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (14)$$

Where AFAI is African atmospheric index, $AFAI_{t-1}$ represents the first lag of African atmospheric index, AFLI represents African land degradation index, $AFLI_{t-1}$ being the first lag of African land degradation index, AFEI is African environmental index, GEI_{t-1} is for the first lag of global environmental index. All other variables remain as explained in equations 9, 10 and 11 above.

4.6.1.3 Empirical Models For Asian Economies

The reduced form of an improved Arellano-Bover/ Blundell-Bond (1995;1998) for Asian economies is given as shown below:

$$\Delta ASAI_{i,t} = \beta_i \Delta ASAI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (15)$$

$$\Delta ASLI_{i,t} = \beta_i \Delta ASLI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (16)$$

$$\Delta ASEI_{i,t} = \beta_i \Delta ASEI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (17)$$

Where ASAI is Asian atmospheric index, $ASAI_{t-1}$ represents the first lag of Asian atmospheric index, ASLI represents global land degradation index, $ASLI_{t-1}$ being the first lag of Asian land degradation index, ASEI is Asian environmental index, $ASEI_{t-1}$ is for the first lag of Asian environmental index. All other variables remain as explained in equations 9, 10 and 11.

4.6.1.4 Empirical Models For European Economies

The reduced form of an improved Arellano-Bover/ Blundell-Bond (1995;1998) for European economies is given as shown below:

$$\Delta EUAI_{i,t} = \beta_i \Delta EUAI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (18)$$

$$\Delta EULI_{i,t} = \beta_i \Delta EULI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (19)$$

$$\Delta EUEI_{i,t} = \beta_i \Delta EUEI_{i,t-1} + \beta_{i1} \Delta GDPC_{i,t} + \beta_{i2} \Delta GDPC^2{}_{i,t} + \beta_{i3} \Delta GDPC^3{}_{i,t} + \beta_{i4} \Delta ICV_{i,t} + \beta_{i5} \Delta EEU_{i,t} + \beta_{i6} \Delta REC_{i,t} + \beta_{i7} \Delta IGS_{i,t} + \beta_{i8} \Delta EGS_{i,t} + \beta_{i9} \Delta FDI_{i,t} + \beta_{i10} \Delta DCP_{i,t} + \Delta \varepsilon_{i,t} \quad (20)$$

Where EUAI is European atmospheric index, $EUAI_{t-1}$ represents the first lag of European atmospheric index, EULI represents European land degradation index, $EULI_{t-1}$ being the first lag of European land degradation index, EUEI is European environmental index, $EUEI_{t-1}$ is for the first lag of European environmental index. All other variables remain as explained in equations 9, 10 and 11 above.

4.6.1.5 Empirical Models For The Americas

The reduced form of an improved Arellano-Bover/ Blundell-Bond (1995;1998) for the Americas is given as shown below:

$$\Delta AMAI_{i,t} = \beta_i \Delta AMAI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (21)$$

$$\Delta AMLI_{i,t} = \beta_i \Delta AMLI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (22)$$

$$\Delta AMEI_{i,t} = \beta_i \Delta AMEI_{i,t-1} + \beta_{i1}\Delta GDPC_{i,t} + \beta_{i2}\Delta GDPC^2{}_{i,t} + \beta_{i3}\Delta GDPC^3{}_{i,t} + \beta_{i4}\Delta ICV_{i,t} + \beta_{i5}\Delta EEU_{i,t} + \beta_{i6}\Delta REC_{i,t} + \beta_{i7}\Delta IGS_{i,t} + \beta_{i8}\Delta EGS_{i,t} + \beta_{i9}\Delta FDI_{i,t} + \beta_{i10}\Delta DCP_{i,t} + \Delta\varepsilon_{i,t} \quad (23)$$

Where AMAI is the Americas atmospheric index, $AMAI_{t-1}$ represents the first lag of the Americas atmospheric index, AMLI represents the Americas land degradation index, $AMLI_{t-1}$ being the first lag of the Americas land degradation index, AMEI is the Americas environmental index, $AMEI_{t-1}$ is for the first lag of the Americas environmental index. All other variables will remain as explained in equations 9, 10 and 11 above.

4.6.1.6 Empirical Models For Emerging Economies

Since we have considered a special case of emerging economies in our research study by employing atmospheric indicators only, it is appropriate to make a separate representation of the empirical model. Therefore an improved Arellano-Bover/Blundel-Bond (1995; 1998) reduced form empirical technique for Emerging economies is shown as:

$$\Delta CO2_{i,t} = \beta_i \Delta CO2_{i,t-1} + \beta_{i1}\Delta GDP_{i,t} + \beta_{i2}\Delta GDP^2{}_{i,t} + \beta_{i3}\Delta IVA_{i,t} + \beta_{i4}\Delta DCF_{i,t} + \beta_{i5}\Delta TRS_{i,t} + \beta_{i6}\Delta TSP_{i,t} + \beta_{i7}\Delta REC_{i,t} + \beta_{i8}\Delta EPC_{i,t} + \Delta\varepsilon_{i,t} \quad (12)$$

$$\Delta FFC_{i,t} = \beta_i \Delta FFC_{i,t-1} + \beta_{i1}\Delta GDP_{i,t} + \beta_{i2}\Delta GDP^2{}_{i,t} + \beta_{i3}\Delta IVA_{i,t} + \beta_{i4}\Delta DCF_{i,t} + \beta_{i5}\Delta TRS_{i,t} + \beta_{i6}\Delta TSP_{i,t} + \beta_{i7}\Delta REC_{i,t} + \beta_{i8}\Delta EPC_{i,t} + \Delta\varepsilon_{i,t} \quad (13)$$

$$\Delta NOE_{i,t} = \beta_i \Delta NOE_{i,t-1} + \beta_{i1} \Delta GDP_{i,t} + \beta_{i2} \Delta GDP^2{}_{i,t} + \beta_{i3} \Delta IVA_{i,t} + \beta_{i4} \Delta DCF_{i,t} + \beta_{i5} \Delta TRS_{i,t} + \beta_{i6} \Delta TSP_{i,t} + \beta_{i7} \Delta REC_{i,t} + \beta_{i8} \Delta EPC_{i,t} + \Delta \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Where carbon dioxide emissions is presented as CO2, the lag of carbon dioxide emissions being $CO2_{t-1}$, fossil-fuel energy consumption being FFC, lag fossil-fuel energy consumption is shown by FFC_{t-1}, nitrous oxide emissions is shown as NOE, the lag of nitrous oxide emissions being NOE_{t-1}, real GDP per-capita being shown as GDP, square of real GDP per-capita being shown as GDP^2, Industry value-added including construction being IVA, Domestic Credit provided by financial sector being represented by DCF, Transport services being TRS, Travel services is TSP, Renewable energy consumption being REC, electric power energy consumption is shown as EPC, ε is the disturbance or error-term and ∆ represents first difference operator.

As revealed by equations (9) up to (14) there exists a non-linear relationship with respect to environmental indicators and growth of the economy, and the models incorporate the lag of the dependent variables in all cases. Therefore the results from our modelling process will be free from simultaneity, heterogeneity and serial correlation due to the incorporation of lag of dependent variable as alluded in Arellano and Bond (1999).

4.6.2 Dumitrescu-Hurlin Non-Causality Test Technique

This technique was developed by Dumitrescu and Hurlin (2012) as non-causality testing strategy for dissimilar panels. According to Gorus and Aslan (2019), two dimensions of heterogeneity are accounted for in this techniques,that is that of the causality model used and that for the causal relations. Zeren and Ari (2013) also emphasised that the Dumitrescu-Hurlin non-causality technique accounts for the heterogeity of causality relations as well as heterogeneity of the model employed. Further, Gorus and Aslan (2019) revealed a multiplicity of benefits of this technique. The first benefit the duo noted was that, the Dumitrescu-Hurlin non-causality testing technique is simple to implement. A second benefit supported by results from Monte-Carlo

simulation is that the panel statistics increases the robustness of the non-causality tests, including that for small samples with small number of panels and time components. The third benefit is that the Dumitrescu and Hurlin non-causality test statistic does not require any specific panel estimations. The fourth benefit as explicated by Dumitrescu and Hurlin (2012) is that the technique is implementable under conditions of balanced and unbalanced panel data series. The specification for the Dumitrescu and Hurlin (2012) as also restated by Zeren and Ari (2013) in Gorus and Aslan (2019) is provided below as:

$$y_{i,t} = a_i + \sum_{j-1}^{N} \varphi^n{}_i y_{i,t-n} + \sum_{j-1}^{N} \beta^n{}_i x_{i,t-n} + \varepsilon_{i,t} \quad \text{..... (15)}$$

In equation (15) above, x and y represents observable variables for N countries and T time, $\beta_i = (\beta^1{}_i, \ldots., \beta^N{}_i$' and a_i being assumed fixed all the time. The null hypothesis under this non-causality testing technique is that, no causality with respect to any panels. Alternatively, the null hypothesis assumes at least a single causality is there between the panels and is presented as:

$H_0 = \beta_i = 0$, for $\forall_i = 1, \ldots, N$

$$H_1 = \begin{pmatrix} \beta_i = 0 \; for \; \forall_i = 1, \ldots.., N_1 \\ \beta_i \neq 0 \; for \; \forall_i = N_1 + 1, \ldots.., N \end{pmatrix}$$

The non-causality test results will be instrumental in crafting robust public policy recommendations for the panel of economies considered in our research study.

4.7 Chapter Summary

In the chapter, researchers delved into, a recap of the research questions, research study design, research study philosophy, research study population, data gathering and sorting, empirical model in which the panel generalised method of moments (GMM) was considered with special emphasis on the empirical models for both global and emerging economies. The next chapter will consider empirical results from our data analysis.

CHAPTER 5

RESULTS

5.0 Introduction

This chapter presents the results of the research study on the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment for the global economies, African economies, Asian economies, European economies and the Americas. Therefore section 5.1 presents the global results, 5.2 presents African results, in section 5.3 we present Asian results, while section 5.4 will present European results and section 5.5 will delve into results for the Americas. In section 5.6 researchers will present results for a special case of emerging economies.

5.1 Global Results

In this subsection we present the results for the global sample comprising 115 countries from around the world. The results for panel system GMM estimations are presented in table 2 below for Global atmospheric index (GAI), Global land degradation index (GLI) and Global environmental index (GEI).

Table 2: Global panel GMM estimation results of environmental sustainability

Variables	MODEL 1	MODEL 2	MODEL 3
GAI (LI)	0.4783736 (0.0176585)***		
GLI (LI)		0.9922675 (0.0088331)***	
GEI (LI)			0.4459107 (0.017921)***
GDPC	0.000016 (2.13E-06)***	-2.42E-08 (5.03E-08)	5.36E-06 (1.02E-06)***
GDPC2	-6.53E-10 (6.12E-11)***	-1.70E-12 (1.44E-12)	-2.87E-10 (2.92E-11)***
GDPC3	5.29E-15 (5.05E-16)***	2.59E-17 (1.20E-17)**	2.36E-15 (2.41E-16)***
ICV	1.87E-13 (3.26E-14)***	7.25E-15 (1.37E-15)***	1.18E-13 (1.66E-14)***
EEU	-0.003581 (0.0003311)	2.33E-06 (4.07E-06)	0.0000125 (0.000162)
REC	0.0019033 (0.0002984)***	7.87E-06 (6.84E-06)	0.0009243 (0.0001426)***
IGS	1.61E-13 (4.88E-14)***	-2.10E-15 (1.56E-15)	8.08E-14 (2.42E-14)***
EGS	-2.32E-13 (4.34E-14)***	-1.66E-15 (1.46E-15)	-9.82E-14 (2.18E-14)***
FDI	0.0001984 (0.0001247)	-8.68E-08 (3.04E-06)	0.0000933 (0.0000611)
DCP	0.0001163 (0.0000863)	4.58E-06 (1.91E-06)**	-9.39E-06 (0.0000398)
Constants	-0.047656 (0.018255)***	0.0000482 (0.0006084)	0.0143826 (0.0082219)*
Observations	2070	2070	2070
Number of countries	115	115	115
Wild Chi-square	827.25***	16669.37***	711.17***

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

The results in table 2 above reveal that the real GDP per capita has a positive relationship with global atmospheric index (GAI), a negative relationship exists with respect to the square of GDP per capita and global atmospheric index and a positive relationship holds in respect of the cube of GDP per capita and global atmospheric index. Industry value added including construction, renewable energy consumption and imports of goods and services has a positive and significant relation with global atmospheric index. Exports of goods and services as well as the constant term revealed a negative relationship with global atmospheric index; while GDP per unit of energy use, foreign direct invest and domestic credit provided had non-significant negative, positive and positive relations with the global atmospheric index.

The case for global land degradation index (GLI) in table 2 revealed that real GDP per capita, its square, imports and exports of goods and services and foreign direct investment had a non-significant negative relationship with global land degradation index. The cube of GDP per capita, industry value added including construction and domestic credit provided by financial sector have revealed a positive and significant relation with global environmental index. On the other hand, GDP per unit of energy use, renewable energy consumption and constant term revealed a non-significant positive relationship with global land degradation index.

In respect of global environmental index (GEI), the results indicate that a positive relationship exists with per capita GDP, a negative relation in respect of the square of real GDP per capita and positive with respect to the cube of per capita GDP. The results further revealed that a significant and positive relationship holds with respect to industry value added including construction, renewable energy consumption, imports of goods and services, and a constant term with global environmental index. Exports of goods and services have indicated a negative and significant relationship with global environmental index; while foreign direct investment has a positive and non-significant relation and domestic credit provided by financial sector shows a negative and

non-significant relationship with global environmental index too. In all cases, the lag of our dependent variables was positive and significant. The results with respect to Global economies are presented graphically in figure 17 below:

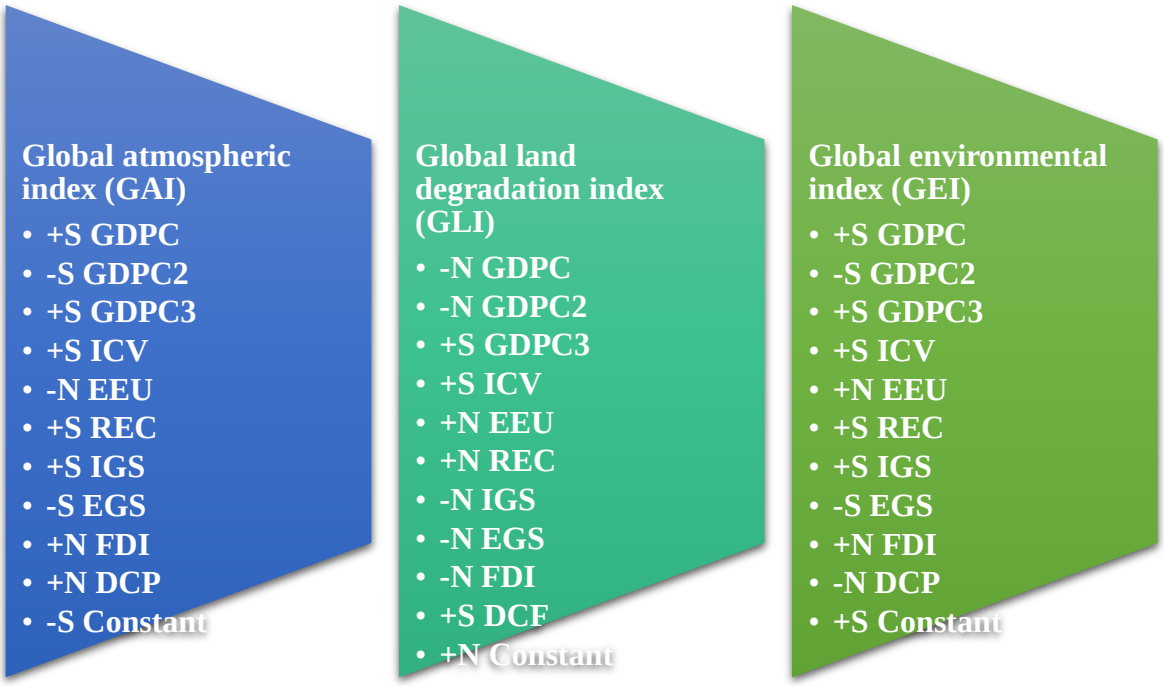

Figure 17: Panel system GMM graphical results for Global economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.1.1 Short-Term And Long-Term Elasticity Estimates For Global Economies

The results in table 3 below show short term and long term elasticity estimates for the global economies:

Table 3: Short-term and Long-term elasticity estimates for Global economies

Variable	GAI	GLI	GEI
Short-term elasticity			
GDPC	0.000016	-2.42E-08	5.36E-06
GDPC2	-6.53E-10	-1.70E-12	-2.87E-10
GDPC3	5.29E-15	2.59E-17	2.36E-15
ICV	1.87E-13	7.25E-15	1.18E-13
EEU	-0.003581	2.33E-06	0.0000125
REC	0.0019033	7.87E-06	0.0009243
IGS	1.61E-13	-2.10E-15	8.08E-14
EGS	-2.32E-13	-1.66E-15	-9.82E-14
FDI	0.0001984	-8.68E-08	0.0000933
DCP	0.0001163	4.58E-06	-9.39E-06
Constants	-0.047656	0.0000482	0.0143826
Long-term elasticity			
GDPC	0.00003067329414	-1034.594245	-10.82857944
GDPC2	-19.17080884	-1551.891368	-18.04763239
GDPC3	-28.75621326	-2198.512771	-27.07144859
ICV	-24.92205149	-1939.86421	-23.46192211
EEU	-0.006865066645	-775.9456838	0.00002255954049
REC	0.00648780046	-775.9456838	0.001668142662
IGS	-24.92205149	-1939.86421	-25.26668535
EGS	-24.92205149	-1939.86421	-25.26668535
FDI	0.0003803488474	-1034.594245	0.0001683844102
DCP	0.0002229565068	-775.9456838	-10.82857944
Constants	-0.09136040661	0.006233430327	0.02595718777

Source: Researchers' computations

The short-term elasticity results presented in table 3 above are similar to panel GMM results for our global panel of 115 countries in table 2 above for global atmospheric index (GAI), global land degradation index (GLI) and global environmental index (GEI). Generally, long-term elasticity estimates reveal larger values compared to our short-term results. The results in table 3 with respect to global atmospheric index reveal that in the long-range real GDP per capita, renewable energy consumption, foreign direct investment and domestic

credit provided by financial sector has a positive impact on the global atmospheric index.

On the other hand, long-range elasticity estimates pointed that the square of GDP per capita, its cube, industry value added including construction, GDP per unit of energy use, imports and exports of goods and services as well as the constant term have a negative relation with global atmospheric index. The long-term elasticity estimates in table 3 above indicated that GDP per capita, its square and cube, industry value added including construction, GDP per unit of energy use, renewable energy consumption, Imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector has a negative relationship with global land degradation index. It was also revealed that the constant term has a positive relationship with global land degradation index in the long term.

Table 3 above also indicated that in the long-range, real GDP per capita, its square and cube, industry value addition including construction, imports and exports of goods and services and domestic credit provided by financial sector impacts negatively on global environmental index. Furthermore, the results revealed that long-range elasticity estimates with respect to GDP per unit of energy use, renewable energy consumption and the constant term positively impacts on global environmental index.

5.2 African Results

In this subsection we present African results for African atmospheric index (AFAI), African land degradation index (AFLI) and African environmental index (AFEI). Thus the results for 29 African countries are shown in table 5 below:

Table 5 : African panel GMM estimation results of environmental sustainability

Variables	MODEL 1	MODEL 2	MODEL 3
AFAI (LI)	0.7079658 (0.0257483)***		
AFLI (LI)		0.7832035 (0.0281885)***	
AFEI (LI)			0.775246 (0.0249514)***
GDPC	-1.89E-06 (2.19E-06)	1.92E-06 (4.79E-07)***	2.66E-07 (6.76E-07)
GDPC2	2.55E-10 (2.24E-10)	-1.56E-10 (5.59E-11)***	2.27E-11 (7.99E-11)
GDPC3	-8.56E-15 (6.79E-15)	3.64E-15 (1.80E-15)**	-1.57E-15 (2.58E-15)
ICV	6.54E-14 (5.33E-14)	-1.08E-13 (2.09E-14)***	-3.11E-14 (2.80E-14)
EEU	-3.26E-06 (0.0000546)	-0.0000315 (0.0000184)*	-0.000036 (0.0000243)
REC	0.000042 (0.0000546)	-0.0000173 (0.0000182)	-8.93E-06 (0.0000237)
IGS	4.44E-14 (3.14E-14)	3.59E-14 (1.34E-14)**	3.73E-14 (1.69E-14)**
EGS	6.08E-15 (4.21E-14)	3.03E-14 (1.77E-14)*	2.17E-14 (2.30E-14)
FDI	0.0001259 (0.0000593)**	2.07E-06 (0.0000224)	0.0000339 (0.0000286)
DCP	-0.0000557 (0.0000225)***	-0.0000552 (8.37E-06)***	-0.0000414 (0.0000115)***
Constants	0.0053976 (0.0058122)	0.0072279 (0.0072279)***	0.0054892 (0.0021046)***
Observations	522	522	522
Number of countries	29	29	29
Wild Chi-square	1219.68***	1742.53***	1807***

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

The results in table 5 above in respect of African atmospheric index (AFAI) indicated that real GDP per capita has a negative but non-significant relationship, its square has a positive and non-significant relation and its cube revealed a negative and non-significant relationship. Industry value added including construction, renewable energy consumption, imports and exports of goods and services as well as the constant term has a positive and non-significant relationship with African atmospheric index. Further, the results indicate that there is a positive and negative significant relationship between African atmospheric index and foreign direct investment and domestic credit provided by financial sector respectively.

The results in respect of African land degradation index shows a positive and significant relationship with per capita GDP, a significantly negative relationship with its square and a positive and significant relationship with the cube of real GDP per capita. The results in table 5 further reveal that industry value addition including construction, GDP per unit of energy use and domestic credit provided by financial sector has a significantly negative relationship with African land degradation index. Renewable energy consumption has a negative and non-significant relationship with African land degradation index. Whereas, the results in respect of imports and exports of goods and services and a constant term exposed a significantly positive relationship with African land degradation index.

On the other hand, foreign direct investment was positive and not significant with respect to African land degradation index. In the case of African environmental index presented in table 5 above, real GDP per capita is positive and not significant, the square of per capita real GDP is positive and non-significant with respect to African environmental index. The cube of GDP per capita had a negative and non-significant relation with African environmental index, the same was in the case of industry value added including construction, GDP per unit of energy use and renewable energy consumption. Imports of goods and services and a constant term revealed a significant positive

relationship with African environmental index; while exports of goods and services and foreign direct investments revealed a non-significant negative relationship to it, whereas domestic credit provided by financial sector had a significant and negative relation to the same. The lag of the dependent variable had positive relationship with African atmospheric index, African land degradation index and African environmental index and it was significant in all cases. The graphical results for 29 African countries are provided in figure 18 below:

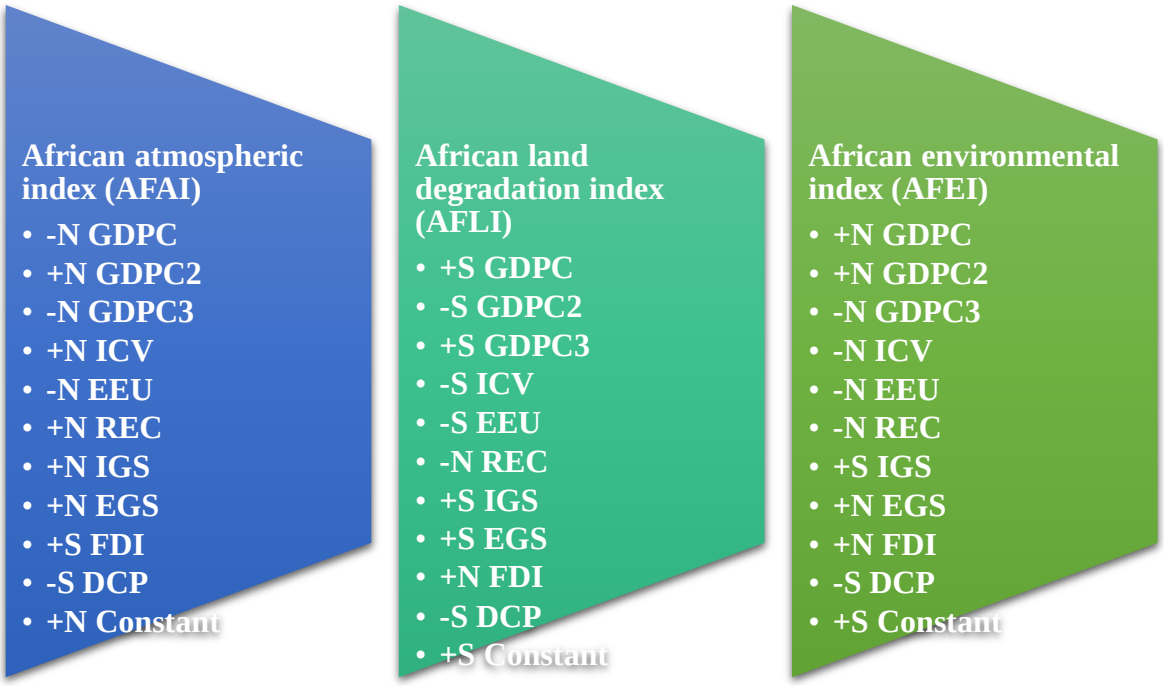

Figure 18: Panel system GMM graphical results for African economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.2.1 Short-term and Long-term Elasticity Estimates for African Economies.

In this sub-section the researcher will diligently present the short-range and long-range elasticity estimates for African economies for African atmospheric index (AFAI), African land degradation index (AFLI) and African environmental

index (AFEI). The results for short-range and long-range elasticity estimates are thus in table 6 below:

Table 6: Short-term and Long-term elasticity estimates for African economies

Variable	AFAI	AFLI	AFEI
Short-term elasticity			
GDPC	-1.89E-06	1.92E-06	2.66E-07
GDPC2	2.55E-10	-1.56E-10	2.27E-11
GDPC3	-8.56E-15	3.64E-15	-1.57E-15
ICV	6.54E-14	-1.08E-13	-3.11E-14
EEU	-3.26E-06	-0.0000315	-0.000036
REC	0.000042	-0.0000173	-8.93E-06
IGS	4.44E-14	3.59E-14	3.73E-14
EGS	6.08E-15	3.03E-14	2.17E-14
FDI	0.0001259	2.07E-06	0.0000339
DCP	-0.0000557	-0.0000552	-0.0000414
Constants	0.0053976	0.0072279	0.0054892
Long-term elasticity			
GDPC	-20.54553884	-27.67572355	-31.14516316
GDPC2	-34.24256474	-46.12620591	-48.94239925
GDPC3	-51.36384711	-69.18930887	-66.73963533
ICV	-47.93959064	-59.96406769	-62.29032631
EEU	-20.54553884	-0.0001452975486	-0.0001601751248
REC	0.0001438187719	-0.00007979833623	-26.69585413
IGS	-47.93959064	-64.57668828	-62.29032631
EGS	-51.36384711	-64.57668828	-62.29032631
FDI	0.0004311138901	-27.67572355	0.0001508315759
DCP	-0.0001907310856	-0.0002546166566	-0.0001842013935
Constants	0.01848276674	0.03333956037	0.02442314709

Source: Researchers computations

The short-range elasticity results presented in table 6 above were the same as the GMM panel estimates for African countries with respect to African atmospheric index, African land degradation index and African environmental index. The magnitude of long-range elasticity estimates for African economies were larger compared to short-range elasticity estimates. The results in table 6 above clearly indicate that real GDP per capita, its square, cubic function,

industry value added including construction, GDP per unit of energy use, imports and exports of goods and services and domestic credit provided by financial sector had a negative relationship with African atmospheric index in the long-range.

On the other hand renewable energy consumption, foreign direct investment and a constant term had a positive marriage with African atmospheric index in the long-term. The results with respect to African land degradation index revealed that real GDP per capita, its square, cubic, industry value added including construction, GDP per unit of energy use, renewable energy consumption, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector indicated a negative long-range relationship with African land degradation index, while the constant term had a positive relationship.

Further, table 6 indicated that real GDP per capita, its square, cubic function, industry value added including construction, GDP per unit of energy use, renewable energy consumption, imports and exports of goods and services and domestic credit provided by financial sector indicated a negative long-term marriage with African environmental index. Contrarily, foreign direct investment and a constant term had a positive relationship with African environmental index in the long term.

5.3 Asian Results

In this subsection results are presented for Asian atmospheric index (ASAI), Asian land degradation index (ASLI) and Asian environmental index (ASEI) for 29 Asian countries. The results are depicted in table 8 below:

Table 8: Asian panel GMM estimation results of environmental sustainability

Variables	MODEL 1	MODEL 2	MODEL 3
ASAI (LI)	0.3100752 (0.033601)***		
ASLI (LI)		0.9565618 (0.016638)***	
ASEI (LI)			0.2787185 (0.0347081)***
GDPC	-5.43E-07 (7.32E-07)	-2.41E-07 (1.46E-07)*	-9.90E-07 (3.42E07)***
GDPC2	-1.79E-11 (2.93E-11)	2.26E-12 (6.10E-12)	-4.18E-12 (1.35E-11)
GDPC3	3.16E-16 (3.16E-16)	-6.99E-18 (6.84E-17)	1..50E-16 (1.49E-16)
ICV	2.91E-14 (9.42E-15)***	8.99E-15 (2.94E15)***	3.42E-14 (6.06E-15)***
EEU	-0.0002351 (0.0000739)***	0.0000128 (5.06E-06)***	0.0000126 (0.0000146)
REC	-0.0000557 (0.0000975)	-0.0000332 (0.0000142)**	0.0001218 (0.000034***
IGS	-2.68E-15 (1.27E-14)	3.96E-15 (3.65E-15)	9.54E-15 (5.90E-15)
EGS	1.26E-15 (1.41E-14)	-5.31E-15 (3.51E-15)	-3.09E-15 (7.47E-15)
FDI	-0.0000141 (0.0000242)	-4.66E-06 (5.59E-06)	-1.0000138 (0.0000111)
DCP	-0.0000389 (0.0000216)*	1.18E-06 (3.78E-06)	-2.23E-06 (8.88E-06)
Constants	0.0238587 (0.0055786)***	0.0034956 (0.0009007)***	0.0242156 (0.0022335)***
Observations	522	522	522
Number of countries	29	29	29
Wild Chi-square	124.96***	4179.55***	173.12***

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

The result in table 8 above with respect to Asian atmospheric index (ASAI) indicated that real GDP per capita and its square has a negative and non-significant relation with Asian atmospheric index, while its cubic polynomial function has non-significant positive relationship. Industry value added including construction and a constant term are positive and significantly related with Asian atmospheric index while GDP per unit of energy use and domestic credit provided by financial sector are significantly negatively related with it. The results further pointed that renewable energy consumption, imports of goods and services and foreign direct investment are negatively and non-significantly related with Asian atmospheric index.

In table 8 above, the results for Asian land degradation index (ASLI) proved that real GDP per capita is negative and significant, its square is positive and non-significant and its cubic polynomial function is negatively and significantly related with Asian land degradation index. Furthermore, the results revealed that industry value added including construction, GDP per unit of energy use and a constant term have a positive and significant relationship with Asian land degradation index, however renewable energy consumption was negatively and significantly related to it. In respect of exports of goods and services and foreign direct investment, the relationship was negative and not significant with Asian land degradation index, yet domestic product provided by financial sector proved a positive and non-significant relationship with Asian land degradation index.

The results with respect to Asian environmental index (ASEI) exposed that real GDP per capita has a negative and significant relationship with Asian environmental index, its square having a non-significant negative relation, while the cubic polynomial revealed a positive non-significant relation. In respect with industry value added including construction, renewable energy consumption and a constant term, a positively significant relationship holds with Asian environmental index. There was a positive non-significant between Asian environmental index and GDP per unit of energy use as well as imports

of goods and services. As for exports of goods and services, foreign direct investment and domestic credit provided by financial sector, they had a negative and non-significant relationship with Asian environmental index. The lags of dependent variables had a positive and significant marriage with Asian environmental index. The graphical results for 29 Asian countries are provided in figure 19 below:

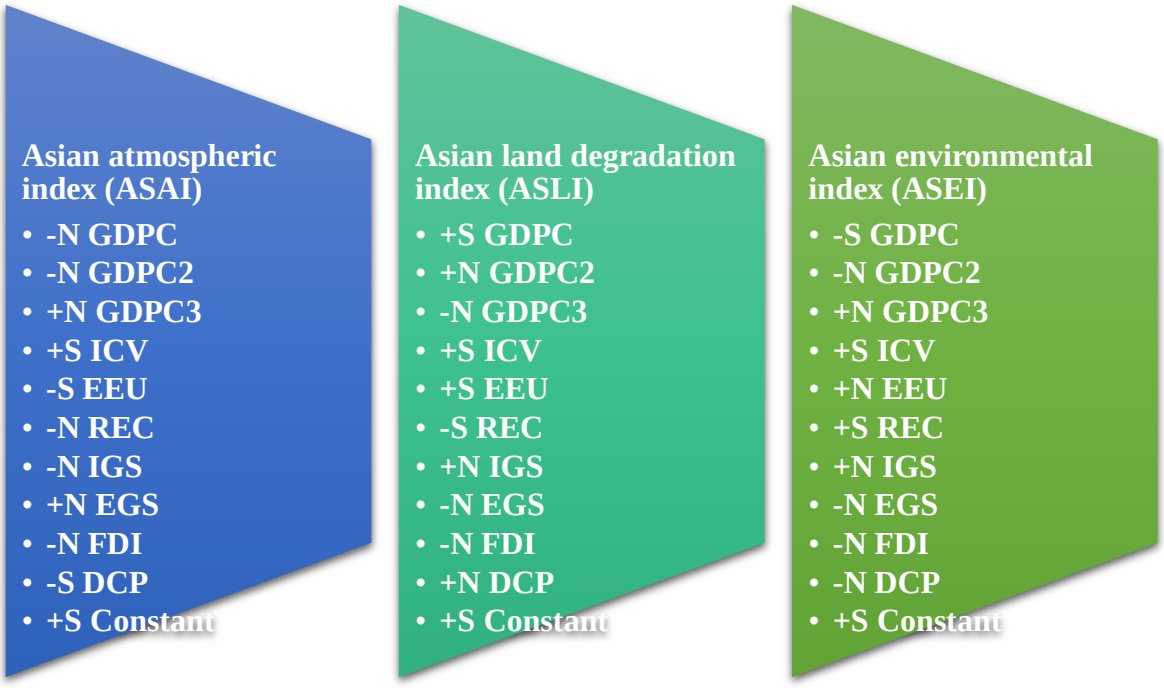

Figure 19: Panel system GMM graphical results for Asian economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.3.1 Short-Term And Long-Term Elasticity Estimates For Asian Economies

The results in table 9 below reveal short-range and long-range elasticity estimations for 29 Asian countries. The short-range results were obtained from the panel GMM estimations presented in table 8 above and long-range elasticity estimates were obtained by short-range elasticity estimates relative to one minus lag of the dependent variable.

Table 9: Short-term and Long-term elasticity estimates for Asian economies

Variable	ASAI	ASLI	ASEI
Short-term elasticity			
GDPC	-5.43E-07	-2.41E-07	-9.90E-07
GDPC2	-1.79E-11	2.26E-12	-4.18E-12
GDPC3	3.16E-16	-6.99E-18	1..50E-16
ICV	2.91E-14	8.99E-15	3.42E-14
EEU	-0.0002351	0.0000128	0.0000126
REC	-0.0000557	-0.0000332	0.0001218
IGS	-2.68E-15	3.96E-15	9.54E-15
EGS	1.26E-15	-5.31E-15	-3.09E-15
FDI	-0.0000141	-4.66E-06	-1.0000138
DCP	-0.0000389	1.18E-06	-2.23E-06
Constants	0.0238587	0.0034956	0.0242156
Long-term elasticity			
GDPC	-10.14603331	-616.1484822	-9.704948761
GDPC2	-15.94376663	-276.2545409	-16.63705502
GDPC3	-23.19093327	-414.3818114	-22.18274003
ICV	-20.29206661	-345.3181762	-19.40989752
EEU	-0.0003407617758	0.0002946715103	0.00001746890777
REC	0.00008073343646	-0.0007643042299	0.0001688661084
IGS	-21.74149994	-345.3181762	-20.79631877
EGS	-21.74149994	-345.3181762	-20.79631877
FDI	-0.00002043700995	-138.1272705	-1.386440384
DCP	-5.638295652	-138.1272705	-8.31852751
Constants	0.03458159498	0.08047294777	0.03357302246

Source: Researchers' computations

The results in table 9 above indicate that long-range elasticity estimates have larger magnitudes compared to their short-range counterparts. In the long-range real GDP per capita, its square and cubic polynomial function, industry value added including construction, GDP per unit of energy use, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector had a negative relationship with Asian atmospheric index, while renewable energy consumption and a constant term had positive relationship to it.

In another case, real per capita GDP, its square and cubic polynomial, industry value added including construction, renewable energy consumption, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector revealed a negative marriage with Asian land degradation index. However, GDP per unit of energy use and a constant term indicated a positive long-range relationship with Asian land degradation index. On the other hand, real GDP per capita, its square and cubic polynomial function, industry value added including construction, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector unearthed a negative long-range relation with Asian environmental index.

5.4 European Results

The results for 26 European Union member countries are presented in this subsection with respect to European atmospheric index (EUAI), European land degradation index (EULI) and European environmental index (EUEI). These results are presented in table 11 below. The results indicated that real GDP per capita and its cubic polynomial function has a negative and non-significantly related to European atmospheric index, while a positive and also non-significant relationship was revealed. Industry value added including construction, imports of goods and services and a constant term has significantly positive relation with European atmospheric index. The results also proved that GDP per unit of energy use had a non-significant negative relationship with European atmospheric index, but renewable energy consumption and exports of goods and services revealed a significant negative relationship with it. It was also revealed that foreign direct investment and domestic credit provided by financial sector had a non-significant positive relationship with European atmospheric index.

Table 11: European panel GMM estimation results of environmental sustainability

Variables	MODEL 1	MODEL 2	MODEL 3
EUAI (LI)	0.7561734 (0.0283173)***		
EULI (LI)		0.7436765 (0.0332295)***	
EUEI (LI)			0.8746196 (0.0308281)***
GDPC	-4.97E-08 (1.56E-07)	4.18E-07 (2.21E-07)*	3.39E-08 (1.40E-07)
GDPC2	3.46E-12 (4.51E-12)	-1.60E-11 (6.70E-12)**	-2.81E-12 (4.19E-12)
GDPC3	-3.19E-17 (3.88E-17)	1.45E-16 (5.88E-17)***	3.07E-17 (3.64E-17)
ICV	1.06E-14 (3.72E-15)***	-2.37E-14 (8.42E-15)***	3.24E-15 (4.25E-15)
EEU	-0.0000213 (0.0000807)	-0.0001429 (0.0001109)	-0.0001512 (0.0000659)**
REC	-0.0000698 (0.0000245)***	0.0000517 (0.0000404)	0.0000862 (0.0000248)***
IGS	9.09E-15 (4.58E-15)**	6.49E-15 (9.19E-15)	-1.91E-15 (5.41E-15)
EGS	-7.22E-15 (4.16E-15)*	-6.18E-15 (7.42E-15)	4.27E-17 (4.34E-15)
FDI	1.60E-07 (4.86E-06)	4.47E-06 (7.75E-06)	3.53E-06 (4.71E-06)
DCP	3.19E-06 (3.51E-06)	9.35E-06 (5.53E-06)*	3.17E-06 (3.22E-06)
Constants	0.0030202 (0.0012679)**	0.0089313 (0.0022576)***	0.0039129 (0.0017166)***
Observations	468	468	468
Number of countries	26	26	26
Wild Chi-square	769.36***	559.28***	1085.66***

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

The results with respect of European land degradation index pointed to the existence of positive and significant relationship with real GDP per capita and its cubic polynomial function, while a positive and also significant relation was existing with the square of real GDP per capita. It was also revealed in table 11 above that industry value added including construction has a negative and significant relationship with European land degradation index. The study further revealed that GDP per unit of energy use and exports of goods and serviced have a non-significant negative relationship with European land degradation index, while renewable energy consumption, imports of goods and services and foreign direct investments have a non-significant positive relationship with it.

Finally, domestic provided by financial sector and a constant term revealed the existence of a significantly positive relationship with European land degradation index. Our results in respect of European environmental index revealed a positive but a non-significant relationship with real GDP per capita and the cubic polynomial function of real GDP per capita, however the results revealed a non-significant relation with respect to the square of real GDP per capita. Industry value added including construction, exports of goods and services, foreign direct investments and domestic credit provided by financial sector respected a non-significant relationship with European environmental index.

The results with respect to European environmental index and GDP per unit of energy use was negatively significant, while a positive and significant relationship existed with renewable energy consumption. Furthermore, a non-significant negative relationship existed between European environmental index and imports of goods and services, however, the constant term revealed significant positive relation. The lags of dependent variables had a positive and significant relationship in all cases. The graphical results for European countries are provided in figure 20 below:

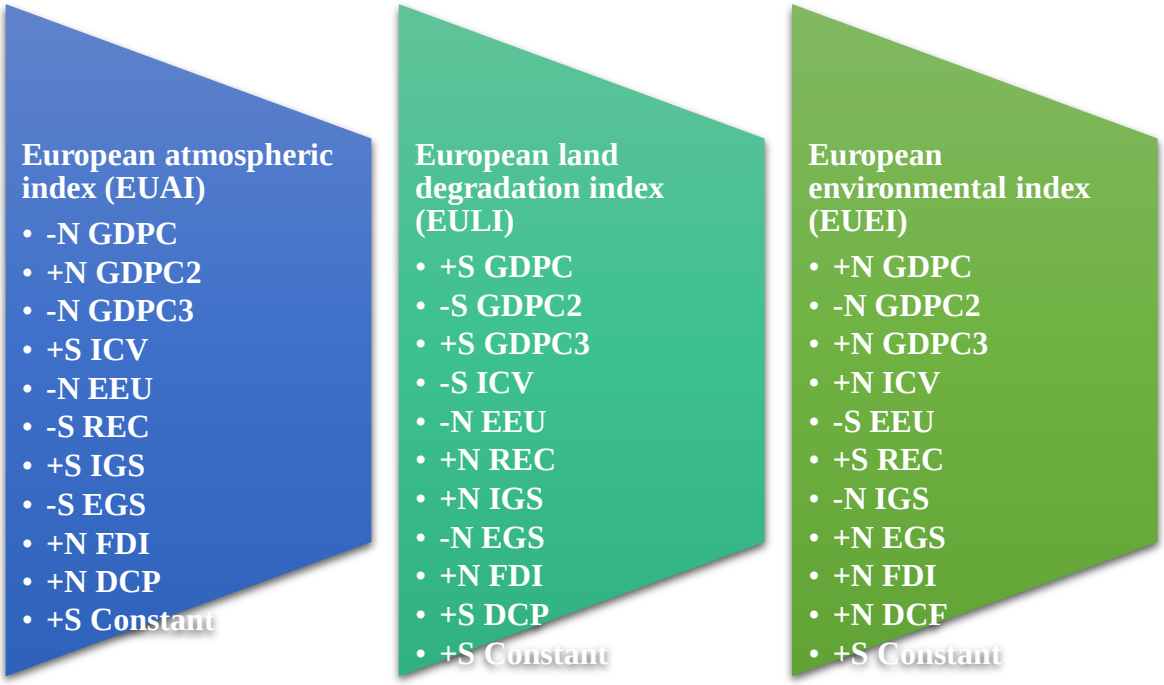

Figure 20: Panel system GMM graphical results for European economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.4.1 Short-Term And Long-Term Elasticity Estimates For European Economies

The results in table 12 below reveals short-range and long-range elasticity estimates in respect of 26 European countries. The short-range elasticity estimations were extracted from panel GMM presented in table 11 above, while long-range elasticity estimates were obtained by short-range elasticity estimates relative to one minus lag of the dependent variables.

Table 12: Short-term and Long-term elasticity estimates for European economies

Variable	EUAI	EULI	EUEI
Short-term elasticity			
GDPC	-4.97E-08	4.18E-07	3.39E-08
GDPC2	3.46E-12	-1.60E-11	-2.81E-12
GDPC3	-3.19E-17	1.45E-16	3.07E-17
ICV	1.06E-14	-2.37E-14	3.24E-15
EEU	-0.0000213	-0.0001429	-0.0001512
REC	-0.0000698	0.0000517	0.0000862
IGS	9.09E-15	6.49E-15	-1.91E-15
EGS	-7.22E-15	-6.18E-15	4.27E-17
FDI	1.60E-07	4.47E-06	3.53E-06
DCP	3.19E-06	9.35E-06	3.17E-06
Constants	0.0030202	0.0089313	0.0039129
Long-term elasticity			
GDPC	-32.81014818	-27.30924008	-63.80582611
GDPC2	-49.21522227	-42.91452013	-95.70873916
GDPC3	-69.72156488	-62.42112019	-135.5873805
ICV	-57.41775931	-54.61848016	-119.635924
EEU	-0.00008735701953	-0.0005574986297	-0.001205930113
REC	-0.0002862685429	0.0002016982446	-0.0006875077763
IGS	-61.51902784	-58.51980017	-119.635924
EGS	-61.51902784	-58.51980017	-135.5873805
FDI	-28.70887966	-23.40792007	-47.85436958
DCP	-24.60761113	-23.40792007	-47.85436958
Constants	0.01238665119	0.03484385942	0.03120822712

Source: Researchers' computations

The results in table 12 above revealed that long-range elasticity estimates had a larger magnitude compared to their short-range counterparties. The results reveal that real GDP per capita, its square, cubic polynomial functions, industry value added including construction, GDP per unit of energy use, renewable energy consumption, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector had a negative long-range relationship with European atmospheric index. However, there was

revealed a positive long-range relationship between European atmospheric index and a constant term.

The results also revealed that there is a negative long-range relationship between real GDP per capita, its square, cubic polynomial function, industry value added including construction, GDP per unit of energy use, imports and exports of goods and services, foreign direct investments and domestic credit provided by financial sector and European land degradation index. On the other hand the long-range results pointed that renewable energy consumption and the constant term have a positive relationship with European land degradation index.

The long-range results with respect to GDP per capita, its square, cubic polynomial function, industry value added including construction, GDP per unit of energy use, renewable energy consumption, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector was negative with European environmental index. Finally, our results revealed the existence of a positive long-range relationship between European environmental index and the constant term.

5.5 The Americas Results

The results in table 14 below are for the Americas atmospheric index (AMAI), Americas land degradation index (AMLI) and Americas environmental index (AMEI). It is revealed that real GDP per capita, its square and cubic polynomial function had a non-significant negative-positive-negative relationship with the Americas atmospheric index respectively. The results also revealed that industry value added including construction and a constant term unmasked a positive and significant relation with the Americas atmospheric index.

Table 14: Americas panel GMM estimation results of environmental sustainability

Variables	MODEL 1	MODEL 2	MODEL 3
AMAI (LI)	0.490211 (0.039952)***		
AMLI (LI)		0.8401261 (0.0563753)***	
AMEI (LI)			0.567373 (0.0511436)***
GDPC	-8.84E-07 (5.68E-07)	-8.07E-07 (4.93E-07)	-1.16E-06 (3.58E-07)***
GDPC2	2.47E-11 (2.00E-11)	3.03E-11 (1.94E-11)	4.40E-11 (1.35E-11)***
GDPC3	-2.58E-16 (2.02E-16)	-3.08E-16 (2.04E-16)	-4.52E-16 (1.40E-16)***
ICV	1.11E-13 (1.07E-14)***	2.22E-14 (1.40E-14)	5.51E-14 (7.62E-15)***
EEU	0.000204 (0.0002066)	0.0000382 (0.0001755)	0.0000269 (0.0001223)
REC	-0.0002005 (0.0000504)***	-0.0000567 (0.0000307)*	-0.0000744 (0.0000295)**
IGS	-1.04E-14 (9.74E-15)	-2.34E-15 (1.14E-14)	-9.01E-15 (6.92E-15)
EGS	-3.31E-14 (8.93E-15)***	-6.42E-15 (8.30E-15)	-1.03E-14 (6.16E-15)*
FDI	0.0000978 (0.0000855)	-5.53E-06 (0.0000709)	0.0000357 (0.0000581)
DCP	-0.0000209 (0.0000161)	-0.0000286 (0.0000149)*	-0.0000133 (0.0000115)
Constants	0.0153795 (0.0035232)***	0.0118354 (0.0038821)***	0.0174541 (0.0026788)***
Observations	396	396	396
Number of countries	22	22	22
Wild Chi-square	229.73	385.96	173.78

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

Table 14 above revealed that GDP per unit of energy use and foreign direct investment unleashed a positive and non-significant relationship with the Americas atmospheric index. Further results pointed that renewable energy consumption and exports of goods and services had a negative and significant relationship with the Americas atmospheric index, while imports of goods and services and domestic credit provided by financial sector were negative and not significantly related to it.

In addition table 14 indicated that real GDP per capita, its square and cubic polynomial function were non-significantly negative-positive-negative respectively with Americas land degradation index. The results also pointed that industry value added included construction and GDP per unit of energy use had positive but non-significant relationship with Americas land degradation index. Whereas renewable energy consumption and domestic credit provided by financial sector revealed a significant and negative relationship with Americas land degradation index, imports and exports of goods and services and foreign direct investment were negative and non-significant.

Furthermore, the results have shown a significant and positive constant term being related to Americas land degradation index. Moreover, table 14 alluded that real GDP per capita, its square and cubic polynomial function had a significant negative-positive-negative relationship with the Americas environmental index respectively. Industry value added including construction and a constant term exposed a significant and positive relation with the Americas environmental index.

The results also pointed that GDP per unit of energy use and foreign direct investment were positive and non-significantly related with the Americas environmental index. It was also revealed that renewable energy consumption and exports of goods and services were significant and positively associated

with the Americas environmental index. Finally, the results in table 14 have shown that imports of goods and services and domestic credit provided by financial sector were non-significant and negatively related with the Americas environmental index. The graphical results for 22 the Americas countries are provided in figure 21 below:

Figure 21: Panel system GMM graphical results for the Americas economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.5.1 Short-Term And Long-Term Elasticity Estimates For Americas Economies.

In table 15 below, we present short-range and long-range elasticity estimates for 22 Americas countries. The short-range elasticity estimates were obtained from panel GMM estimations in table 14 above and the long-range elasticity estimates where obtained from short-range elasticity estimates relative to one minus lag of dependent variable. The results are thus presented in table 15 below. The results show that in the long-range real GDP per capita, its square

and cubic polynomial, industry value added including construction, renewable energy consumption, imports and exports of goods and services and domestic credit provided by financial sector have a negative relationship with American atmospheric index. However, GDP per unit of energy use, foreign direct investment and a constant term pointed to a positive relationship with American atmospheric index in the long-term.

Table 15: Short-term and Long-term elasticity estimates for the Americas economies

Variable	AMAI	AMLI	AMEI
Short-term elasticity			
GDPC	-8.84E-07	-8.07E-07	-1.16E-06
GDPC2	2.47E-11	3.03E-11	4.40E-11
GDPC3	-2.58E-16	-3.08E-16	-4.52E-16
ICV	1.11E-13	2.22E-14	5.51E-14
EEU	0.000204	0.0000382	0.0000269
REC	-0.0002005	-0.0000567	-0.0000744
IGS	-1.04E-14	-2.34E-15	-9.01E-15
EGS	-3.31E-14	-6.42E-15	-1.03E-14
FDI	0.0000978	-5.53E-06	0.0000357
DCP	-0.0000209	-0.0000286	-0.0000133
Constants	0.0153795	0.0118354	0.0174541
Long-term elasticity			
GDPC	-13.73117113	-43.78176915	-13.86875992
GDPC2	-21.57755464	-68.79992294	-25.42605986
GDPC3	-31.38553402	-100.0726152	-36.9833598
ICV	-25.50074639	-87.56353829	-32.36043982
EEU	0.0004001655587	0.0002389233688	0.00006217827366
REC	-0.000393299973	-0.0003546323301	-0.0001719726231
IGS	-27.46234226	-93.81807674	-34.67189981
EGS	-27.46234226	-93.81807674	-32.36043982
FDI	0.0001918440767	-37.5272307	0.00008251912155
DCP	-0.00004099735381	-0.0001788797997	-0.00003074241783
Constants	0.03016836377	0.07402496436	0.04034445377

Source: Researchers' computations

Table 15 above also reveal that real GDP per capita, its square and cubic polynomial, industry value added including construction, renewable energy consumption, imports and exports of goods and services, foreign direct investment and domestic credit provided by financial sector have positive long-range relation with Americas land degradation. On the other hand, GDP per unit of energy use and a constant indicated a positive long-range linkage with Americas land degradation index.

Furthermore, table 15 above exposed that real GDP per capita, its square and cubic polynomial, industry value added including construction, renewable energy consumption, imports and exports of goods and services and domestic credit provided by financial sector have a negative long-range relationship with Americas environmental index. In the same vein, GDP per unit of energy use, foreign direct investment and a constant term revealed a positive long-range relation with the Americas environmental index.

5.6 Emerging Economies Results

In this subsection we present the results for our special case of emerging economies for carbon dioxide emissions (CO2), fossil fuel energy consumption (FFC) and nitrous oxide emissions (NOE). Table 17 below shows results for 24 emerging economies:

Table 17: Emerging economies panel GMM estimation results for environmental pollutants.

Variables	CO2	FFC	NOE
CO2(LI)	0.4554337 (0.0417315)***		
FFC(LI)		0.58903 (0.032428)***	
NOE (LI)			0.7400969 (0.0462681)***
GDP	-0.0001516 (0.0000473)***	-0.0005391 (0.000167)***	5.19327 (2.459468)**

GDP2	1.44E-09 (6.12E-10)**	8.06E-09 (2.26E-09)***	-0.0000733 (0.0000336)**
IVA	1.27E-13 (1.45E-13)	-2.48E-13 (3.77E-13)	4.17E-08 (8.22E-09)***
DCF	0.0094323 (0.0019695)***	-0.0016043 (0.0050156)	263.0132 (110.2632)**
TRS	-0.0128082 (0.0051877)***	-0.0184783 (0.0089896)**	-541.7885 (163.9816)***
TSP	-0.0081075 (0.0053973)	0.0066529 (0.0104787)	-117.5975 (180.51)
REC	-0.101601 (0.0122209)***	-0.4813347 (0.0365287)***	271.7739 (211.5515)
EPC	0.0005015 (0.0001414)***	0.0000999 (0.0004336)	-17.72809 (5.457959)***
Constant	4.650105 (0.5600933)***	46.9526 (3.563847)***	19209.42 (17887.35)
Number of observations	333	332	287
Number of countries	24	24	24
Wild Chi-square	924.63***	14135.71***	4570.15***

Notes: The Standard Errors are in parenthesis, LI represents lag of dependent variable, *** being 1% level of significance, ** is 5% level of significance and * shows 10% level of significance.

The results in table 17 above indicated that real GDP per capita had a negative and significant relationship with carbon dioxide emissions, while the square of GDP per capita revealed a positive and significant relationship with carbon dioxide emissions. It was also shown that industry value added in emerging economies has a positive and non-significant marriage with carbon dioxide emissions. Further, domestic credit provided by financial sector, electric power consumption and a constant term revealed a positive and significant relationship with carbon dioxide emissions.

On the other hand transport services and renewable energy consumption have pointed to a negative and significant relationship with carbon dioxide in emerging economies. In addition, table 17 have exposed that real GDP had a negative and significant relationship with fossil fuel energy consumption in

emerging economies, while the square of real GDP had a positive and significant relation with fossil fuel energy consumption. Table 16 above also revealed that industry value added including construction and domestic credit provided by financial sector had a non-significant negative relationship with fossil fuel energy consumption in emerging economies. However, transport services and renewable energy consumption in emerging economies had a negative and significant marriage with fossil fuel energy consumption. Further results pointed out that transport services and electric power consumption had a non-significant positive relationship with fossil fuel energy consumption in emerging economies and a constant term revealed positive and significant relationship.

Moreover, table 16 above unmasked that real GDP per capita in emerging economies had a positive and significant linkage with nitrous oxide emissions, while the square of GDP per capita alluded to the existence of a negative and significant relation with nitrous oxide emissions. On the other hand, industry value added including construction and domestic credit provided by financial sector revealed a positive and significant relationship with nitrous oxide emissions in emerging economies.

The results also showed that transport services and electric power consumption in emerging economies have a negative and significant linkage with nitrous oxide emissions in emerging economies. Travel services proved that it had a negative and non-significant relationship with nitrous oxide emissions in emerging economies, however renewable energy consumption and a constant term had a positive and non-significant relationship. The graphical results for 24 emerging economies are presented in figure 22 below:

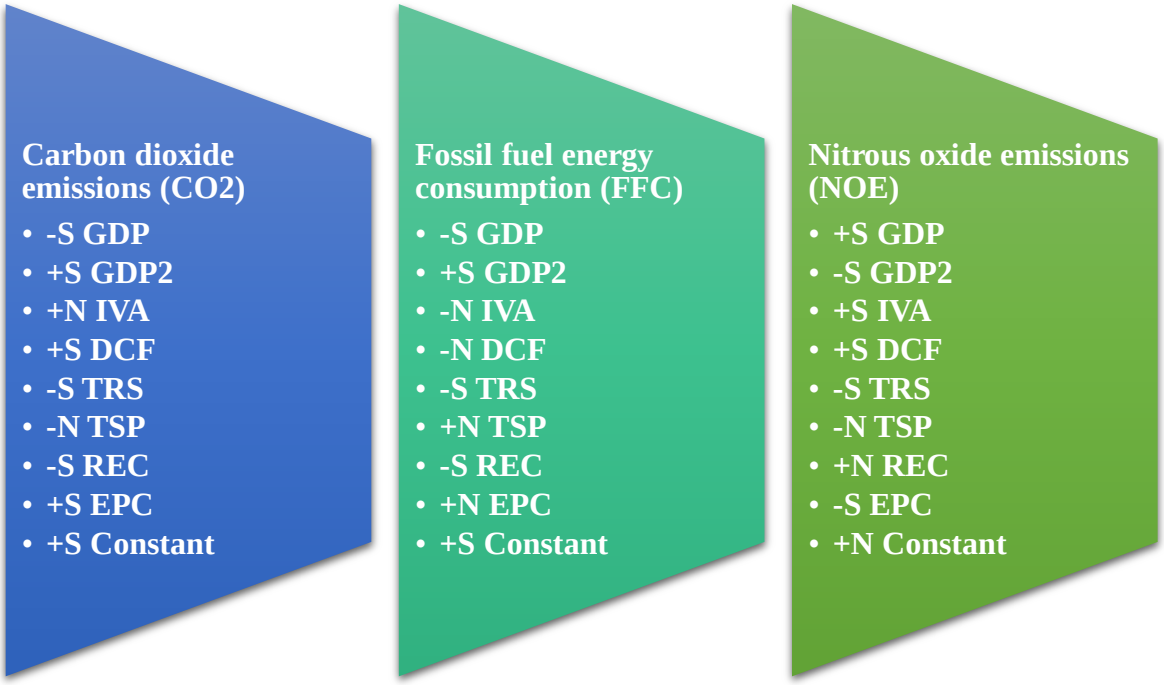

Figure 22: Panel system GMM graphical results for Emerging economies

Notes: The symbols **+S** reveal positive and significant, **-S** indicates negative and significant, **+N** being positive and non-significant and **–N** shows negative and non-significant results.

5.6.1 Short-Term And Long-Term Elasticity Estimates For Emerging Economies

In table 18 below we present short-range and long-range elasticity estimates for Emerging economies in respect of carbon dioxide emissions, fossil fuel energy consumption and nitrous oxide emissions. The short-range elasticity estimates in table 18 below were obtained from panel GMM estimates in table 17 above and their long-term counterparts were obtained from short-range elasticity estimates relative to one minus lag of dependent variable.

Table 18: Short-term and Long-term elasticity estimates for Emerging economies

Variable	CO2	FFC	NOE
Short-term elasticity			
GDP	-0.0001516	-0.0005391	5.19327
GDP2	1.44E-09	8.06E-09	-0.0000733
IVA	1.27E-13	-2.48E-13	4.17E-08
DCF	0.0094323	-0.0016043	263.0132
TRS	-0.0128082	-0.0184783	-541.7885
TSP	-0.0081075	0.0066529	-117.5975
REC	-0.101601	-0.4813347	271.7739
EPC	0.0005015	0.0000999	-17.72809
Constant	4.650105	46.9526	19209.42
Long-term elasticity			
GDPC	-0.0002783866721	-0.001311774582	19.98156236
GDPC2	-16.52691325	-21.89940872	-0.0002820281867
IVA	-23.87220803	-31.63247926	-30.7807025
DCF	0.01732075599	-0.003903691267	1011.966383
TRS	-0.02352000115	-0.04496264934	-2084.57883
TSP	-0.01488799435	0.01618828625	-452.4667078
REC	-0.1865723237	-1.171216147	1045.673945
EPC	0.0009209163329	0.0002430834367	-68.21038302
Constants	8.539097994	114.248242	73909.93028

Source: Researchers' computations

The long-range elasticity estimates in table 18 above indicated that GDP per capita and its square has a negative relationship with carbon dioxide emissions. It was also revealed in table 18 that industry value added including construction, transport and travel services and renewable energy consumption have a negative long-range relationship with carbon dioxide emissions in emerging economies.

Domestic credit provided by financial sector, electric power consumption and a constant positively impacted on carbon dioxide in emerging countries. More-so, the results in table 18 above pointed that GDP per capita and its square had a negative impact to long-range fossil fuel energy consumption in

emerging economies. The case for industry value added including construction, domestic credit provided by financial sector, transport services and renewable energy consumption had a negative long-range impact on fossil fuel energy consumption in a panel of emerging countries. On the other hand transport services, electric power consumption and a constant term have a long-range positive impact on fossil fuel energy consumption in the emerging world.

Furthermore, table 18 above explicitly pointed that GDP per capita had a long-range positive impact on nitrous oxide emissions in our panel of emerging countries, while its square had a negative relationship to it. The long-range results with respect to industry value added including construction, transport and travel services and electric power consumption reveal a negative relationship with nitrous oxide emissions. Finally, our long-range elasticity estimates indicated that domestic credit provided by financial sector, renewable energy consumption and a constant term had a positive and significant relationship with nitrous oxide emissions in the emerging countries.

5.7 Chapter Summary

In this chapter we have presented panel GMM results, short-range and long-range elasticity estimates for Global, African, Asian, European, Americas and Emerging economies. The next chapter will delve into the discussion of the results in this chapter.

CHAPTER 6

DISCUSION

6.0 Introduction

In this chapter we discuss the results presented in chapter 5 and this will set the stage for both theoretical and policy implication arising from our study, later to be presented in the conclusion and policy recommendation chapter. To be specific this chapter will address the how, why, and what questions arising from our research study.

6.1 Global Economies

The findings in table 2 indicate that Global environmental sustainability is damaged by economic growth as testified by the existence of the environmental Kuznets curve between economic growth and Global atmospheric index. Our findings also attest that industry value added including construction, renewable energy consumption and imports of goods and services are responsible for massive atmospheric pollutants in the global economy, hence responsible for damaging the environment. The export of goods and services and avoiding interference with the natural environment promotes global environmental sustainability due to their ability to reduce environmental pollutants.

Such findings are due to the fact that the majority of global economies are yet to develop and their economies are heavily reliant on fossil fuel consumption

which pollutes too much into the atmosphere. Further extractive industries like mining and construction activities cause too much air pollution, hence a damage to environmental sustainability yet they dominate global economic activities. These findings have also changed existing understanding on the role of renewable energy consumption in reducing environmental pollution since it is not the case in this study. Long-range economic growth reduces environmental damage, leading to improved global environmental sustainability. In the long-range industry value added including construction, GDP per unit of energy use, imports and exports of goods and services as well as not intervening in the natural environment are critical in reducing atmospheric pollution. The reason being the long-term benefits of global commitments to reducing environmental degradation for example the Paris Agreement and also increased awareness on the consequences of climate change.

Energy efficiency initiatives also played a critical role in reducing environmental damage globally and also reducing human interference with the mother-nature, hence have provided these long-range benefits to the global environment. Findings in table 2 indicate that the environmental Kuznets curve does not hold for global economies in the case of the global land degradation index, while at the same time industry value added including construction and domestic credit provided by financial sector wreaks havoc on environmental sustainability. This finding is due to the global reliance on fossil fuels although there are measures to encourage renewable energy consumption as a source of energy and also the unsustainable nature of global financing is more revealing than would otherwise be thought. However, in the long-range global land degradation deescalates, an indication that reforestation and afforestation interventions as well as sustainable fishing bears fruits over some considerable duration and bring environmental sustainability globally. In addition our findings in table 2 have revealed that the environmental Kuznets curve is valid with respect of global environmental index and industry value added including construction does not promote environmental sustainability

globally. It was apparent from the findings that renewable energy consumption, imports of goods and services as well as doing nothing leads to environmental degradation of the global economies, however exports of goods and services are environmentally sustainable.

The sustainable nature of exports of goods and services are a testimony of the benefits of technological development which promotes mass production of goods and services while being efficient on the utilisation of raw materials and other productive inputs. In the long-range benefits from economic growth, industry value added including construction, imports and exports of goods and services as well as domestic credit provided by financial sector continue to be negligible, however energy efficiency and renewable energy initiative are not sufficient to reduce global environmental degradation.

6.2 African Economies

Our findings in table 5 indicate that there is no environmental Kuznets curve relationship between economic growth and African atmospheric index, however there is an inverse N-shaped pattern. This is an indication that it is not economic growth which causes atmospheric damage to Africa, but foreign direct investment claims that responsibility due to the fact that multinational corporations transfer dirty industrial activities to Africa through direct investment thereby causing damage to the environment.

The finding on domestic credit provided by financial sector pointed that financial activities in Africa are not as dirty as they are thought of but are rather environmentally sustainable enough although more need to be done. The reason for such findings in Africa in respect of atmospheric indicators is traceable to its lower industrial capabilities although there is a heavy reliance of fossil fuels and also the fact that Africa is dominated by agricultural activities which impact heavily on physical land degradation than on atmospheric pollutants.

An interesting finding was revealed in table 5 with respect to African land degradation index where the environmental Kuznets curve was validated. This finding supports our claim above that Africa is a predominantly agricultural based economy and is far less industrialised to cause atmospheric damage. Such a finding testifies that land degradation in Africa is caused by unsustainable agricultural practices which result in clearance of indigenous forests with little reforestation and afforestation to replace the damages. Interestingly, industry value addition including construction, GDP per unit of energy use and domestic credit provided by financial sector is environmentally sustainable in Africa.

Such a finding retraces to interventions such as Ecosystems Based Adaptation for Food Security Assembly (EBAFOSA), which is a comprehensive initiative that utilises connections, skills, talents and actions of multiple stakeholders in an economy to foster climate action to the roots of communities by using innovative volunteerism. However, the finding on imports and exports of goods and services as well as doing nothing proved to be degrading the environment in Africa.

It was apparent from these findings that trade in Africa is dominated by primary products especially agricultural products and Africa is proving a dumping site for environmentally unsustainable condemned products from developed states. The majority of these condemned products from developed states are in the form of second hand vehicles, plant and equipment for use in mining, construction and agriculture which are by nature degrading to the environment. If Africa ignores this and decides to do nothing, there will be nothing to talk about mother-nature but the mess of land degradation which will heavily destroy ecosystems.

Furthermore, findings in table 5 revealed that there is no environmental Kuznets curve pattern between economic growth and African environmental index. This is attributed to the greater proportion of atmospheric indicators in forming the African environmental index, whose findings could not support the environmental Kuznets curve. The findings also pointed that imports of goods and services as well as doing nothing is a real dilemma to environmental sustainability in Africa. The possibility of this finding was due to some of the reasons we gave above such as Africa being a victim of dumping of condemned vehicles, plant and equipment from developed states.

However, our claims for the role of domestic credit provided by financial sector in reducing environmental damage has been vindicated once again, this goes against common knowledge which view Africa as an inferior territory. Table 6 revealed long term findings which shew that economic growth, industry value added including construction, GDP per unit of energy use, imports and exports of goods and services and domestic credit provided by financial sector has a beneficiary effect of reducing atmospheric pollutants in Africa, while renewable energy, foreign direct investments and doing nothing remains a dilemma to the environment.

Such findings are due to concerted efforts by various stakeholders including clean value addition initiatives across the agricultural value chain in Africa, however the belief that renewable energy consumption will rescue Africa should be reconsidered because it is not supported in our findings and the same is with doing nothing to the natural environment as well as foreign direct investment. Our findings with respect to table 6 also pointed that long-range environmental sustainability is a possibility due to reduced land degradation and also an overall environmental improvement due to various interventions being implemented.

6.3 Asian Economies

In this case our findings in table 8 are clear that the environmental Kuznets curve does not hold with respect of economic growth and Asian atmospheric index, but industry value addition including construction is damaging the Asian atmosphere. This finding is due to armed conflicts in this region which require the establishment of military bases but this is to the detriment of the environment although the nature of economic activities are not environmentally damaging. These armed conflicts also require value addition of some military hardware and equipment which are air pollution prone due to emissions of air particulate matter as well as smoke during testing and battles.

Our findings also revealed that energy efficiency initiatives and domestic credit provided by financial sector are environmentally sustainable in the Asian territories, such a finding qualify to be the reason why the environmental Kuznets curve does not hold in the Asian countries. Due to Islamic financial initiatives in Asian countries, the environment is benefiting since credit creation is not meant to reap borrowers through interest rate charges, but credit is channelled where it matters most in renewable energy production which in turn reduces environmental pollutants.

Findings in table 8 indicated that there is no environmental Kuznets curve between economic growth and Asian land degradation index in Asian countries since an inverted N-shaped pattern is observable. Our finding is attributed to composition of economic activities as opposed to scale of economic activities in these countries. The majority of these activities are technology based which means no damage to the mother-nature as is in Africa where economic activities are primarily based on extractive activities, hence the environmental Kuznets curve in Africa in this respect. Interestingly, industry value addition including construction remain environmentally unsustainable in Asian countries and the reason is war and civil strives in this conflict ridden territory. The major thrust in Asia is seemingly more aligned to the development of military superiority, however at the sacrifice of the environment.

Over and above, our findings revealed that energy efficiency initiatives and lack of interventions in Asia are damaging the environment through land degradation. We attributed this to neglect of the environment due to lack of foresight on the part of responsible authorities who prefer to be reactionary as opposed to being proactive to environmental issues. The study also found that the environmental Kuznets curve does not exist between economic growth and Asian environmental index since there was no significant pattern between these variables. Such a findings is due to the nature of the relationships existing between economic growth and both Asian atmospheric index and Asian land degradation index due to their shared proportions in the Asian environmental index. This is aggravated by the reasons behind the relations between economic growth and these indices as we have alluded to before.

As we have alluded to before, industry value added including construction is not environmentally sustainable in the Asian territories due possibly to some or all of the reasons we have given above. Interestingly our findings have once again defiled existing understanding with respect to renewable energy consumption in Asia as it is revealing to be environmentally dangerous as opposed to what is presumed of it. Such an interesting finding is due to the impact of industry value addition including construction in causing environmental unsustainability which have neutralised all renewable energy initiatives in Asian territories.

Long term findings in table 9 reveal that there are environmental benefits from economic growth, industry value added including construction and energy efficiency, however renewable energy consumption and doing nothing proved to be environmentally unsustainable since they increase atmospheric pollutants. The same findings were echoed with respect of land degradation in Asia, however GDP per unit of energy use is damaging the environment which means Asia is not doing well in its energy efficiency initiatives. However, there are still long-range environmental sustainability benefits to be harnessed in Asian territories. Our long-range findings also has it that GDP per unit of

energy use and renewable energy have a damaging effect on environmental sustainability. This being attributed to afore mentioned reasons above.

6.4 European Economies

Our findings in table 11 above indicated that there is no environmental Kuznets curve between economic growth and European atmospheric index, however industry value addition including construction and imports of goods and services are causing atmospheric pollution in Europe. Such findings are a testimony that, Europe is not as clean as it is presumed and its industrial value addition activities still require innovation so as to avoid over reliance on imported fossil fuels.

The damage inflicted on the European atmosphere is also traceable to Africa, since it is the source of unprocessed raw materials including crude oil and coal mainly used in European industries. In this vein too, doing nothing is atmospherically hazardous for Europe, an indication that these economies should not be complacent when it comes to fighting atmospheric pollution in their jurisdictions.

Furthermore, our findings suggest the good news brought by renewable energy consumption and exports of goods and services in Europe since these have the capacity to significantly reduce atmospheric pollutants in the region. This is attributable to the vast availability of resources to invest in cleaner and more efficient industrial processes which have boosted exports of goods and service. Such initiatives like electric vehicles, electric trains, green logistics and a host of other measures are positively benefiting Europe and this should continue if the world is to be cleaner once again.

Further revelations from our findings suggest the existence of the environmental Kuznets between economic growth and European land degradation index. This finding in Europe can be retraced to technological impacts as well as composition of economic activities in this region, an indication that Europe is graduating from a technologically based to service based economy, notwithstanding the political dynamics of democracy being preached. Therefore this transition is more of a political move than an economic move as one would be made to believe. This position is even reinforced with the capacity of industrial value addition including construction to reduce land degradation in the European region.

However, domestic credit provided by the financial sector and doing nothing is environmentally precarious in Europe due to increased defence funding for military capabilities which consequently damage the land during testing and launch. It is now clear at this point that the existence of the environmental Kuznets curve between economic growth and European land degradation index is a political economy phenomenon driven by the service sector and technological dynamics.

Further findings from our study are indicating that there is no environmental Kuznets curve between economic growth and European environmental index. This is due to the influence of atmospheric indicators which failed to yield the environmental Kuznets curve with economic growth. Our findings also alludes to an interesting realisation that Europe is energy efficient, although it still relies on fossil fuel in its industrial value addition activities.

On the other hand, renewable energy consumption in Europe is environmentally dangerous because it is responsible for land degradation during the construction of solar farms and also wind farms to generate cleaner energy. However, doing nothing has consistently proved to be environmentally unsustainable in Europe, this is due to the reason alluded to above. Our long-

range findings are showing that Europe will reap the benefits of current initiatives, including the Paris Agreement in the fight against global climate change but the region should avoid complacency with regard to the fight for global environmental sustainability.

6.5 The Americas Economies

Findings for the Americas presented in table 14 pointed that the environmental Kuznets curve does not hold between economic growth and Americas atmospheric index, however industry value added including construction is responsible for atmospheric pollution in the Americas. Although the majority of Americas countries are better developed, the consumption of fossil fuel in value addition including construction could not be ruled out since the majority of construction vehicles, plant and equipment are diesel powered, hence emitting pollutants into the atmosphere.

The Americas findings suggest that environmental sustainability is driven by renewable energy consumption and exports of goods and services. This finding is due to resourcefulness in the Americas which makes them benefit from renewable energy initiatives which they do on a larger scale to be relied upon to power the economy. Further the finding above can also be retraced to the ability of the Americas to remove polluting vehicles, plant and equipment from their economies through export to third world countries, hence promoting environmental sustainability in their jurisdiction by reducing atmospheric pollutants.

Our findings also suggest that the environmental Kuznets curve does not hold in the Americas between economic growth and Americas land degradation. Such a finding can only be possible due to best land use practices such as land reclamation, reforestation and afforestation as well as strict environmental regulations that heavily penalises the perpetrators of land degradation. The findings for the Americas also suggest that these economies are enjoying the

benefits from renewable energy consumption and domestic credit from financial sector which then translates to environmental sustainability. The abundance of financial resources, coupled with strong financial systems and sound credit allocation to support renewable energy consumption makes it possible for the Americas to realise these benefits as reflected in our findings.

Generally, our findings have revealed that the environmental Kuznets curve does not hold between economic growth and Americas environmental index, but an inverted N-shaped pattern is revealing; while industry value added including construction continue to damage the environment. On the other hand renewable energy consumption and exports of goods and service have continued to support environmental sustainability in the Americas. Such findings are due partly to the reasons we have alluded above and also due to the proportions of atmospheric index and land degradation index in crafting the Americas environmental index. If the Americas does nothing or does not intervene in environmental issues, there will be too much environmental damage both atmospheric and land degradation.

Table 16 indicates our long-term findings which are suggesting the possibility of long-range benefits to environmental sustainability with respect to atmospheric indicators. However, GDP per unit of energy use and foreign direct investment are environmentally unsustainable in the long-range for the Americas. This finding is due to technological obsolescence and also technological catch-up from countries such as China and Russia who will be able to invest in the Americas, however bringing counterfeit technologies which are atmospheric pollutants ridden. The same long-range findings could be observed and attributed to the reasons above with respect to Americas land degradation index and Americas environmental degradation index.

6.6 Emerging Economies

In table 17 we have the findings for emerging countries in which it was indicated that the environmental Kuznets curve does not hold between economic growth and carbon dioxide emissions, instead a U-shaped pattern is revealing. The findings also indicated that domestic credit provided by the financial sector, electric energy consumption and doing nothing is environmentally unsustainable in the emerging economies with respect to carbon dioxide emissions.

In addition, our findings revealed that transport services and renewable energy consumption supports environmental sustainability in emerging economies. Findings with respect to fossil fuel energy consumption indicated that there was no environmental Kuznets curve with economic growth, however, there is a U-shaped relationship. Our findings indicated that transport services and renewable energy consumption are supportive of environmental sustainability in the emerging world and doing nothing is environmentally unsustainable.

An interesting finding suggested the environmental Kuznets curve between economic growth and nitrous oxide emissions, hence an inverted U-shaped pattern in emerging countries. We had findings which indicated that domestic credit provided by financial sector in emerging economies is environmentally unsustainable with respect to nitrous oxide emissions. On the other hand our findings are clearly indicating that transport services and electric power consumption in emerging countries is environmentally sustainable.

Table 18 reveal long-range findings and it is clear that environmental sustainability will be realisable in the emerging territories. However, domestic credit provided by financial sector, travel services, renewable energy consumption, electric power consumption and doing nothing damages the environment in the emerging economies. Such findings are a testimony that the growth of the economy in emerging countries is realised at the peril of

environmental sustainability, however, if sound policy interventions are employed economic growth and environmental sustainability could be concurrently realised. Further, these findings attest that emerging economies are transitioning from agricultural based economies to industrial based economies which consume the bulk of fossil fuels which cause carbon dioxide emissions thereby causing environmental unsustainability.

6.7 Chapter Summary

This chapter delved into the discussion of the findings from chapter 6 for Global, African, Asian, European, the Americas and a special case of emerging economies. The next chapter will conclude the research study and provide general and practical policy implications based on the Dumitrescu-Hurlin causality test results.

CHAPTER 7

CONCLUSION AND POLICY RECOMMENDATIONS

7.0 Introduction

In order to develop sound and robust public policy recommendations, this chapter employed findings from Dumitrescu-Hurlin causality test results. Therefore both general and practical policy suggestions were made for Global economies and African, Asian, European, the Americas and a special case of emerging economies respectively. These causality tests findings are presented in Appendix 1, 2, 3, 4, 5 and 6.

7.1 Conclusion

The research study aimed at examining the global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment with a view to unleash robust public policy and regulatory interventions for global sustainable development. The study utilised two sets of data, global data of 115 economies covering the duration 2000 to 2018 and data for 24 emerging economies over the duration 2000 to 2017. Three environmental sustainability indices were developed using principal component analysis (PCA) with respect to global economies that is atmospheric index, land degradation index and an environmental index combining the previous two indices.

Global economies were subdivided into Africa, Asia, Europe and the Americas, however the study included a special case of emerging economies of which three atmospheric indicators were used as environmental variables. Therefore,

the variables for our special case of emerging economies includes carbon dioxide emissions, fossil fuel energy consumption, nitrous oxide emissions, GDP per capita, industry value added including construction, domestic credit provided by financial sector, travel services, transport services, renewable energy consumption and electric power consumption.

The results in respect of global economies revealed that there is an environmental Kuznets curve between economic growth and global atmospheric index and also between economic growth and global environmental index. It was also revealed that industry value added including construction damages environmental sustainability to the global economy. Renewable energy consumption and imports of goods and services damages environmental sustainability through global atmospheric index and global environmental index; while exports of goods and services promotes environmental sustainability in that respect.

The results also revealed that domestic credit provided by financial sector increases land degradation in the global economy; while doing nothing is dangerous to global environmental index. There was the environmental Kuznets curve between economic growth and African land degradation index; while an inverted N-shaped pattern existed with Africa atmospheric index. Our results revealed that industry value added including construction, GDP per unit of energy use and domestic credit provided by financial sector reduces African land degradation; however imports and exports of goods and services as well as doing nothing increases land degradation in Africa. It was also revealed that foreign direct investment increases atmospheric pollution; while domestic credit provided by financial sector reduces it. Imports of goods and services and doing nothing increases African environmental damage; but domestic credit provided by financial sector reduces it.

The results with respect to Asia revealed that the environmental Kuznets curve was not supported between economic growth and all environmental indices and there was not even a related pattern formed though not significant. The researchers found that industry value added including construction and doing

nothing is not environmentally sustainable in Asia; while domestic credit provided by financial sector reduces Asian atmospheric pollution. Further, it was revealed that renewable energy consumption and doing nothing increases Asian environmental index.

The results also revealed the environmental Kuznets curve between economic growth and European land degradation index, while there was no significant pattern with respect to European atmospheric index and European environmental index. In Europe, industry value added including construction damages the atmosphere, however it reduced land degradation significantly; in the same vein, energy efficiency initiatives in Europe proved to be environmentally sustainable.

On the other hand, renewable energy consumption proved beneficial to the atmosphere in Europe but it is not good for the overall environment. European results also pointed that imports of goods and services damages the atmosphere, while exports of goods and services protects the atmosphere. Domestic credit provided by financial sector promotes land degradation in Europe and doing nothing is environmentally unsustainable.

An inverted N-shaped pattern was revealed between economic growth and the Americas environmental index. It was also revealed that industry value added including construction and doing nothing damaged the Americas atmosphere and also the environment in general. In addition we found that renewable energy consumption, imports of goods and services and domestic credit provided by financial sector proved to be environmentally sustainable in the Americas.

As for our special case of emerging economies, the researchers found the existence of the environmental Kuznets curve between economic growth and nitrous oxide emissions; while a U-shaped pattern was observed with respect to carbon dioxide emissions and fossil fuel energy consumption. The study also pointed that industry value added including construction escalates nitrous oxide emission in emerging economies; while domestic credit provided by financial sector increases carbon dioxide emissions and nitrous oxide emissions.

More so, the study found that travel services and renewable energy consumption supports environmental sustainability in the emerging case; whereas, electric power consumption wreaks havoc to carbon dioxide emissions but reduces nitrous oxide emission. In the same vein, doing nothing does not help the environment in the emerging countries since it increases carbon dioxide emissions and fossil fuel energy consumption.

Finally, long-range findings in this study suggested that environmental sustainability is a possibility, however this will depend on the quality of public policy and regulatory interventions by authorities in emerging economies.

7.2 Policy Analysis

In order to devise robust general and practical public policy and regulatory recommendations, Dumitrescu-Hurlin causality tests were employed. Table 4 (Appendix 1) reveal both unidirectional and bidirectional causality test results for 115 global economies. The result for unidirectional causality tests was confirmed between: global land degradation index and foreign direct investment; foreign direct investment and renewable energy consumption, and GDP per unit of energy use and foreign direct investment.

Furthermore, bidirectional causality results were confirmed between: global environmental index and global atmospheric index; global land degradation index and global atmospheric index; real per capita GDP and global atmospheric index; the square of real GDP per capita and global atmospheric index; the cubic polynomial function of real GDP per capita and global atmospheric index; industry value added including construction and global atmospheric index; GDP per unit of energy use and global atmospheric index; renewable energy consumption and global atmospheric index; imports and exports of goods and services and global atmospheric index; foreign direct investment and global atmospheric index; domestic credit provided by financial sector and global atmospheric index; global land degradation index and global environmental index; real GDP per capita and global environmental index; the square of real GDP per capita and global environmental index; the cubic polynomial function of real GDP per capita; renewable energy consumption and global environmental index; imports and exports of goods and services and global environmental index; foreign direct investment and global environmental index; domestic credit provided by financial sector and global environmental index; real GDP per capita and global land degradation index; the square of real GDP per capita and global land degradation index; the cubic polynomial function of real GDP per capita and global land degradation index; industry value added including construction and global land degradation index; GDP per unit of energy use and global land degradation index; renewable energy consumption and global land degradation index; imports and exports of goods and services and global land degradation index; domestic credit provided by financial sector and global land degradation index; the square of real GDP per capita and real GDP per capita; the cubic polynomial function of real GDP per capita and real GDP per capita; industry value added including construction and real GDP per capita; GDP per unit of energy use and real GDP per capita; renewable energy consumption and real GDP per capita; imports and exports of goods and services and real GDP per capita; foreign direct investment and real GDP per capita; domestic credit provided by financial sector and real GDP per capita; the cubic polynomial function of real GDP per capita and the square of real GDP per capita; industry value added

including construction and the square of real GDP per capita; GDP per unit of energy use and the square of real GDP per capita; renewable energy consumption and the square of real GDP per capita; imports and exports of goods and services; foreign direct investment and the square of real GDP per capita; domestic credit provided by financial sector and the square of real GDP per capita; industry value added including construction and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and the cubic polynomial function of real GDP per capita; renewable energy consumption and the cubic polynomial function of real GDP per capita; imports and exports of goods and services and the cubic polynomial function of real GDP per capita; foreign direct investment and real GDP per capita; domestic credit provided by financial sector and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and industry value added including construction; imports and exports of goods and services and industry value added including construction; imports and exports of goods and services and industry value added including construction; foreign direct investment and industry value added including construction; domestic credit provided by financial sector and industry value added including construction; renewable energy consumption and GDP per unit of energy use; imports of goods and services and GDP per unit of energy use; exports of goods and services and renewable energy consumption; exports of goods and services and imports of goods and services; foreign direct investment and imports of goods and services; domestic credit provided by financial sector and imports of goods and services, and domestic credit provided by financial sector and foreign direct investment.

In table 7 (Appendix 2), we present both unidirectional and bidirectional causality results for 29 African countries. The unidirectional causality results were relevant between: African atmospheric index and African environmental index; real GDP per capita and African atmospheric index; the square of real GDP per capita and African atmospheric index; the cubic polynomial function of real GDP per capita and African atmospheric index; industry value added

including construction and African atmospheric index; African atmospheric index and exports of goods and services; domestic credit provided by financial sector and African atmospheric index; African land degradation index and African environmental index; industry value added including construction and African environmental index; GDP per unit of energy use and African environmental index; industry value added including construction and African land degradation index; domestic credit provided by financial sector and African land degradation index; GDP per unit of energy use and African land degradation index; real GDP per capita and industry value added including construction; real GDP per capita and exports of goods and services; foreign direct investment and real GDP per capita; the square of real GDP per capita and exports of goods and services; foreign direct investments and the square of real GDP per capita; the square of real GDP per capita and exports of goods and services; foreign direct investments and the cubic polynomial function of real GDP per capita; foreign direct investment and industry value added including construction; GDP per unit of energy use and renewable energy consumption; GDP per unit of energy use and domestic credit provided by financial sector; GDP per unit of energy use and exports of goods and services; imports of goods and services and renewable energy consumption; exports of goods and services and renewable energy consumption; foreign direct investment and renewable energy consumption, and foreign direct investment and imports and exports of goods and services.

On the other hand a bidirectional causality results were relevant between: imports of goods and services and African atmospheric index; real GDP per capita and African environmental index; the square of real GDP per capita and African environmental index; the cubic polynomial function of real GDP per capita and African environmental index; renewable energy consumption and African environmental index; imports and exports of goods and services and African environmental index; real GDP per capita and African land degradation index; the square of real GDP per capita and African land degradation index; the cubic polynomial function of real GDP per capita and African land

degradation index; renewable energy consumption and African land degradation index; imports and exports of goods and services and African land degradation index; domestic credit provided by financial sector and African land degradation index; the square of real GDP per capita and real GDP per capita; the cubic polynomial function of real GDP per capita and real GDP per capita; GDP per unit of energy use and real GDP per capita; renewable energy consumption and real GDP per capita; imports of goods and service and real GDP per capita; domestic credit provided by financial sector and real GDP per capita; the cubic polynomial function of real GDP per capita and the square of real GDP per capita; industry value added including construction and the square of real GDP per capita; GDP per unit of energy use and the square of real GDP per capita; renewable energy consumption and the square of real GDP per capita; imports of goods and services and the square of real GDP per capita; domestic credit provided by financial sector and the square of real GDP per capita; industry value added including construction and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and the cubic polynomial function of real GDP per capita; renewable energy consumption and the cubic polynomial function of real GDP per capita; imports and exports of goods and services and the cubic polynomial function of real GDP per capita; domestic credit provided by financial sector and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and industry value added including construction; renewable energy consumption and industry value added including construction; imports and exports of goods and services and industry value added including construction; domestic credit provided by financial sector and industry value added including construction; imports of goods and services and GDP per unit of energy use; domestic credit provided by financial sector and renewable energy consumption; exports of goods and services and imports of goods and services, domestic credit provided by financial sector and imports and exports of goods and services.

Table 10 (Appendix 3) represent both unidirectional and bidirectional causality test results for 29 Asian countries. These results confirm a unidirectional causality between: Asian atmospheric index and Asian land degradation index; real GDP per capita and Asian atmospheric index; the square of real GDP per capita and Asian atmospheric index; industry value added including construction and Asian atmospheric index; GDP per unit of energy use and Asian atmospheric index; renewable energy consumption and Asian atmospheric index; imports of goods and services and Asian atmospheric index; Asian environmental index and Asian land degradation index; Asian environmental index and industry value added including construction; Asian environmental index and domestic credit provided by financial sector; Asian land degradation index and renewable energy consumption; Asian land degradation index and foreign direct investment; Asian land degradation index and domestic credit provided by financial sector; real GDP per capita and industry value added; real GDP per capita and renewable energy consumption; real GDP per capita and domestic credit provided by financial sector; the square of real GDP per capita and renewable energy consumption; the cubic polynomial function of real GDP per capita and GDP per unit of energy use; the cubic polynomial function of real GDP per capita and domestic credit provided by financial sector; industry value added including construction and renewable energy consumption; foreign direct investment and GDP per unit of energy use; GDP per unit of energy use and domestic credit provided by financial sector; imports of goods and services and renewable energy consumption; foreign direct investment led renewable energy consumption; imports of goods and services and foreign direct investment, and imports of goods and services and domestic credit provided by financial sector.

The policy results also pointed to a bidirectional causality between: the cubic polynomial function of real GDP per capita and Asian atmospheric index; exports of goods and services and Asian atmospheric index; domestic credit provided by financial sector and Asian atmospheric index; real GDP per capita and Asian environmental index; the square of real GDP per capita and Asian

environmental index; the cubic polynomial function of real GDP per capita and Asian environmental index; GDP per unit of energy use and Asian environmental index; renewable energy consumption and Asian environmental index; imports and exports of goods and services and Asian environmental index; real GDP per capita and Asian land degradation index; the square of real GDP per capita and Asian land degradation index; the cubic polynomial function of real GDP per capita and Asian land degradation index; industry value added including construction and Asian land degradation index; GDP per unit of energy use and Asian land degradation; imports and exports of goods and services and Asian land degradation index; the square of real GDP per capita and real GDP per capita; the cubic polynomial function of real GDP per capita and real GDP per capita; GDP per unit of energy use and real GDP per capita; imports and exports of goods and services and real GDP per capita; foreign direct investment and real GDP per capita; the cubic polynomial function of real GDP per capita and the square of real GDP per capita; industry value added including construction and the square of real GDP per capita; GDP per unit of energy use and the square of real GDP per capita; imports and exports of goods and services and the square of real GDP per capita; foreign direct investment and the square of real GDP per capita; industry value added including construction and the cubic polynomial function of real GDP per capita; renewable energy consumption and the cubic polynomial function of real GDP per capital; import and exports of goods and services and the cubic polynomial function of real GDP per capita; foreign direct investment and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and industry value added including construction; imports and exports of goods and services and industry value added including construction; renewable energy consumption and GDP per unit of energy use; imports and exports of goods and services and GDP per unit of energy use; exports of goods and services and renewable energy consumption; domestic credit provided by financial sector and renewable energy consumption; exports of goods and services and imports of goods and services; foreign direct investment and exports of goods and services; domestic credit provided by

financial sector and exports of goods and services, and domestic credit provided by financial sector and foreign direct investment.

Our results shown in table 13 (Appendix 4) presents unidirectional and bidirectional causality test results for 26 European Union member countries. Unidirectional causality was relevant between: European atmospheric index and European land degradation index, European atmospheric index and European environmental index, real GDP per capita and European atmospheric index, the square of GDP per capita and European atmospheric index, the cubic polynomial function of real GDP per capita and European atmospheric index, industry value added including construction and European atmospheric index, renewable energy consumption and European Atmospheric index, domestic credit provided by financial sector and European atmospheric index, European land degradation index and the cubic polynomial function of real GDP per capita, European land degradation index and GDP per unit of energy use, European land degradation index and imports and exports of goods and services, European environmental index and GDP per unit of energy use, renewable energy consumption and GDP per unit of energy use, domestic credit provided by financial sector and GDP per unit of energy use, real GDP per capita and industry value added including construction, foreign direct investment and real GDP per capita, domestic credit provided by financial sector and real GDP per capita, GDP per unit of energy use and the square of real GDP per capita, foreign direct investment and the square of real GDP per capita, the square of real GDP per capita and domestic credit provided by financial sector, GDP per unit of energy use and the cubic polynomial function of real GDP per capita, foreign direct investment and the cubic polynomial function of real GDP per capita, the cubic polynomial function of real GDP per capita and domestic credit provided by financial sector, industry value added including construction and renewable energy consumption, industry value added including construction and exports of goods and services, exports of goods and services and GDP per unit of energy use, domestic credit provided by financial sector and GDP per unit of energy

use, domestic credit provided by financial sector and renewable energy consumption, exports of goods and services and imports of goods and services, foreign direct investment and imports of goods and services, foreign direct investment and exports of goods and services, exports of goods and services and domestic credit provided by financial sector, and domestic credit provided by financial sector and foreign direct investment. Bidirectional causality in Europe was also observed between: European atmospheric index and GDP per unit of energy use, exports of goods and services and European atmospheric index, European environmental index and European land degradation index, real GDP per capita and European land degradation index, industry value added including construction and European land degradation index, domestic credit provided by financial sector and European land degradation index, real GDP per capita and European environmental index, the square of real GDP per capita and European environmental index, the cubic polynomial function of real GDP per capita and European environmental index, industry value added including construction and European environmental index, imports of goods and services and European environmental index, exports of goods and services and European environmental index, GDP per unit of energy use and real GDP per capita, imports of goods and services and real GDP per capita, renewable energy consumption and the square of real GDP per capita, imports of goods and services and the square of real GDP per capita, exports of goods and services and the square of real GDP per capita, renewable energy consumption and the cubic polynomial function of real GDP per capita, imports and exports of goods and services and the cubic polynomial function of real GDP per capita, imports of goods and services and industry value added including construction, domestic credit provided by financial sector and industry value added, renewable energy consumption and GDP per unit of energy use, imports of goods and services and GDP per unit of energy use, imports of goods and services and renewable energy consumption, and exports of goods and services and renewable energy consumption.

The results in table 16 (Appendix 5) shows both unidirectional and bidirectional causality results for 22 the Americas countries. The unidirectional causality results are confirmed between: real GDP per capita and Americas atmospheric index; the square of real GDP per capita and Americas atmospheric index; industry value added including construction and Americas atmospheric index; Americas atmospheric index and exports of goods and services; domestic credit provided by financial sector and Americas atmospheric index; real GDP per capita and Americas environmental index; Americas environmental index and GDP per unit of energy use; exports of goods and services and Americas environmental index; domestic credit provided by financial sector and Americas environmental index; Americas land degradation index and renewable energy consumption; Americas land degradation index and exports of goods and services; domestic credit provided by financial sector and Americas land degradation index; real GDP per capita and industry value added including construction; real GDP per capita and renewable energy consumption; foreign direct investment and real GDP per capita; the square of real GDP per capita and industry value added including construction; the square of real GDP per capita and renewable energy consumption; foreign direct investment and the square of real GDP per capita; the cubic polynomial function of real GDP per capita and industry value added including construction; the cubic polynomial function of real GDP per capita and renewable energy consumption; foreign direct investment and the cubic polynomial function of real GDP per capita; imports of goods and services and industry value added including construction; foreign direct investment and industry value added including construction; GDP per unit of energy use and exports of goods and services; GDP per unit of energy use and foreign direct investment; imports and exports of goods and services and renewable energy consumption; foreign direct investment and imports of goods and services; imports of goods and services and domestic credit provided by financial sector, and domestic credit provided by financial sector and foreign direct investment.

The other side of table 16 reveal bidirectional causality between: renewable energy consumption and Americas environmental index; the square of real GDP per capita and Americas environmental index; the cubic polynomial function of real GDP per capita and Americas environmental index; industry value added including construction and Americas environmental index; renewable energy consumption and Americas environmental index; imports of goods and services and Americas environmental index; real GDP per capita and Americas land degradation index; the square of real GDP per capita and Americas land degradation index; the cubic polynomial function of real GDP per capita and Americas land degradation index; industry value added including construction and Americas land degradation index; GDP per unit of energy use and Americas land degradation index; imports of goods and services and Americas land degradation index; GDP per unit of energy use and real GDP per capita; exports of goods and services and real GDP per capita; GDP per unit of energy use and the square of real GDP per capita; exports of goods and services and the square of real GDP per capita; domestic credit provided by financial sector and the square of real GDP per capita; GDP per unit of energy use and the cubic polynomial function of real GDP per capita; exports of goods and services and the cubic polynomial function of real GDP per capita; domestic credit provided by financial sector and the cubic polynomial function of real GDP per capita; GDP per unit of energy use and industry value added including construction; renewable energy consumption and industry value added including construction; exports of goods and services and industry value added including construction; domestic credit provided by financial sector and industry value added including construction; renewable energy consumption and GDP per unit of energy use; domestic credit provided by financial sector and GDP per unit of energy use; domestic credit provided by financial sector and renewable energy consumption; exports of goods and services and imports of goods and services, and domestic credit provided by financial sector and exports of goods and services.

Table 19 (Appendix 6) presents the both unidirectional and bidirectional causality results for 24 emerging countries. The unidirectional causality was supported between: real GDP per capita and carbon dioxide emissions; the square of real GDP per capita and carbon dioxide emissions; industry value added including construction and carbon dioxide emissions; travel services and fossil fuel energy consumption; carbon dioxide emissions and travel services; carbon dioxide emissions and transport services; carbon dioxide emissions and renewable energy consumption; industry value added including construction and fossil fuel energy consumption; fossil fuel energy consumption and renewable energy consumption; electric power consumption and fossil fuel energy consumption; real GDP per capita and nitrous oxide emissions; the square of real GDP per capita and nitrous oxide emissions; industry value added including construction and nitrous oxide emissions; domestic credit provided by financial sector and nitrous oxide emissions; nitrous oxide emissions and travel services; transport services and nitrous oxide emissions; renewable energy consumption and nitrous oxide emissions; electric power consumption and nitrous oxide emissions; real GDP per capita and travel services; real GDP per capita and transport services; industry value added including construction and the square of real GDP per capita; the square of real GDP per capita and travel services; the square of real GDP per capita and transport services; industry value added including construction and travel services; industry value added including construction and renewable energy consumption; renewable energy consumption and travel services; electric power consumption and transport services, and electric power consumption and renewable energy consumption.

On the contrary, bidirectional causality was exposed between: fossil fuel energy consumption and carbon dioxide emissions; domestic credit provided by financial sector and carbon dioxide emissions; nitrous oxide emissions and fossil fuel energy consumption; real GDP per capita and fossil fuel energy consumption; the square of real GDP per capita and fossil fuel energy consumption; domestic credit provided by financial sector and fossil fuel

energy consumption; transport services and fossil fuel energy consumption; the square of real GDP per capita and real GDP per capita; industry value added including construction and real GDP per capita; domestic credit provided by financial sector and real GDP per capita; renewable energy consumption and real GDP per capita; domestic credit provided by financial sector and the square of real GDP per capita; renewable energy consumption and the square of real GDP per capita; domestic credit provided by financial sector and industry value added including construction; transport services and industry value added including construction; travel services and domestic credit provided by financial sector; transport services and domestic credit provided by financial sector; electric power consumption and domestic credit provided by financial sector, and transport services and travel serviced.

These causality relationships are important in crafting robust and sound public policy and regulatory interventions so as to achieve environmental sustainability in a panel of countries:

a) Environmental pollution led investment

b) Investment led energy

c) Energy led investment

d) Atmospheric pollution led environmental pollutants

e) Growth led environmental pollution

f) Industry value added environmental pollution

g) Investment led environmental pollution

h) Environmental pollution led trade

i) Land degradation led environmental pollutants

j) Growth led industry value addition

k) Investment led growth

l) Investment led industry value addition

m) Energy led trade

n) Trade led energy

o) Energy led environmental pollution

p) Environmental pollution led industry value addition

q) Environmental pollution led energy

r) Growth led trade

s) Investment led trade

t) Energy efficiency led renewable energy consumption

u) Growth led energy

v) Growth led investment

w) Trade led investment

x) Environmental pollution led transport

y) Transport led energy

z) Growth led transport

This strategy affords strong insight for crafting robust public policies so as to achieve environmental sustainability in the global political economy.

7.3 General Policy Implications

In this study, general policy implications were based on the overall findings from the global panel of 115 countries. The overall findings from our research study suggest the following policy related implication in the global political economy:

a) Global land degradation have a direct impact on the flow of foreign direct investments in the global political economy. Therefore global policy authorities should craft environmental sustainability regulatory policies in such a way that reduces land degradation through initiatives to attract foreign direct investment in afforestation and reforestation.

Policy authorities should also promote healthy and sustainable agricultural activities, sustainable fishing, sustainable forestry management and also economic diversification to avoid reliance on natural resources rents for growing the global economy.

b) Foreign direct investments directly impacts renewable energy consumption in the global political economy. In this regard policies to attract foreign direct investment in renewable energy should be instigated globally since renewable energy consumption is a promising solution to reducing environmental pollution thereby mitigating climate change due to its ability to minimise the emissions of carbon. Therefore global policy authorities should carefully assess the externalities associated with renewable energy developments within their jurisdictions and also bear in mind their energy profiles as they endeavour to attract foreign direct investments.

c) Energy efficiency initiatives attracts foreign direct invest in the global political economy. Against this backdrop, policy authorities should leverage on putting in place measures that should enhance energy efficiency within their jurisdictions and such interventions should mainstream incentives for foreign direct investors to leverage on. This will also go a long way in enhancing and promoting sustainable economic growth and development while environmental sustainability is enhanced in line with the Sustainable Development Goals.

d) Transportation of goods and services substantially contributes to unsustainable environment. Therefore, authorities should put in place sustainable transport and travel services that would enhance the quality of the environment and these should be embedded in green supply chain management and financing for environmental sustainability to be realised for a healthy transportation system.

7.4 Practical Policy Implications

This section provides practical policy implications based on findings from Dumitrescu-Hurlin causality tests. The practical policy implications will thus focus on specific regions such as Africa, Asia, Europe, the Americas and Emerging economies as in our categorisation of countries in our panels.

7.4.1 Practical Policy Implications For Africa

Massive industrialisation and rapid economic growth as well trade in Africa is not environmentally sustainable since it is predominantly agro-based and in most cases rely on the extractive sector. Authorities in Africa should therefore consider environmentally sustainability issues in their policies such as the African Continental Free Trade Area (AfCFTA) so as to achieve a balance between the ecosystems and biodiversity across countries. Such initiatives could also spill over to energy policies, since there exists a direct linkage between energy efficiency initiatives and environmental pollution in Africa. Therefore, the appropriate policy move is for authorities to harmonise their policies through the creation of inter-ministerial policy task forces by bringing together the ministries responsible for agriculture, energy, environment and trade.

Furthermore, in order to harness the benefits from clean energy, policy initiatives should be crafted in such a way as to promote the development and use of clean energy in industrial value addition of commodities while promoting sustainable economic growth. Innovative financing initiatives should be prioritised in Africa through the establishment and promotion of partnerships between investors, clean energy suppliers and other players in the economic value chain. To this end green financing initiatives becomes indispensable and is a strategic solution available to environmental and financial policy authorities in Africa. Such initiatives could also take the form of selective lending, interest rates incentives and also flexible refinancing options to players in renewable energy and trade value chains.

7.4.2 Practical Policy Implications For Asia

Asian economies are set to benefit from ongoing renewable energy initiatives which are ear marked at abating climate change and environmental pollution in the region. Notwithstanding these benefits, policy authorities should review available renewable energy resources within their jurisdictions and in the process consider opportunities and costs associated therewith. Renewable energy production and energy efficiency initiatives should be embedded in Asian energy policies as compliments so as to enhance environmental sustainability in the region. Accelerated economic growth and massive industrialisation in the Asian territory damages the environmental sustainability through promoting both environmental pollution and land degradation in the region. It is therefore important for policy authorities to integrate policy initiatives for ministries responsible for energy, industry, environment and trade. Value addition and economic growth initiatives in the region should be aligned with the dictates of both the Kyoto protocol and the Paris agreement so as to realise environmental sustainability.

Trade policies in Asia should integrate renewable energy and green financing initiatives such as innovative financing, priority lending, interest rates incentives and refinancing options which enhance environmental sustainability. Such policies should also leverage on technological developments in these countries to promote linkages among players in the economic value chain to enhance trade, clean energy use and energy efficiency. Peaceful means to resolve conflicts in the Asian region benefits the environment in a number of ways such as reducing land degradation and environmental pollution from armed battles and testing of weapons. Therefore peace initiatives such as dialogues should be embedded in trade, energy, environmental and economic policies as a way to promote environmental sustainability in the Asian region. Furthermore, land reclamation should be a policy priority in the Asian region and this can be an avenue to attract foreign direct investment in these countries.

7.4.3 Practical Policy Implications For Europe

Rapid economic growth and sustained industrialisation in Europe is environmentally unsustainable since it leads to land degradation and air pollution respectively. Therefore authorities in this region should rollout massive land reclamation, and forestation initiatives and expedite energy efficiency in value addition including the use of renewable energy sources. European policy and regulatory authorities should escalate green financing initiatives since it is paramount in promoting environmental sustainability while enhancing sustainable economic growth simultaneously. This is achievable through strengthening conditions for foreign direct investment and directing domestic credit supply to the private sector with the aim of arresting hazards to the environment.

Renewable energy consumption and energy efficiency initiatives are the messiahs in achieving environmental sustainability in Europe, however policy makers should be cautious with renewable energy developments in their jurisdictions since it may cause land degradation. Energy efficiency initiatives should therefore be cascaded across the economic value chains including households, and trade in a way that will guarantee environmental sustainability into the long-range. This should take the form of supporting green transportation to support trade through inventive and innovative vehicle production, electrification of heavy vehicles, use of green trains and green transport management.

7.4.4 Practical Policy Implications for The Americas

Industrialisation and rapid economic growth, coupled with technological obsolescence in the Americas causes environmental deterioration. Authorities in the Americas should consider the environment when crafting their policy agendas so that a balanced ecosystem and biodiversity is realised. Innovative financing initiatives such as green financing becomes important for both environmental and financial authorities in the Americas so as to achieve environmental sustainability. Domestic credit provided by financial sector

reveal the capacity of domestic institutions in the Americas to innovatively finance initiatives to reduce environmental damage such as clean energy production, directed lending, interest rates incentives, tax reliefs and exemptions and also flexible refinancing options. As economic transformation continues in the Americas from technology based economies to service based economies, the promotion of renewable energy consumption should be prioritised. This will benefit the environment through reduction of environmental pollutants, although caution must be taken to prevent land degradation in the process.

Therefore investment policies should embrace renewable energy production and consumption as well as mainstreaming energy efficiency initiatives in trade policies and also upholding international trade commitments. To this end, sanctions and trade wars are not environmentally sustainable for the Americas as this will crowd out desirable foreign direct investments from global giants like China and Russia. The policy option for the Americas is to foster dialogue as a policy prescription to inform trade with other countries instead of resorting to diplomatic chaos which are environmentally unsustainable, with the potential to cause armed battles thereby aggravating environmental damage in the region and the globe at large. Domestic credit initiatives in the Americas are lucrative to attract foreign direct investments in the region, hence the need for policy authorities to review all financing mechanisms so as to strengthen them through plugging out policy uncertainties.

7.4.5 Practical Policy Implications for Emerging Economies

The sustainability of both travel and transport services promotes environmental sustainability in emerging economies, hence the need for policy authorities in this jurisdiction to include it in policy agendas. Authorities in emerging economies should penalise dirty industrial production operation processes through crafting strict regulatory frameworks and prohibitive taxing so as to enhance environmental sustainability; however cleaner industrial operation processes should be incentivised by offering subsidies and also tax

reliefs. Opportunities embedded in the emerging economies' energy profiles should be well understood and in the process map out the possible externalities associated. Sustainability principles embedded in the Kyoto protocol and the Paris agreement should inform economic growth in emerging economies since rapid economic growth and industrialisation is environmentally damaging.

Investment policies and other financing mechanisms adopted in emerging economies such as innovative financing, environmental certification and also eco-labelling of manufactured goods should be incorporated in policy agendas. Complimenting renewable energy consumption and electric power consumption should be prioritised in order to reduce environmental pollutants in emerging economies and this could be achieved by powering electricity generation plants with solar energy so as to arrest environmental pollutants from use of fossil fuel energy consumption. Policy authorities in the emerging world should consider policy harmonisation for the ministries responsible for energy, environment, industry and commerce as well as ministries of transport; however, this should be done on a coordinated way across the emerging world.

The global political economy of economic growth dynamics, environmental sustainability, energy, trade and investment is a critical way that could be harnessed when crafting environmental sustainability initiatives since these factors have greater volatility in the face of diverse macroeconomic policies. The focus of studies in the future should incorporate sea, ocean and coral reefs in crafting different environmental indices and other techniques for this purpose should be considered rather than solely relying on principal components analysis. The Global financial crisis and information value added should be included in future studies, including environmental indices for emerging economies. This should be done in the context of both the Kyoto protocol and the Paris agreement in questioning the environmental Kuznets curve hypothesis.

REFERENCE

Acemoglu, D., & Robinson, J. (2008). The Role of Institutions in Growth and Development Commission on Growth and Development Working Paper No. 10. *Washington, DC: The World Bank*.

Akpor, O. B., & Muchie, M. (2010). Bioremediation of polluted wastewater influent: phosphorus and nitrogen removal. Scientific Research and Essays, 5(21), 3222-3230.

Alban, A., & Andersen, N. B. (2007). HIV/AIDS'spread and impact on other health-related millennium development goals. Danish medical bulletin, 54(2), 163-166.

Alonso-Borrego, C., & Arellano, M. (1999). Symmetrically normalized instrumental-variable estimation using panel data. *Journal of Business & Economic Statistics*, *17*(1), 36-49.

Alt, J. E., & Lassen, D. D. (2006). Transparency, political polarization, and political budget cycles in OECD countries. *American Journal of Political Science*, *50*(3), 530-550.

Alvarado, R., Iñiguez, M., & Ponce, P. (2017). Foreign direct investment and economic growth in Latin America. *Economic Analysis and Policy*, *56*, 176-187.

Anangisye, W. A. (2010). Revisiting the alternative responses to the perceived quality" decline" in basic education in Tanzania. KEDI Journal of Educational Policy, 7(1).

Angelov, S., Dambrauskas, O., & Haq, H. (2019). Anthrophilia Preservation Initiative.

Appunni, S. S., & Hamisi, H. F. (2013). Is millennium development goal 4 achievable in Tanzania?.

Arellano, M., & Bond, S. (1991). Estimation of dynamic models with error components. *Journal of the American Statistical Association*, *76*(1), 598-606.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, *68*(1), 29-51.

Arends, F., & Winnaar, L. (2016). Millennium Development Goal 2: achieve universal primary education 2015.

Ashe, J. W., Van Lierop, R., & Cherian, A. (1999, August). The role of the alliance of small island states (AOSIS) in the negotiation of the United Nations framework convention on climate change (UNFCCC). In Natural Resources Forum (Vol. 23, No. 3, pp. 209-220). Oxford, UK: Blackwell Publishing Ltd.

Asongu, S. A., & Odhiambo, N. M. (2019). Basic formal education quality, information technology, and inclusive human development in Sub-Saharan Africa. *Sustainable Development*, *27*(3), 419-428.

Assembly, G. (2015). Sustainable Development goals. *SDGs), Transforming our world: the*, *2030*.

Aydin, C., Esen, Ö., & Aydin, R. (2019). Is the ecological footprint related to the Kuznets curve a real process or rationalizing the ecological consequences of the affluence? Evidence from PSTR approach. *Ecological indicators*, *98*, 543-555.

Azizalrahman, H. (2019). A model for urban sector drivers of carbon emissions. *Sustainable Cities and Society*, *44*, 46-55.

Baldwin, R. (1995). Does sustainability require growth? *The economics of sustainable development*, 51-78.

Bank for International Settlement (BIS) (2017). International Banking and Financial Market Development, *BIS Quarterly Review*. Basel Switzerland.

Barua, P., Tawney, L., & Weischer, L. (2012). Delivering on the clean energy economy: The role of policy in developing successful domestic solar and wind industries. World Resources Institute Working Paper). World Resources Institute. Retrieved from http://pdf. wri. org/delivering_clean_energy_economy. pdf.)

Barnes, A., & Brown, G. W. (2011). The Idea of Partnership within the Millennium Development Goals: context, instrumentality and the normative demands of partnership. Third World Quarterly, 32(1), 165-180.

Barrett, S. (1998). Political economy of the Kyoto Protocol. Oxford review of economic policy, 14(4), 20-39.

Bauer, T. N., Erdogan, B., & Taylor, S. (2012). Creating and maintaining environmentally sustainable organizations: Recruitment and on-boarding.

Bhat, S. A. (2013a). Millennium development goals: Achieve universal primary education from Indian perspective. Int J Sci Res Publications, 3(11), 1-9.

Bhat, S. A. (2013b). Millennium development goals: Eradicate extreme poverty and hunger Indian perspective. ZENITH International Journal of Business Economics & Management Research, 3(9), 59-72.

Blanchard, J. L., Watson, R. A., Fulton, E. A., Cottrell, R. S., Nash, K. L., Bryndum-Buchholz, A., ... & Davidson, L. N. (2017). Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture. Nature Ecology & Evolution, 1(9), 1240.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Borio, C., & Shin, H. S. (2017). BIS Quarterly Review, March 2017-media briefing.

Bruce, S. (2018). Global Energy Governance and International Institutions. Encyclopedia of the UN Sustainable Development Goals. Affordable and Clean Energy (Springer, 2019).

Burrell, G. (1979). Morgan. G.(1979) Sociological paradigms and organizational analysis. *London: I-leinemann*.

Caliari, A. (2014). Analysis of Millennium Development Goal 8: A global partnership for development. Journal of Human Development and Capabilities, 15(2-3), 275-287.

Cao, X., Kostka, G., & Xu, X. (2019). Environmental political business cycles: the case of PM2. 5 air pollution in Chinese prefectures. *Environmental science & policy*, *93*, 92-100.

Carson, R. T. (2009). The environmental Kuznets curve: seeking empirical regularity and theoretical structure. *Review of environmental Economics and Policy*, *4*(1), 3-23.

Cass, D. (1965). Optimum growth in an aggregative model of capital accumulation. *The Review of economic studies*, *32*(3), 233-240.

Chen, Y., Li, H., & Zhou, L. A. (2005). Relative performance evaluation and the turnover of provincial leaders in China. *Economics Letters*, *88*(3), 421-425.

Cieślik, A., & Goczek, Ł. (2018). Control of corruption, international investment, and economic growth–Evidence from panel data. *World Development*, *103*, 323-335.

Clémençon, R. (2016). The two sides of the Paris climate agreement: Dismal failure or historic breakthrough?

Colecraft, E. (2008). HIV/AIDS: nutritional implications and impact on human development. Proceedings of the Nutrition Society, 67(1), 109-113.

Copeland, B. R., & Taylor, M. S. (2005). Free trade and global warming: a trade theory view of the Kyoto protocol. Journal of Environmental Economics and Management, 49(2), 205-234.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage.

Dadzie, P. S., Martin-Yeboah, E., & Tachie-Donkor, G. (2016). Ensuring healthy lives and promoting well-being for all: the role of Ghanaian academic libraries in achieving the 2030 Agenda for Sustainable Development.

Deere, C. D. (2018). Sustainable Development Goals, Gender Equality and the Distribution of Land in Latin America. cadernos pagu, (52).

Denicolo, P., & Becker, L. (2012). *Developing research proposals*. Sage.

Dimitrov, R. S. (2016). The Paris agreement on climate change: Behind closed doors. Global Environmental Politics, 16(3), 1-11.

Dinda, S. (2004). Environmental Kuznets curve hypothesis: a survey. *Ecological economics*, *49*(4), 431-455.

Ding, Y., Zhang, M., Chen, S., Wang, W., & Nie, R. (2019). The environmental Kuznets curve for PM2. 5 pollution in Beijing-Tianjin-Hebei region of China: A spatial panel data approach. *Journal of Cleaner Production*, *220*, 984-994.

DiSano, J. (2002). Indicators of sustainable development: Guidelines and methodologies. *United Nations Department of Economic and Social Affairs, New York*.

Domar, E. D. (1946). Capital expansion, rate of growth, and employment. *Econometrica, Journal of the Econometric Society*, 137-147.

Drazen, A. (2000). The political business cycle after 25 years. *NBER macroeconomics annual*, *15*, 75-117.

Dyrstad, J. M., Skonhoft, A., Christensen, M. Q., & Ødegaard, E. T. (2019). Does economic growth eat up environmental improvements? Electricity production and fossil fuel emission in OECD countries 1980–2014. *Energy policy*, *125*, 103-109.

Du Pont, Y. R., Jeffery, M. L., Gütschow, J., Rogelj, J., Christoff, P., & Meinshausen, M. (2017). Equitable mitigation to achieve the Paris Agreement goals. Nature Climate Change, 7(1), 38.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Economic modelling, 29(4), 1450-1460.

Economic Commission for Latin America and the Caribbean (ECLAC) (2017). Foreign Direct Investment Reports, *Santiago.*

Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Kadner, S., Zwickel, T., ... & Matschoss, P. (Eds.). (2011). *Renewable energy sources and climate change mitigation: Special report of the intergovernmental panel on climate change*. Cambridge University Press.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of management journal*, *50*(1), 25-32.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Esquivel, V., & Sweetman, C. (2016). Gender and the sustainable development goals. Gender & Development, 24(1), 1-8.

Falkner, R. (2016). The Paris Agreement and the new logic of international climate politics. International Affairs, 92(5), 1107-1125.

Fernandez, R. (2019). SDG3 Good Health and Well-Being: Integration and connection with other SDGs. Springer.

Ferraro, T., Dos Santos, N. R., Pais, L., & Mónico, L. (2016). Historical landmarks of decent work. European Journal of Applied Business and Management, 2(1).

Flyvberg, B. (2011). Case Study', i Denzin, NK och Lincoln, YS (red.).

Gillies, D. (2010). Economic goals, quality discourse and the narrowing of European state education. Education, Knowledge & Economy, 4(2), 103-118.

Ginting, M. L., & Anzela, R. L. (2019, August). Implementation “Peace Is Possible” Campaign by Junior Chamber International as a Supporting Part of Sustainable Development Goals. In First International Conference on Administration Science (ICAS 2019). Atlantis Press.

Glasbergen, P. (2007). Setting the scene: the partnership paradigm in the making. Partnerships, governance and sustainable development: reflections on theory and practice, 125.

Gorus, M. S., & Aslan, M. (2019). Impacts of economic indicators on environmental degradation: evidence from MENA countries. *Renewable and Sustainable Energy Reviews*, *103*, 259-268.

Greene, L. A. (2000). EHPnet: United Nations Framework Convention on Climate Change.

Greyling, S., Patel, Z., & Davison, A. (2017). Urban sustainability disjunctures in Cape Town: learning the city from the inside and out. Local Environment, 22(sup1), 52-65.

Griliches, Z., & Hausman, J. A. (1986). Errors in variables in panel data. *Journal of econometrics*, *31*(1), 93-118.

Grossman, G. M., & Krueger, A. B. (1991). *Environmental impacts of a North American free trade agreement* (No. w3914). National Bureau of Economic Research.

Gui, S., Zhao, L., & Zhang, Z. (2019). Does municipal solid waste generation in China support the Environmental Kuznets Curve? New evidence from spatial linkage analysis. *Waste management*, *84*, 310-319.

Güneralp, B. (2015). Resource use for the construction and operation of built environments. In The Routledge Handbook of Urbanization and Global Environmental Change (pp. 101-116). Routledge.

Guo, G. (2009). China's local political budget cycles. *American Journal of Political Science*, *53*(3), 621-632.

Gupta, S., & Gupta, N. (2016). Millennium development goals-5 and sexual and reproductive health in post-2015 United Nations global development goals. International Journal of Health & Allied Sciences, 5(1), 60-60.

Hale, T. (2016). “All hands on deck”: The Paris agreement and non-state climate action. Global Environmental Politics, 16(3), 12-22.

Haller, A. P. (2012). Concepts of economic growth and development challenges of crisis and of knowledge. *Economy Transdisciplinarity Cognition*, *15*(1), 66.

Hao, Y., Xu, Y., Zhang, J., Hu, X., Huang, J., Chang, C. P., & Guo, Y. (2019). Relationship between forest resources and economic growth: Empirical evidence from China. *Journal of cleaner production*, *214*, 848-859.

Harod, R. F. (1939). An Essay in Dynamic Theory. *Economic Journal*, *49*(3), 14-33.

Hassan, S. A., & Nosheen, M. (2019). Estimating the Railways Kuznets Curve for high income nations—A GMM approach for three pollution indicators. *Energy Reports*, *5*, 170-186.

Hoekstra, E. J., McFarland, J. W., Shaw, C., & Salama, P. (2006). Reducing measles mortality, reducing child mortality. The Lancet, 368(9541), 1050-1052.

Holmstrom, B., & Milgrom, P. (1991). (1991) Multitask principal-agent analysis: Incentive contracts, asset ownership and job design. *Journal of Law, Economics and Organization*, *7*.

Hove, S., & Tursoy, T. (2019). An investigation of the environmental Kuznets curve in emerging economies. *Journal of Cleaner Production*, *236*, 117628.

https://sustainabledevelopment.un.org/?menu=1300 (accessed on 11 December 2019 at 14:42pm)

IGBP Terrestrial Carbon Working Group. (1998). The terrestrial carbon cycle: implications for the Kyoto Protocol.

International Energy Agency (EIA) (2018) CO_2 Emissions from Fuel Combustion: Highlights. Paris: *International Energy Agency/ Organization for Economic Cooperation and Development*.

International Energy Agency (EIA) (2016) CO_2 Emissions from Fuel Combustion: Highlights. Paris: *International Energy Agency/ Organization for Economic Cooperation and Development*.

Institute of International Finance (IIF) (2017). Capital Flows to Emerging Markets: *A Brighter Outlook.*

Janetos, A. C., Malone, E., Mastrangelo, E., Hardee, K., & de Bremond, A. (2012). Linking climate change and development goals: framing, integrating, and measuring. Climate and Development, 4(2), 141-156.

Jia, R., Kudamatsu, M., & Seim, D. (2015). Political selection in China: The complementary roles of connections and performance. *Journal of the European Economic Association*, *13*(4), 631-668.

Joshi, P., & Beck, K. (2018). Democracy and carbon dioxide emissions: Assessing the interactions of political and economic freedom and the environmental Kuznets curve. *Energy Research & Social Science*, *39*, 46-54.

Kaldor, N. (1963). Taxation for economic development. *The Journal of Modern African Studies*, *1*(1), 7-23.

Keen, M. R., Schwarz, A. M., & Wini-Simeon, L. (2018). Towards defining the Blue Economy: Practical lessons from Pacific ocean governance. Marine Policy, 88, 333-341.

Kibria, A., Akhundjanov, S. B., & Oladi, R. (2019). Fossil fuel share in the energy mix and economic growth. *International Review of Economics & Finance*, *59*, 253-264. T

Kim, D. H., Suen, Y. B., & Lin, S. C. (2019). Carbon dioxide emissions and trade: Evidence from disaggregate trade data. *Energy Economics*, *78*, 13-28.

Knott, C., & Neis, B. (2017). Privatization, financialization and ocean grabbing in New Brunswick herring fisheries and salmon aquaculture. Marine Policy, 80, 10-18.

Konefal, J. (2018). Fault lines in agricultural sustainability: Contestation, cooptation, reform, and transformation. In Contested Sustainability Discourses in the Agrifood System (pp. 279-286). Routledge.

Koopmans, T. (1965). On the concept of optimal growth, The Econometric Approach to Development Planning. *Econometric approach to development planning, 1st edn. North Holland, Amsterdam*, 225-287.

Kuznets, S. (1976). Demographic aspects of the size distribution of income: An exploratory essay. *Economic Development and Cultural Change*, *25*(1), 1-94.

Kuznets, S. (1955). Economic growth and income inequality. *The American economic review*, *45*(1), 1-28.

Labucay, I. D., & Stations, S. W. Gender Equality in Political Empowerment in Southeast Asia.

Lee, C. C., Chiu, Y. B., & Sun, C. H. (2010). The environmental Kuznets curve hypothesis for water pollution: Do regions matter?. *Energy Policy*, *38*(1), 12-23.

Lenssen, G., Arenas, D., Lacy, P., Pickard, S., & Sturchio, J. L. (2008). Business engagement in public programs: the pharmaceutical industry's contribution to public health and the millennium development goals. Corporate Governance: The international journal of business in society.

Lesníková, P., & Schmidtová, J. (2019, May). Performance of Enterprise Sector of Slovakia in Achieving Sustainable Development Goal Related to Industry and Innovation. In Economics, Management and Technology in Enterprises 2019 (EMT 2019). Atlantis Press.

Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The manchester school*, *22*(2), 139-191.

LEWIS, W. (1955). The theory of economic growth George Allen & Unwin.

Li, H., & Zhou, L. A. (2005). Political turnover and economic performance: the incentive role of personnel control in China. *Journal of public economics*, *89*(9-10), 1743-1762.

Lund, S., Windhagen, E., Manyika, J., Härle, P., Woetzel, J., & Goldshtein, D. (2017). The new dynamics of financial globalization. *McKinsey Global Institute*.

Maskin, E., Qian, Y., & Xu, C. (2000). Incentives, information, and organizational form. *The review of economic studies*, *67*(2), 359-378.

Manne, A. S., & Richels, R. G. (1999). The Kyoto Protocol: a cost-effective strategy for meeting environmental objectives? The Energy Journal, 20(Special Issue-The Cost of the Kyoto Protocol: A Multi-Model Evaluation).

McCann, J. (2013). Electoral quotas for women: An international overview. Parliamentary Library.

Mercer, J., Kelman, I., Alfthan, B., & Kurvits, T. (2012). Ecosystem-based adaptation to climate change in Caribbean small island developing states: integrating local and external knowledge. Sustainability, 4(8), 1908-1932.

Munang, R., & Mgendi, R. (2017). Paris Agreement on climate change: One year later, how is Africa faring?. Africa Renewal, 31(1), 32-33.

Nabarro, D. (2016). Transforming our world: How the Sustainable Development Goals will help us achieve zero hunger. IFPRI book chapters, 22-27.

Nazar, R., Chaudhry, I. S., Ali, S., & Faheem, M. (2018). Role Of Quality Education For Sustainable Development Goals (SDGS). PEOPLE: International Journal of Social Sciences, 4(2).

Obergassel, W., Arens, C., Hermwille, L., Kreibich, N., Mersmann, F., Ott, H. E., & Wang-Helmreich, H. (2015). Phoenix from the ashes: an analysis of the Paris Agreement to the United Nations Framework Convention on Climate Change; part 1.

O'Brien, K. J., & Li, L. (2017). Selective policy implementation in rural China. In *Critical Readings on Communist Party of China* (pp. 437-460). BRILL.

O'Leary, Z. (2011). *The essential guide to doing your research project*. Sage.

O'Neill, B. C., & Oppenheimer, M. (2002). Dangerous climate impacts and the Kyoto Protocol.

Outlook, B. E. 2019 edition. *London, United Kingdom2019*.

Ouyang, X., Shao, Q., Zhu, X., He, Q., Xiang, C., & Wei, G. (2019). Environmental regulation, economic growth and air pollution: Panel threshold analysis for OECD countries. *Science of The Total Environment*, *657*, 234-241.

Owusu, P. A., & Asumadu-Sarkodie, S. (2016). Revisiting the Environmental Interactions of Pesticides. *Environmental Chemistry*, *1*(1), 14-19.

Owusu, P. A., Asumadu-Sarkodie, S., & Ameyo, P. (2016). A review of Ghana's water resource management and the future prospect. *Cogent Engineering*, *3*(1), 1164275.

Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, *3*(1), 1167990.

Panayotou, T. (1993). *Empirical tests and policy analysis of environmental degradation at different stages of economic development* (No. 992927783402676). International Labour Organization.

Pao, H. T., & Chen, C. C. (2019). Decoupling strategies: CO2 emissions, energy resources, and economic growth in the Group of Twenty. *Journal of cleaner production*, *206*, 907-919.

Pasinetti, L. L. (1964). A Comment on Professor Meade's "Rate of Profit in a Growing Economy". *The Economic Journal*, *74*(294), 488-489.

Pelinescu, E. (2015). The impact of human capital on economic growth. *Procedia Economics and Finance*, *22*, 184-190.

Peters, G. P., Andrew, R. M., Canadell, J. G., Fuss, S., Jackson, R. B., Korsbakken, J. I., ... & Nakicenovic, N. (2017). Key indicators to track current progress and future ambition of the Paris Agreement. Nature Climate Change, 7(2), 118.

Piętak, Ł. (2014). Review of theories and models of economic growth. *Comparative Economic Research*, *17*(1), 45-60.

Powers, M. (2013). Water, Justice, and Public Health. In The Oxford Handbook of Public Health Ethics.

Poveda, A. C. (2011). Economic development, inequality and poverty: an analysis of urban violence in Colombia. *Oxford Development Studies*, *39*(4), 453-468.

Prskawetz, A., Fent, T., Barthel, W., Crespo-Cuaresma, J., Lindh, T., Malmberg, B., & Halvarsson, M. (2007). The relationship between demographic change and economic growth in the EU. *Report for Tender VT/2005/035*.

Raisová, M., & Ďurčová, J. (2014). Economic growth-supply and demand perspective. *Procedia Economics and Finance*, *15*, 184-191.

Ramsey, F. P. (1928). A mathematical theory of saving. *The economic journal*, *38*(152), 543-559.

Reid, H. (2011). Improving the evidence for ecosystem-based adaptation. Sustainable development opinion paper.

Reilly, J., Prinn, R., Harnisch, J., Fitzmaurice, J., Jacoby, H., Kicklighter, D., ... & Wang, C. (1999). Multi-gas assessment of the Kyoto Protocol. Nature, 401(6753), 549.

Robinson, J., Bradley, M., Busby, P., Connor, D., Murray, A., Sampson, B., & Soper, W. (2006). Climate change and sustainable development: realizing the opportunity. AMBIO: A Journal of the Human Environment, 35(1), 2-9.

Rosche, D. (2016). Agenda 2030 and the sustainable development goals: Gender equality at last? An Oxfam perspective. Gender & Development, 24(1), 111-126.

Rostow, W. W. (1960). *The stages of growth: A non-communist manifesto* (pp. 4-16). Cambridge: Cambridge University Press.

Roy, S. (2019). Living standards: reexamining the standard of living of the people of the Southwest coastal areas of Bangladesh: evidences from the Sustainable Development Goal 9. Encyclopedia of the UN Sustainable Development Goals: Industry, Innovation and Infrastructure, 1-11.

Ridgway, V. (2018). Elderly Persons Health and Wellbeing.

Sarkodie, S. A., & Strezov, V. (2019a). Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries. *Science of the Total Environment*, *646*, 862-871.

Sarkodie, S. A., & Strezov, V. (2019b). A review on Environmental Kuznets Curve hypothesis using bibliometric and meta-analysis. *Science of the total environment*, *649*, 128-145.

Sarkodie, S. A., & Strezov, V. (2018a). Assessment of contribution of Australia's energy production to CO2 emissions and environmental degradation using statistical dynamic approach. *Science of The Total Environment*, *639*, 888-899.

Sarkodie, S. A., & Strezov, V. (2018b). Empirical study of the environmental Kuznets curve and environmental sustainability curve hypothesis for Australia, China, Ghana and USA. *Journal of cleaner production*, *201*, 98-110.

Saunders, M., Lewis, P., & Thornhill, A. (2015). Research Methods for Business Students (7th New ed).

Sands, P. (1992). The United Nations framework convention on climate change. Review of European Community & International Environmental Law, 1(3), 270-277.

Sant'Anna, A. A., & Young, C. E. F. (2010). Property rights, deforestation and rural conflicts in Amazonia. Economia Aplicada, 14(3), 381-393.

Schumpeter, J. A., & Redvers, O. P. I. E. (1934). *Theorie der wirtschaftlichen Entwicklung. The Theory of Economic Development. An inquiry into profits, capital, credit, interest, and the business cycle... Translated... by Redvers Opie*.

Shabani, Z. D., & Shahnazi, R. (2019). Energy consumption, carbon dioxide emissions, information and communications technology, and gross domestic product in Iranian economic sectors: a panel causality analysis. *Energy*, *169*, 1064-1078.

Shahbaz, M., Balsalobre-Lorente, D., & Sinha, A. (2019). Foreign direct Investment–CO2 emissions nexus in Middle East and North African countries: Importance of biomass energy consumption. *Journal of cleaner production*, *217*, 603-614.

Shahbaz, M., Haouas, I., & Van Hoang, T. H. (2019). Economic growth and environmental degradation in Vietnam: Is the environmental Kuznets curve a complete picture?. *Emerging Markets Review*, *38*, 197-218.

Shindell, D., Borgford-Parnell, N., Brauer, M., Haines, A., Kuylenstierna, J. C. I., Leonard, S. A., ... & Srivastava, L. (2017). A climate policy pathway for near- and long-term benefits. Science, 356(6337), 493-494.

Singh, G. G., Cisneros-Montemayor, A. M., Swartz, W., Cheung, W., Guy, J. A., Kenny, T. A., ... & Sumaila, R. (2018). A rapid assessment of co-benefits and trade-offs among Sustainable Development Goals. Marine Policy, 93, 223-231.

Soares Oliveira, T. (2018). Businesses, the UN and decent work promotion: a case study of H&M, ILO and Sida's engagement in Cambodia.

Solorzano, C. R., & Fleischman, F. (2018). Institutional legacies explain the comparative efficacy of protected areas: Evidence from the Calakmul and Maya Biosphere Reserves of Mexico and Guatemala. Global Environmental Change, 50, 278-288.

Sznida, E. (2018). The EU's Path Toward Sustainable Development Goals–Responsible Consumption and Production. Available at SSRN 3292067.

Tompkins, E. L., & Amundsen, H. (2008). Perceptions of the effectiveness of the United Nations Framework Convention on Climate Change in advancing national action on climate change. Environmental Science & Policy, 11(1), 1-13.

United Nations (UN) (2018) World Economic Situation and Prospects, *United Nations, New York.*

United Nations Conference on Trade and Development (UNCTAD) (2017a), The State of Commodity Dependence 2016, *United Nations publication, Geneva*

United Nations Conference on Trade and Development (UNCTAD) (2017b) Review of Maritime Transport. *United Nations publication*, Geneva.

United Nations World Tourism Organization (UNWTO) (2017). *UNWTO Tourism Highlights 2017 edition.*

United Nations General Assembly (2015) International Trade and Development. *Report of the Secretary General,* A/70/277. 4 August

Uzawa, H. (1963). On a two-sector model of economic growth II. *The Review of Economic Studies*, *30*(2), 105-118.

Vasconcellos Oliveira, R. (2018). Back to the future: The potential of intergenerational justice for the achievement of the sustainable development goals. Sustainability, 10(2), 427.

von Hirschhausen, C., Flekstad, M., & Meran, G. (2017). Clean drinking water as a Sustainable Development Goal: fair, universal access with increasing block tariffs. DIW Economic Bulletin, 7(28/29), 292-298.

Wahab, S. A., Zawawi, N. F. M., & Fazal, S. A. Sustainable Development and Innovation: Defining the Concept and Malaysian Participation.

Wang, Z., Bu, C., Li, H., & Wei, W. (2019). Seawater environmental Kuznets curve: Evidence from seawater quality in China's coastal waters. *Journal of Cleaner Production*, *219*, 925-935.

World Health Organization. (2003). Progress of maternal mortality reduction in the Western Pacific Region.

Yeates, N. (2014a). Global Poverty Reduction: What can regional organisations do?

Yeates, N. (2014b). Global contexts and challenges of building a regional governance of social policy: Implications for South America.

Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage publications.

Zeren, F., & Ari, A. (2013). Trade openness and economic growth: A panel causality test. *International journal of business and social science*, *4*(9).

Zhang, L., Pang, J., Chen, X., & Lu, Z. (2019). Carbon emissions, energy consumption and economic growth: Evidence from the agricultural sector of China's main grain-producing areas. *Science of the Total Environment*, *665*, 1017-1025.

APPENDIX 1: Global Economies Causality Test Results

Table 4: Pairwise Dumitrescu-Hurlin causality test for Global economies	
GLI→FDI	GEI↔GAI
FDI→REC	GLI↔GAI
EEU→FDI	GDP↔GAI
	GDP2↔GAI
	GDP3↔GAI
	ICV↔GAI
	EEU↔GAI
	REC↔GAI
	IGS↔GAI
	EGS↔GAI
	FDI↔GAI
	DCP↔GAI
	GLI↔GEI
	GDP↔GEI
	GDP2↔GEI
	GDP3↔GEI
	REC↔GEI
	IGS↔GEI
	EGS↔GEI
	FDI↔GEI
	DCP↔GEI
	GDP↔GLI
	GDP2↔GLI
	GDP3↔GLI
	ICV↔GLI
	EEU↔GLI
	REC↔GLI

	IGS↔GLI
	EGS↔GLI
	DCP↔GLI
	GDP2↔GDP
	GDP3↔GDP
	ICV↔GDP
	EEU↔GDP
	REC↔GDP
	IGS↔GDP
	EGS↔GDP
	FDI↔GDP
	DCP↔GDP
	GDP3↔GDP2
	ICV↔GDP2
	EEU↔GDP2
	REC↔GDP2
	IGS↔GDP2
	EGS↔GDP2
	FDI↔GDP2
	DCP↔GDP2
	ICV↔GDP3
	EEU↔GDP3
	REC↔GDP3
	IGS↔GDP3
	EGS↔GDP3
	FDI↔GDP3
	DCP↔GDP3
	EEU↔ICV
	REC↔ICV
	IGS↔ICV
	EGS↔ICV
	FDI↔ICV

	DCP↔ICV
	REC↔EEU
	IGS↔EEU
	EGS↔REC
	DCP↔REC
	EGS↔IGS
	FDI↔IGS
	DCP↔IGS
	FDI↔EGS
	DCP↔EGS
	DCP↔FDI

Notes: Global atmospheric index, Global land degradation index and Global environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 2: African Economies Causality Test Results

Table 7: Pairwise Dumitrescu-Hurlin causality tests for African countries

Unidirectional	Bidirectional
AFAI→AFEI	IGS↔AFAI
GDP→AFAI	GDP↔AFEI
GDP2→AFAI	GDP2↔AFEI
GDP3→AFAI	GDP3↔AFEI
ICV→AFAI	REC↔AFEI
AFAI→EGS	IGS↔AFEI
DCP→AFAI	EGS↔AFEI
AFLI→AFEI	GDP↔AFLI
ICV→AFEI	GDP2↔AFLI
EEU→AFEI	GDP3↔AFLI
DCP→AFEI	REC↔AFLI
ICV→AFLI	IGS↔AFLI
EEU→AFLI	EGS↔AFLI
GDP→ICV	DCP↔AFLI
GDP→EGS	GDP2↔GDP
FDI→GDP	GDP3↔GDP
GDP2→EGS	EEU↔GDP
FDI→GDP2	REC↔GDP
FDI→GDP3	IGS↔GDP
FDI→ICV	DCP↔GDP
EEU→REC	GDP3↔GDP2
EEU→EGS	ICV↔GDP2
EEU→DCP	EEU↔GDP2
IGS→REC	REC↔GDP2
EGS→REC	IGS↔GDP2
FDI→REC	DCP↔GDP2

FDI→IGS	ICV↔GDP3
FDI→EGS	EEU↔GDP3
	REC↔GDP3
	IGS↔GDP3
	EGS↔GDP3
	DCP↔GDP3
	EEU↔ICV
	REC↔ICV
	IGS↔ICV
	EGS↔ICV
	DCP↔ICV
	IGS↔EEU
	DCP↔REC
	EGS↔IGS
	DCP↔IGS
	DCP↔EGS

Notes: African atmospheric index, African land degradation index and African environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 3: Asian Economies Causality Tests Results

Table 10: Pairwise Dumitrescu-Hurlin causality test for Asian countries

Unidirectional	Bidirectional
ASAI→ASLI	GDP3↔ASAI
GDP→ASAI	EGS↔ASAI
GDP2→ASAI	DCP↔ASAI
ICV→ASAI	GDP↔ASEI
EEU→ASAI	GDP2↔ASEI
REC→ASAI	GDP3↔ASEI
IGS→ASAI	EEU↔ASEI
ASEI→ASLI	REC↔ASEI
ASEI→ICV	IGS↔ASEI
ASEI→DCP	EGS↔ASEI
ASLI→REC	GDP↔ASLI
ASLI→FDI	GDP2↔ASLI
ASLI→DCP	GDP3↔ASLI
GDP→ICV	ICV↔ASLI
GDP→REC	EEU↔ASLI
GDP→DCP	IGS↔ASLI
GDP2→REC	EGS↔ASLI
GDP3↔EEU	GDP2↔GDP
GDP3→DCP	GDP3↔GDP
ICV→REC	EEU↔GDP
FDI→EEU	IGS↔GDP
EEU→DCP	EGS↔GDP
IGS→REC	FDI↔GDP
FDI→REC	GDP3↔GDP2
IGS→FDI	ICV↔GDP2
IGS→DCP	EEU↔GDP2

	IGS↔GDP2
	EGS↔GDP2
	IGS↔GDP2
	EGS↔GDP2
	FDI↔GDP2
	ICV↔GDP3
	REC↔GDP3
	IGS↔GDP3
	EGS↔GDP3
	FDI↔GDP3
	EEU↔ICV
	IGS↔ICV
	EGS↔ICV
	REC↔EEU
	IGS↔EEU
	EGS↔EEU
	EGS↔REC
	DCP↔REC
	EGS↔IGS
	FDI↔EGS
	DCP↔EGS
	DCF↔FDI

Notes: Asian atmospheric index, Asian land degradation index and Asian environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 4: European Economies Causality Test Results

Table 13: Pairwise Dumitrescu-Hurlin causality test for European countries

Unidirectional causality	Bidirectional causality
EUAI→EULI	EUAI↔EEU
EUAI →EUEI	EGS↔EUAI
GDP→EUAI	EUEI↔EULI
GDP2→EUAI	GDP↔EULI
GDP3→EUAI	ICV↔EULI
ICV→EUAI	DCP↔EULI
REC→EUAI	GDP↔EUEI
IGS→EUAI	GDP2↔EUEI
DCP→EUAI	GDP3↔EUEI
EULI→GDP3	ICV↔EUEI
EULI→EEU	IGS↔EUEI
EULI→IGS	EGS↔EUEI
EULI→EGS	EEU↔GDP
EUEI→EEU	REC↔GDP
REC→EEU	IGS↔GDP
DCP→EEU	REC↔GDP2
GDP→ICV	IGS↔GDP2
FDI→GDP	EGS↔GDP2
DCF→GDP	REC↔GDP3
EEU→GDP2	IGS↔GDP3
FDI→GDP2	EGS↔GDP3
GDP2→DCP	IGS↔ICV
EEU→GDP3	DCP↔ICV
FDI→GDP3	REC↔EEU
GDP3→DCP	IGS↔EEU
ICV→REC	IGS↔REC

ICV→EGS	EGS↔REC
EGS→EEU	
DCP→EEU	
DCP→REC	
EGS→IGS	
FDI→IGS	
FDI→EGS	
EGS→DCP	
DCP→FDI	

Notes: European atmospheric index, European land degradation index and European environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 5: The Americas Economies Causality Test Results

Table 16: Pairwise Dumitrescu-Hurlin causality test for the Americas	
Unidirectional	Bidirectional
GDP→AMAI	REC↔AMAI
GDP2→AMAI	GDP2↔AMEI
ICV→AMAI	GDP3↔AMEI
AMAI→EGS	ICV↔AMEI
DCP→AMAI	REC↔AMEI
GDP→AMEI	IGS↔AMEI
AMEI→EEU	GDP↔AMLI
EGS→AMEI	GDP2↔AMLI
DCP→AMEI	GDP3↔AMLI
AMLI→REC	ICV↔AMLI
AMLI→EGS	EEU↔AMLI
DCP→AMLI	IGS↔AMLI
GDP→ICV	EEU↔GDP
GDP→REC	EGS↔GDP
FDI→GDP	EEU↔GDP2
GDP→DCP	EGS↔GDP2
GDP2→ICV	DCP↔GDP2
GDP2→REC	EEU↔GDP3
FDI→GDP2	EGS↔GDP3
GDP3→ICV	DCP↔GDP3
GDP3→REC	EEU↔ICV
FDI→GDP3	REC↔ICV
IGS→ICV	EGS↔ICV
FDI→ICV	DCP↔ICV
EEU→EGS	REC↔EEU
EEU→FDI	DCP↔EEU
IGS→REC	DCP↔REC

EGS→REC	EGS↔IGS
FDI→IGS	DCP↔EGS
IGS→DCP	
DCP→FDI	

Notes: Americas atmospheric index, Americas land degradation index and Americas environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 6: Emerging Economies Causality Test Results

Table 19: Pairwise Dumitrescu-Hurlin causality tests for Emerging countries

Unidirectional	Bidirectional
GDP→CO2	FFC↔CO2
GDP2→CO2	DCF↔CO2
IVA→CO2	NOE↔FFC
CO2→TRS	GDP↔FFC
CO2→TSP	GDP2↔FFC
CO2→REC	DCF↔FFC
IVA→FFC	TSP↔TSP
TRS→FFC	GDP2↔GDP
FFC→REC	IVA↔GDP
EPC→FFC	DCF↔GDP
GDP→NOE	REC↔GDP
GDP2→NOE	DCF↔GDP2
IVA→NOE	REC↔GDP2
DCF→NOE	DCF↔IVA
NOE→TRS	TSP↔IVA
TSP→NOE	TRS↔DCF
REC→NOE	TSP↔DCF
EPC→NOE	EPC↔DCF
GDP→TRS	TSP↔TRS
GDP→TSP	
GDP→EPC	
IVA→GDP2	
GDP2→TRS	
GDP2→TSP	
IVA→TRS	
IVA→REC	

REC→TRS	
EPC→TSP	
EPC→REC	

Notes: Emerging atmospheric index, Emerging land degradation index and Emerging environmental index were used as dependent variables, → shows a unidirectional causality and ↔ dictates a bidirectional causality.

APPENDIX 7: African Proportions Based On Principal Component Analysis (PCA)

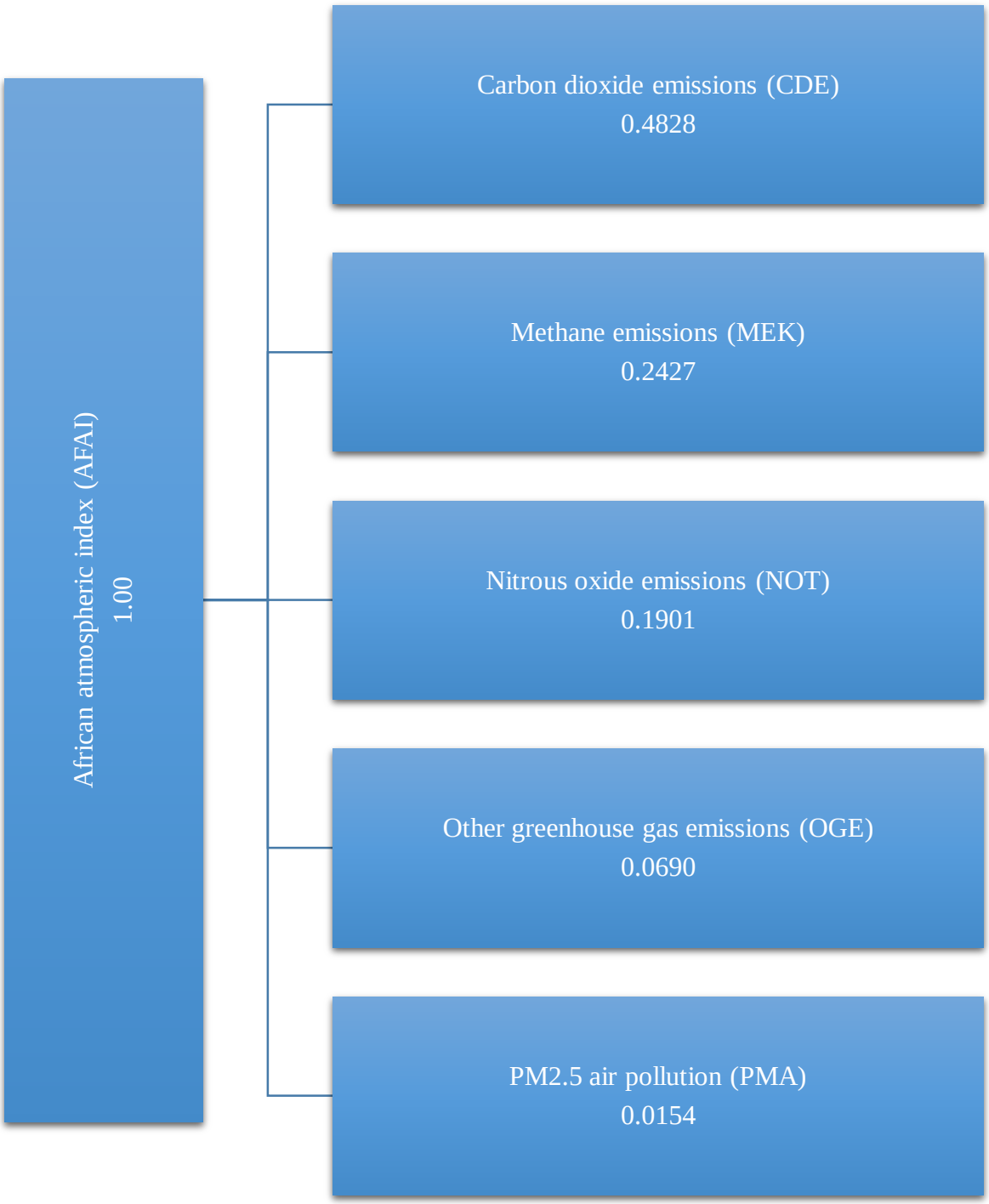

Figure 4: Proportion of atmospheric indicators

APPENDIX 8: African Proportions Based On Principal Component Analysis (PCA)

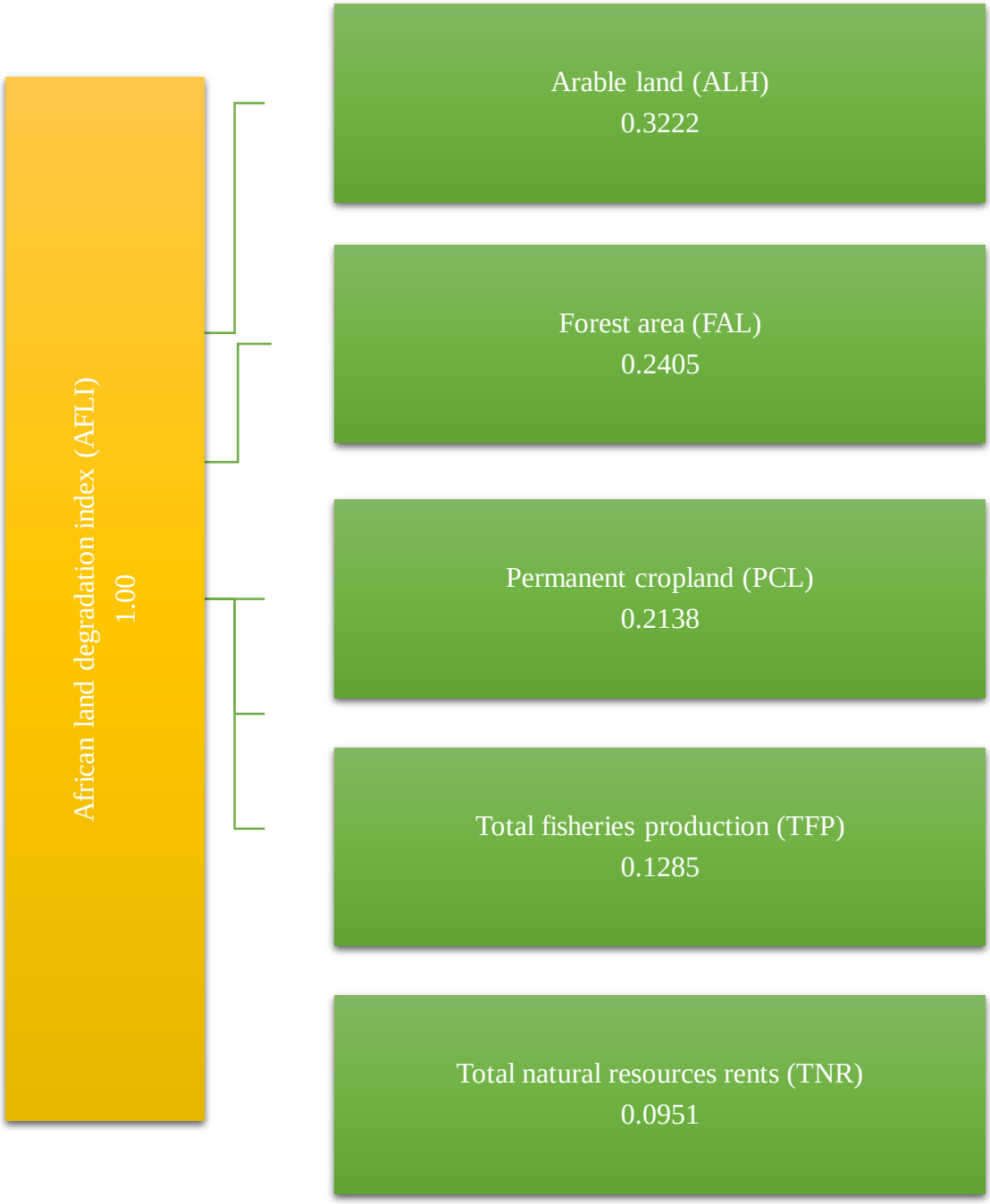

Figure 5: Proportion of land indicators

APPENDIX 9: African proportions based on Principal Component Analysis (PCA)

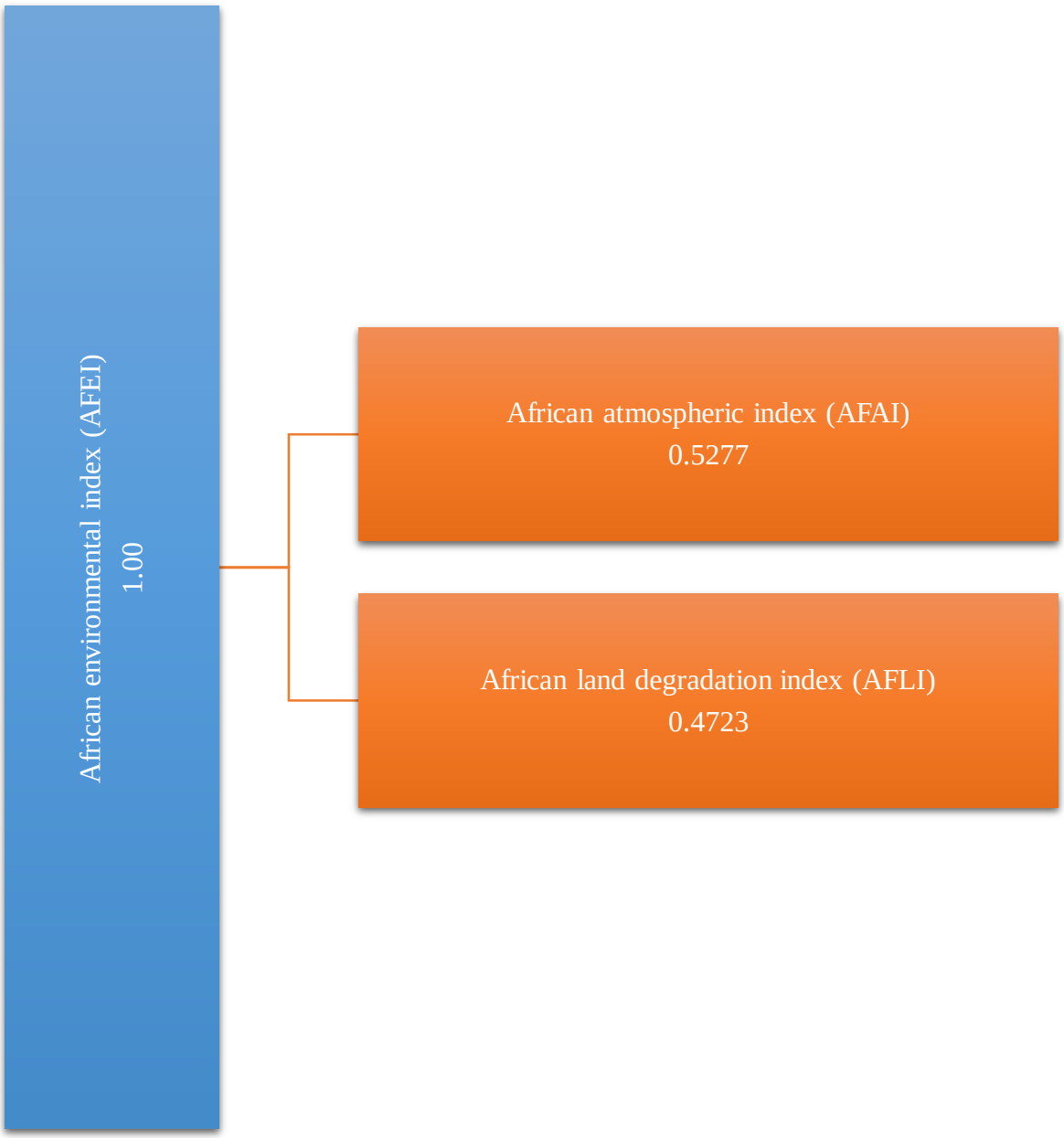

Figure 6: Proportion of atmospheric index and land degradation index

APPENDIX 10: Asian Proportions Based On Principal Component Analysis (PCA)

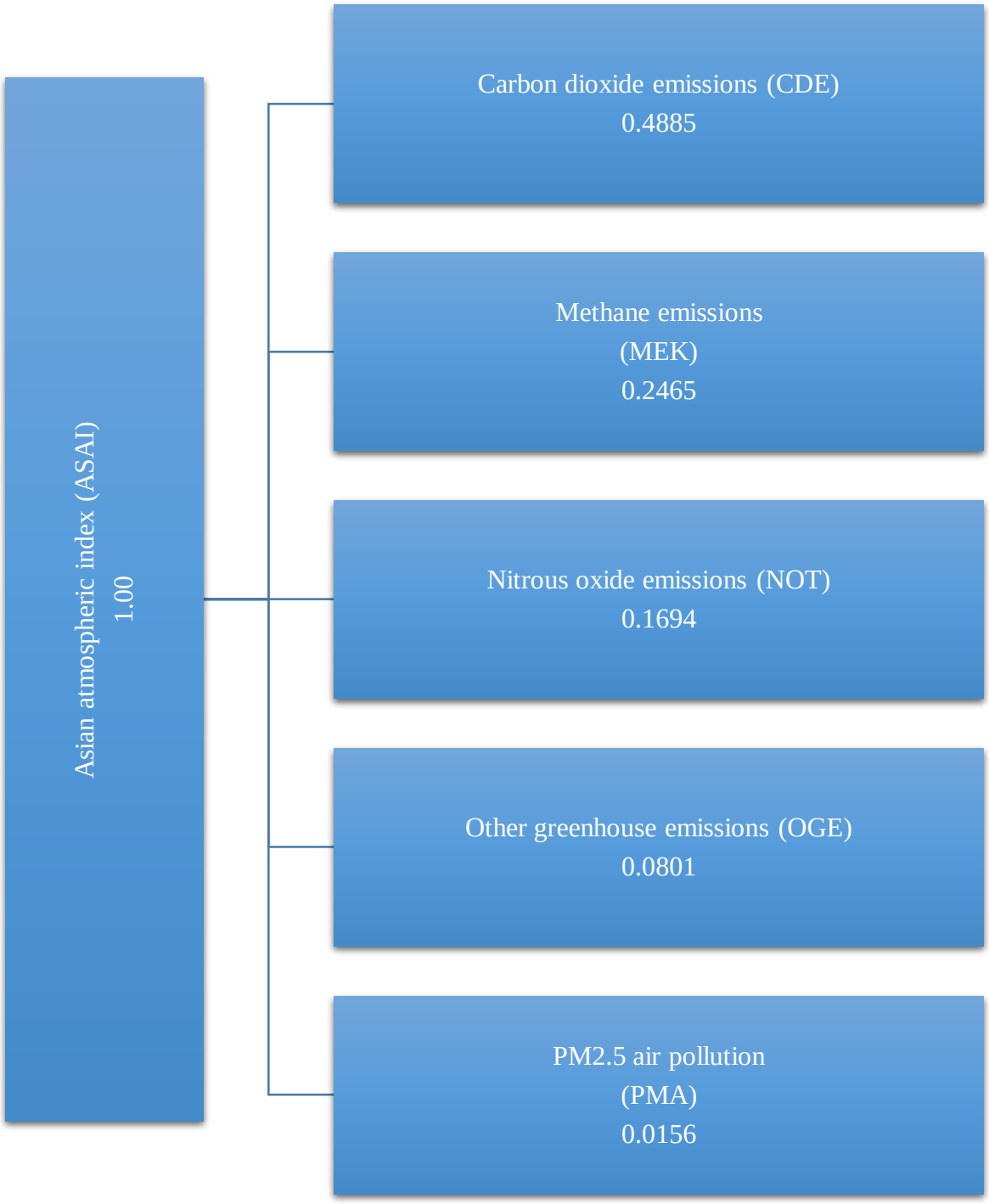

Figure 7: Proportion of atmospheric indicators

APPENDIX 11: Asian Proportions Based On Principal Component Analysis (PCA)

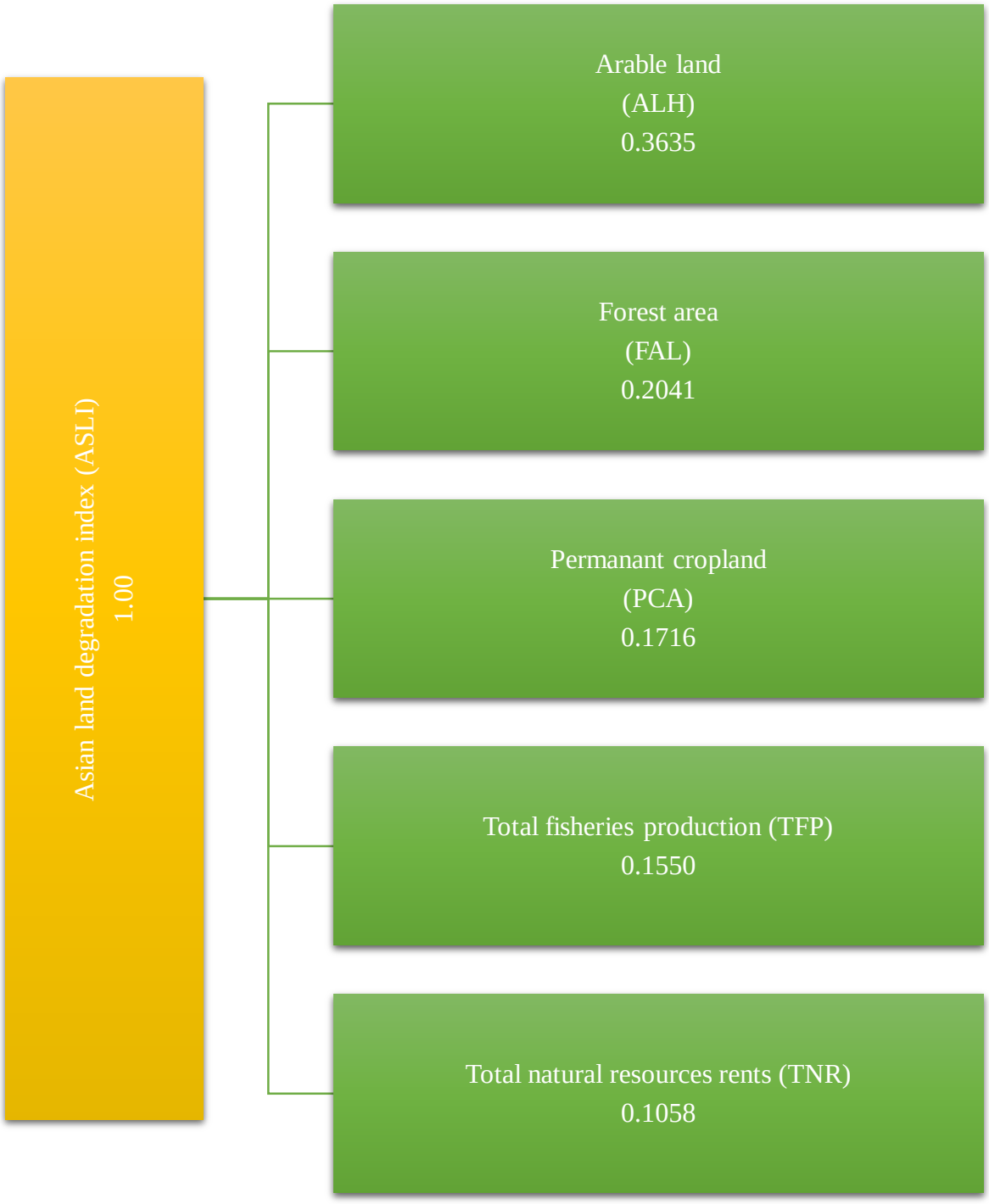

Figure 8: Proportion of land indicators

APPENDIX 12: Asian Proportions Based On Principal Component Analysis (PCA)

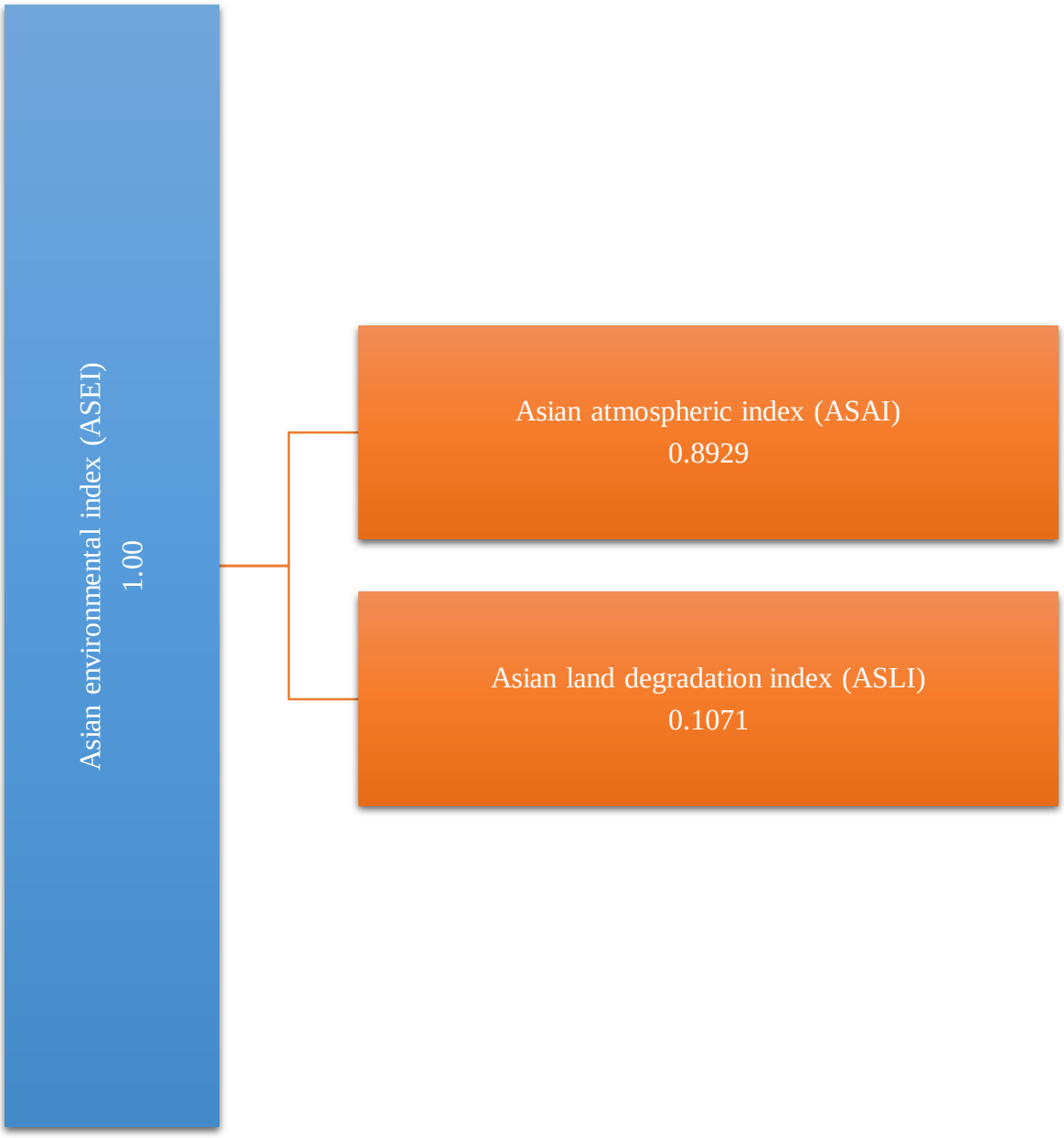

Figure 9: Proportion of atmospheric index and land degradation index

APPENDIX 13: European Proportions Based On Principal Component Analysis (PCA)

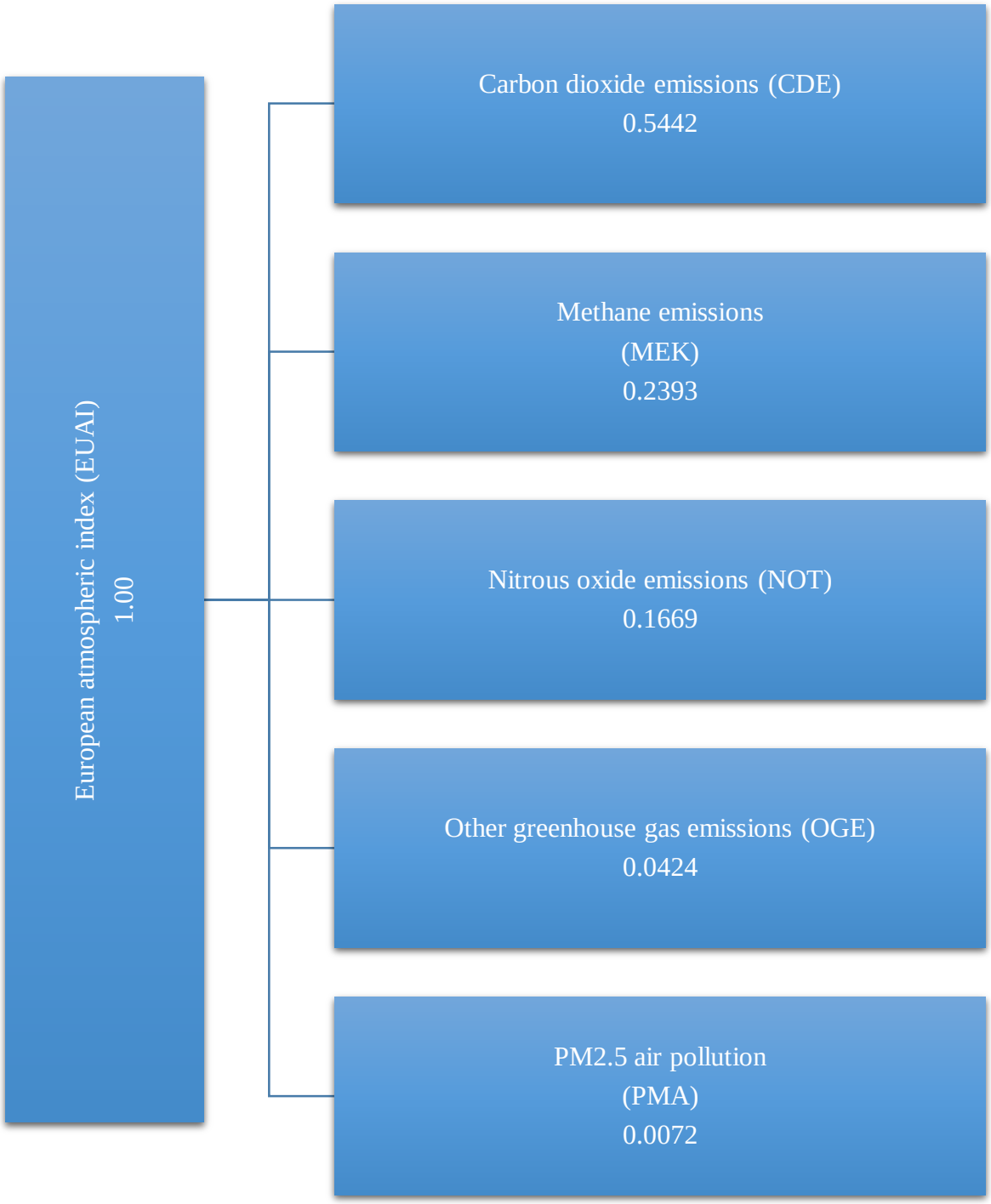

Figure 10: Proportion of atmospheric indicators

APPENDIX 14: European Proportions Based On Principal Component Analysis (PCA)

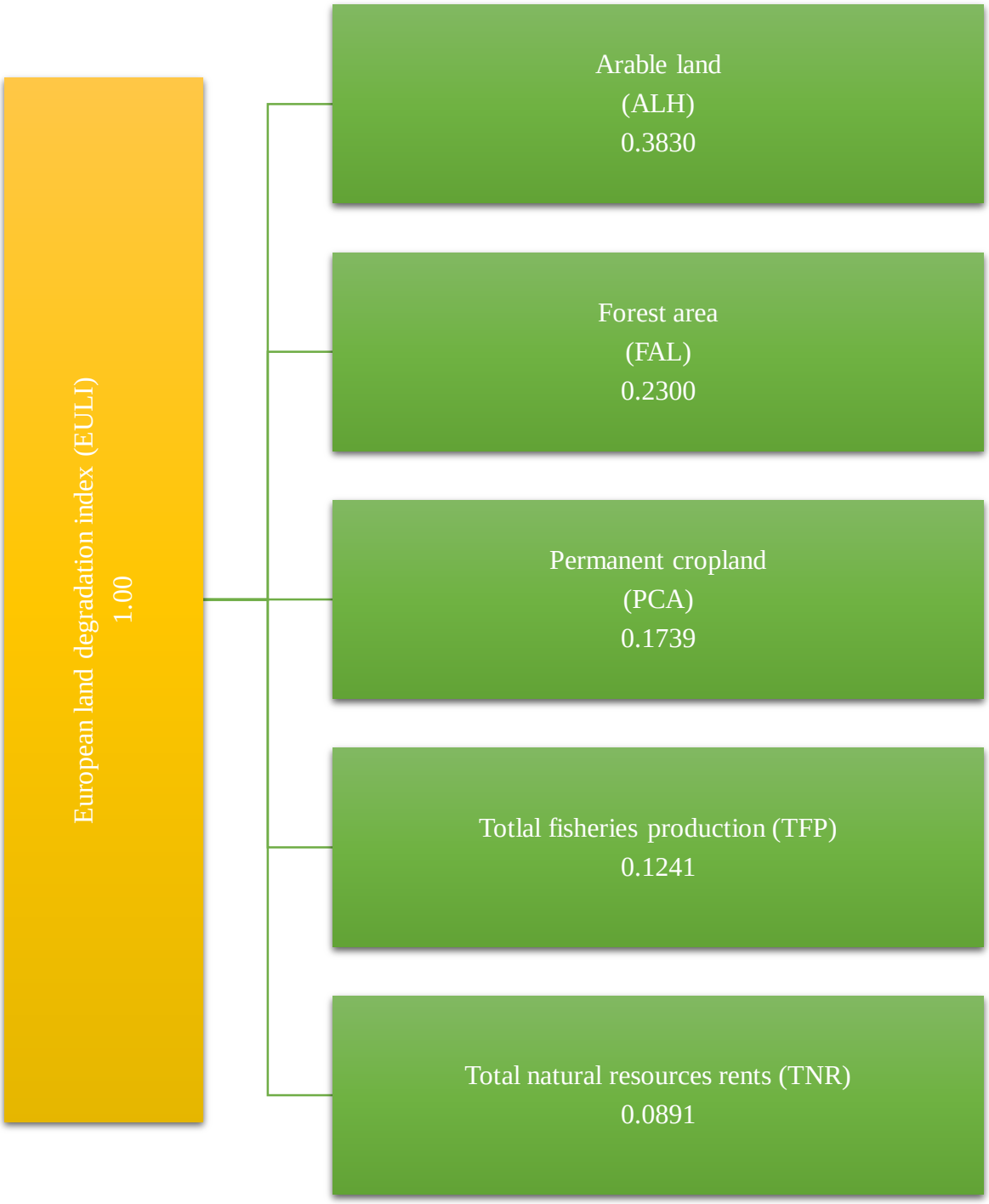

Figure 11: Proportion of land indicators

APPENDIX 15: European Proportions Based On Principal Component Analysis (PCA)

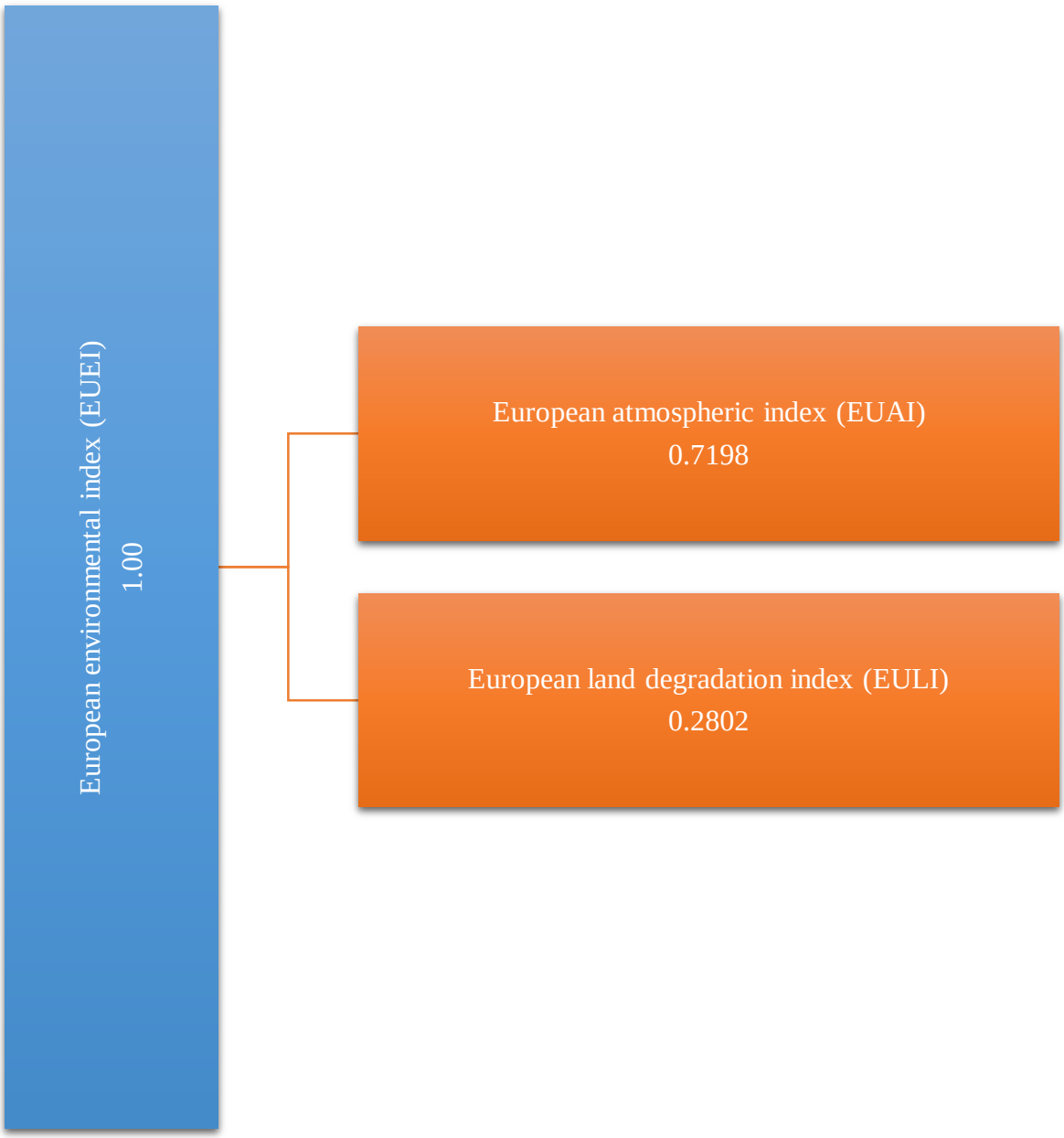

Figure 12: Proportion of atmospheric index and land degradation index

APPENDIX 16: The Americas Proportions Based On Principal Component Analysis (PCA)

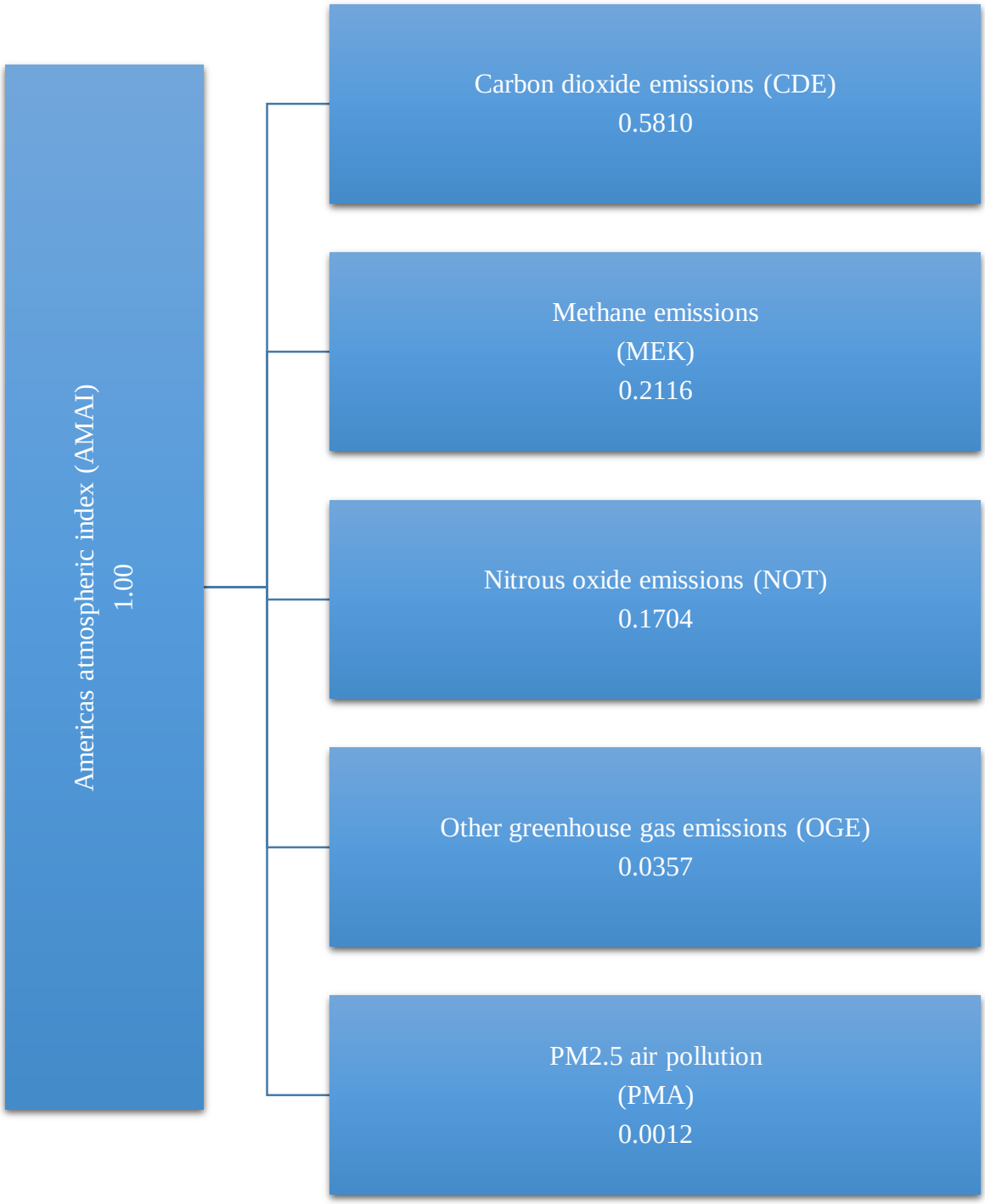

Figure 13: Proportion of atmospheric indicators

APPENDIX 17: The Americas Proportions Based On Principal Component Analysis (PCA)

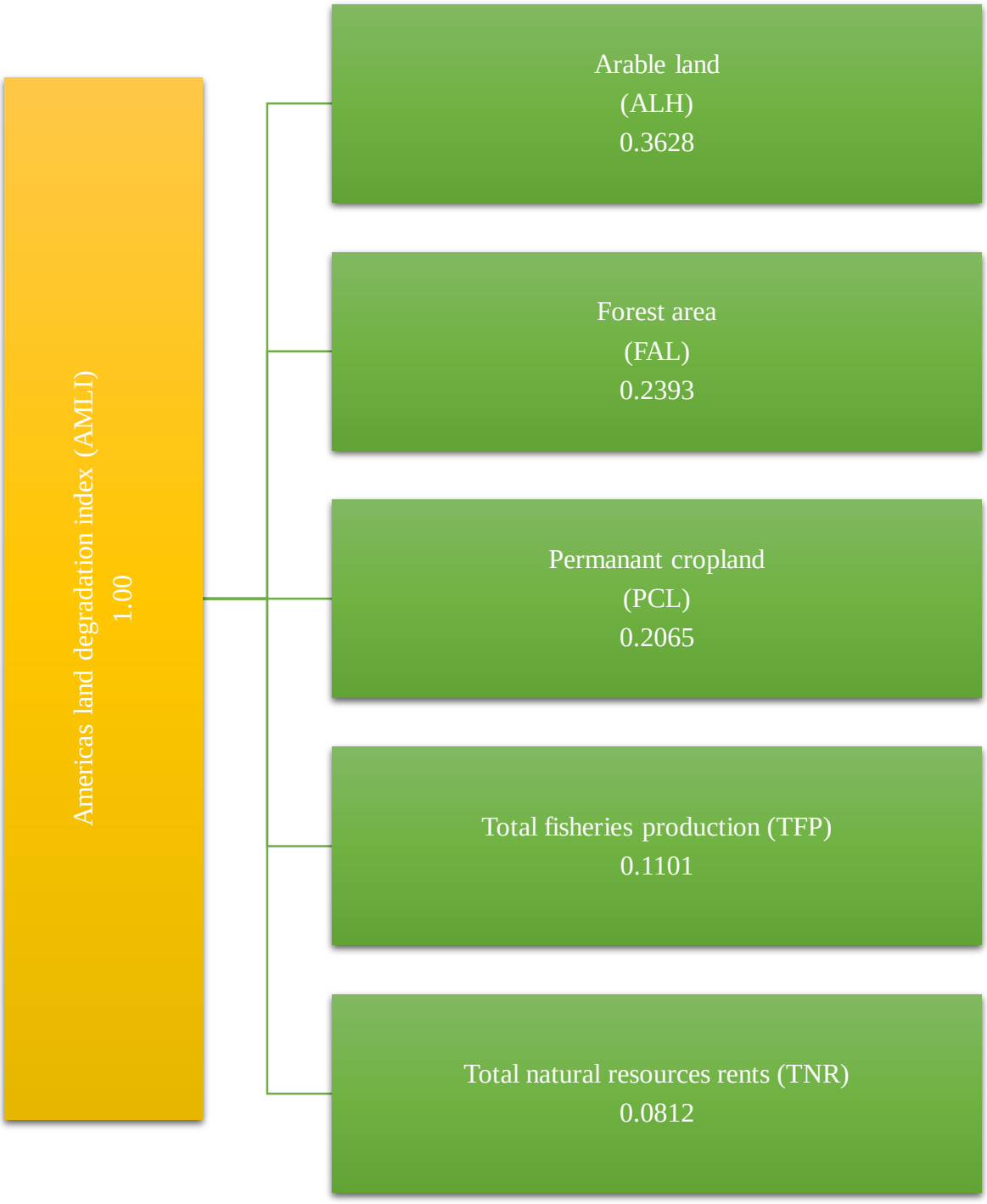

Figure 14: Proportion of land indicators

APPENDIX 18: The Americas Proportions Based On Principal Component Analysis (PCA)

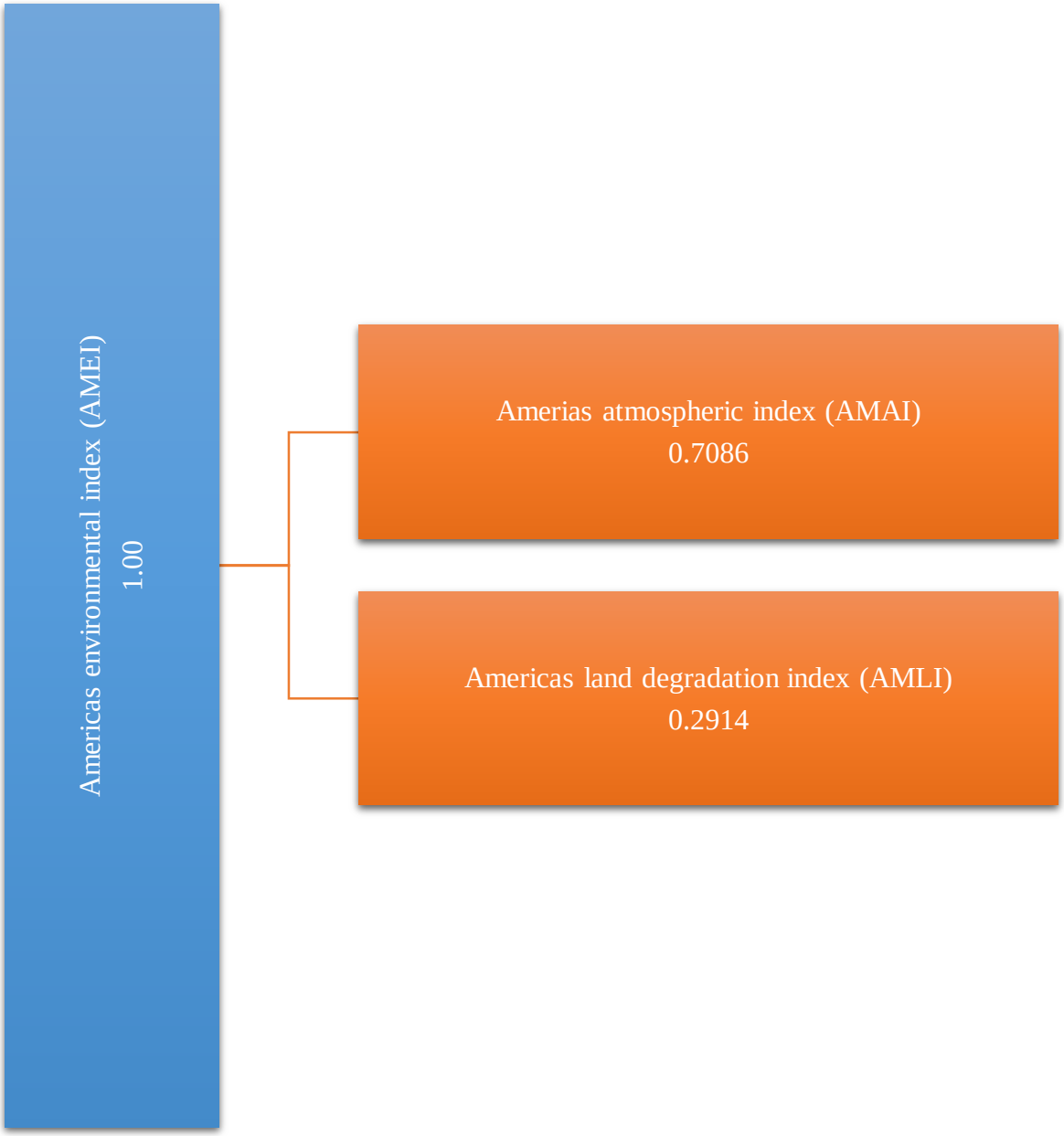

Figure 15: Proportion of atmospheric index and land degradation index

APPENDIX 19: Definitions and Descriptive Statics of Global Variables

Table 20: Definitions and Description of Global variable

Variable	Description of the variable	Mean	Std.Dev.	Obs.
GAI	Global atmospheric index	0.10000	0.15532	2185
GLI	Global land degradation index	0.05000	0.01178	2185
GEI	Global environmental index	0.07500	0.07797	2185
GDPC	Per capita GDP	14538.6	18429.1	2185
$GDPC^2$	Square of per capita GDPC	5.51E+1	1.16E+1	2185
$GDPC^3$	Cubic of per capita GDPC	2.81E+1	8.35E1	2185
ICV	Industry value added	1.25E+1	3.45E+1	2185
EEU	GDP per unit of energy use	11.5640	20.1038	2185
REC	Renewable energy consumption	31.7085	27.5582	2185
IGS	Imports of goods and services	1.31E+1	2.97E+1	2185
EGS	Exports of goods and services	1.33E+1	2.68E+1	2185
DCP	Domestic credit provided	71.7602	61.6721	2185
FDI	Foreign direct investments	4.50355	7.99611	2185

Source: Researchers' computations

APPENDIX 20: Definitions and Descriptive Statics of African Variables

Table 21: Definitions and Description of African Variables

Variable	Description of the variable	Mean	Std.Dev.	Obs.
AFAI	African atmospheric index	0.02000	0.01555	551
AFLI	African land degradation index	0.03000	0.01270	551
AFEI	African environmental index	0.02000	0.01028	551
GDPC	Per capita GDP	2828.85	3199.71	551
$GDPC^2$	Square of per capita GDPC	1822199	4754742	551
$GDPC^3$	Cubic of per capita GDPC	1.91E+1	7.99E+1	551
ICV	Industry value added	1.75E+1	2.90E+1	551
EEU	GDP per unit of energy use	15.4979	32.2726	551
REC	Renewable energy consumption	55.5659	30.1468	551
IGS	Imports of goods and services	1.63E+1	2.44E+1	551
EGS	Exports of goods and services	1.72E+1	2.77E+1	551
DCP	Domestic credit provided	34.0308	40.3104	551
FDI	Foreign direct investments	3.64324	5.42516	551

Source: Researchers' computations

APPENDIX 21: Definitions and Descriptive Statics of Asian Variables

Table 22: Descriptions and Definitions of Asian Variables

Variable	Description of the variable	Mean	Std.Dev.	Obs.
ASAI	Asian atmospheric index	0.02000	0.01564	551
ASLI	Asian land degradation index	0.04000	0.01349	551
ASEI	Asian environmental index	0.03000	0.01112	551
GDPC	Per capita GDP	12165.4	14984.4	551
$GDPC^2$	Square of per capita GDPC	3.72E+1	7.08E+1	551
$GDPC^3$	Cubic of per capita GDPC	1.46E+1	3.52E+1	551
ICV	Industry value added	1.56E+1	3.16E+1	551
EEU	GDP per unit of energy use	12.3166	22.5021	551
REC	Renewable energy consumption	23.6357	26.8126	551
IGS	Imports of goods and services	1.31E+1	1.93E+1	551
EGS	Exports of goods and services	1.45E+1	2.05E+1	551
DCP	Domestic credit provided	77.8470	73.3898	551
FDI	Foreign direct investments	5.36562	11.5726	551

Source: Researchers' computations

APPENDIX 22: Definitions and Descriptive Statics of Europe Variables

Table 23: Description and Definition of European Variables

Variable	Description of the variable	Mean	Std.Dev.	Obs.
EUAI	European atmospheric index	0.02000	0.01651	494
EULI	European land degradation index	0.03000	0.01385	494
EUEI	European environmental index	0.03000	0.01201	494
GDPC	Per capita GDP	29512.8	16198.3	494
$GDPC^2$	Square of per capita GDPC	1.13E+1	1.06E+1	494
$GDPC^3$	Cubic of per capita GDPC	5.01E+1	1.06E+1	494
ICV	Industry value added	1.48E+1	2.17E+1	494
EEU	GDP per unit of energy use	9.07475	3.35562	494
REC	Renewable energy consumption	16.7523	11.5718	494
IGS	Imports of goods and services	2.40E+1	3.02E+1	494
EGS	Exports of goods and services	2.51E+1	3.29E+1	494
DCP	Domestic credit provided	114.898	60.8120	494
FDI	Foreign direct investments	6.38836	13.6574	494

Source: Researchers' computations

APPENDIX 23: Definitions and Descriptive Statics of the Americas Variables

Table 24: Description and Definition of the Americas Variables

Variable	Description of the variable	Mean	Std.Dev.	Obs.
GAI	Global atmospheric index	0.02000	0.07708	418
GLI	Global land degradation index	0.04002	0.01708	418
GEI	Global environmental index	0.03002	0.01193	418
GDPC	Per capita GDP	13569.6	16406.7	418
$GDPC^2$	Square of per capita GDPC	4.53E+1	8.60E+1	418
$GDPC^3$	Cubic of per capita GDPC	1.98E+1	4.48E+1	418
ICV	Industry value added	8.46E+1	1.41E+1	418
EEU	GDP per unit of energy use	919409	3.43724	418
REC	Renewable energy consumption	32.1409	22.9480	418
IGS	Imports of goods and services	6.59E+1	1.18E+1	418
EGS	Exports of goods and services	7.32E+1	1.28E+1	418
DCP	Domestic credit provided	63.8387	42.2896	418
FDI	Foreign direct investments	3.46696	2.84914	418

Source: Researchers' computations

APPENDIX 24: Definitions and Descriptive Statics of Emerging Economies Variables

Table 25: Definitions and Description of Emerging Economies Variables

Variable	Description of the variable	Mean	Std.Dev.	Obs.
CO2	Carbon dioxide emissions	4.2224	3.4180	264
FFC	Fossil fuel energy consumption	75.2898	22.3453	264
NOE	Nitrous oxide emissions	58.789.1	106413.4	264
GDP	GDP per capita	8765.55	9136.019	264
GDP^2	Square of GDP per capita	1.60E+1	3.68E+08	264
IVA	Industry value added	2.06E+1	4.06E+11	264
DCF	Domestic credit provided	72.0838	43.3773	264
TRS	Travel services	42.3222	21.8353	264
TSP	Transport services	24.5241	14.7709	264
REC	Renewable energy consumption	25.0191	23.5005	264
EPC	Electric power consumption	2599.72	2172.507	264

Source: Researchers' computations

APPENDIX 25: Environmental Sustainability Indicators

Environmental sustainability indicators based on literature reviewed include the following:

- Atmospheric-indicators
- Land-indicators
- Coasts, seas, oceans, and biodiversity indicators
- Freshwater-indicators

Box 1: Environmental sustainability indicators

APPENDIX 19: List of Global Economies

1. Albania
2. Algeria
3. Angola
4. Argentina
5. Australia
6. Austria
7. Azerbaijan
8. Bahamas
9. Bangladesh
10. Belarus
11. Belgium
12. Belize
13. Benin
14. Bhutan
15. Bolivia
16. Bosnia and Herzegovina
17. Botswana
18. Brazil
19. Brunei
20. Bulgaria
21. Cabo Verde
22. Cambodia
23. Cameroon
24. Canada
25. Colombia
26. Comoros
27. Congo (DRC)
28. Costa Rica
29. Cote D'Ivoire
30. Croatia
31. Cyprus
32. Czech Republic
33. Denmark
34. Dominica
35. Ecuador
36. Egypt
37. El Salvador
38. Equitorial Guinea
39. Estonia
40. Eswatin
41. Finland
42. France
43. Gabon
44. Georgia
45. Germany
46. Ghana
47. Greece
48. Guatemala
49. Guinea-Bissau
50. Haiti
51. Honduras
52. Hungary
53. India
54. Indonesia
55. Ireland
56. Israel
57. Italy
58. Jamaica
59. Japan
60. Jordan
61. Kazakhstan
62. Kenya
63. Korea Republic
64. Kyrgyz Republic
65. Latvia
66. Lebanon

67. Lesotho
68. Lithuania
69. Malaysia
70. Mexico
71. Moldova
72. Mongolia
73. Morocco
74. Mozambique
75. Namibia
76. Nepal
77. Netherlands
78. New Zealand
79. Nicaragua
80. Niger
81. Nigeria
82. North Macedonia
83. Norway
84. Philippines
85. Poland
86. Portugal
87. Romania
88. Russian Federation
89. Saudi Arabia
90. Senegal
91. Singapore
92. Slovak Republic
93. Slovenia
94. South Africa
95. Spain
96. Sri Lanka
97. Sweden
98. Switzerland
99. Tajikistan
100. Tanzania
101. Thailand
102. Timor-Leste
103. Togo
104. Tunisia
105. Turkey
106. Ukraine
107. United Arab Emirates
108. United Kingdom
109. United States
110. Uruguay
111. Vanuatu
112. Venezuela
113. Vietnam
114. Zambia
115. Zimbabwe

APPENDIX 20: List of Emerging Economies

1. Turkey
2. Brazil
3. Russia
4. India
5. China
6. South Africa
7. Nigeria
8. Egypt
9. Indonesia
10. Philippines
11. Morocco
12. Hungary
13. Mexico
14. Zambia
15. Namibia
16. Poland
17. Colombia
18. Chile
19. Malaysia
20. Czech Republic
21. Peru
22. Thailand

23. Hong Kong

24. Singapore

APPENDIX 21: List of Publications

1. Hove S. and Tursoy T. (2019) An investigation of the environmental Kuznets curve in emerging economies, *Journal of Cleaner Production 236, 117628.*

2. Akalpler E. and Hove S. (2019) Carbon emissions, energy use, real GDP per capita and trade matrix in the Indian economy- an ARDL approach**,** *Energy 168, 1081-1093.*

3**.** Akalpler E. and Hove S. (2019) Carbon emissions, energy use, real GDP per capita and trade matrix in the Indian economy-an ARDL approach**,** *International Conference on Innovative Applied Energy (14-15 March 2019), Oxford, United Kingdom,* ISBN (978-1-912532-05-6)